

RBY1025 RBY1030 RBY1040

PBY1025 PBY1030 PBY1040

# Microprocessor controlled Heavy oil Burners

MANUAL OF INSTALLATION - USE - MAINTENANCE



BURNERS - BRUCIATORI - BRULERS - BRENNER - QUEMADORES - ГОРЕЛКИ

M039253CC Rel. 2.4 09/2021

## DANGERS, WARNINGS AND NOTES OF CAUTION

THIS MANUAL IS SUPPLIED AS AN INTEGRAL AND ESSENTIAL PART OF THE PRODUCT AND MUST BE DELIVERED TO THE USER.

INFORMATION INCLUDED IN THIS SECTION ARE DEDICATED BOTH TO THE USER AND TO PERSONNEL FOLLOWING PRO-DUCT INSTALLATION AND MAINTENANCE.

# THE USER WILL FIND FURTHER INFORMATION ABOUT OPERATING AND USE RESTRICTIONS, IN THE SECOND SECTION OF THIS MANUAL. WE HIGHLY RECOMMEND TO READ IT.

## CAREFULLY KEEP THIS MANUAL FOR FUTURE REFERENCE.

#### 1) GENERAL INTRODUCTION

- The equipment must be installed in compliance with the regulations in force, following the manufacturer's instructions, by qualified personnel.
- Qualified personnel means those having technical knowledge in the field of components for civil or industrial heating systems, sanitary hot water generation and particularly service centres authorised by the manufacturer.
- Improper installation may cause injury to people and animals, or damage to property, for which the manufacturer cannot be held liable.
- Remove all packaging material and inspect the equipment for integrity.

In case of any doubt, do not use the unit - contact the supplier.

The packaging materials (wooden crate, nails, fastening devices, plastic bags, foamed polystyrene, etc), should not be left within the reach of children, as they may prove harmful.

- Before any cleaning or servicing operation, disconnect the unit from the mains by turning the master switch OFF, and/or through the cutout devices that are provided.
- Make sure that inlet or exhaust grilles are unobstructed.
- In case of breakdown and/or defective unit operation, disconnect the unit. Make no attempt to repair the unit or take any direct action.

#### Contact qualified personnel only.

Units shall be repaired exclusively by a servicing centre, duly authorised by the manufacturer, with original spare parts.

Failure to comply with the above instructions is likely to impair the unit's safety.

To ensure equipment efficiency and proper operation, it is essential that maintenance operations are performed by qualified personnel at regular intervals, following the manufacturer's instructions.

- When a decision is made to discontinue the use of the equipment, those parts likely to constitute sources of danger shall be made harmless.
- In case the equipment is to be sold or transferred to another user, or in case the original user should move and leave the unit behind, make sure that these instructions accompany the equipment at all times so that they can be consulted by the new owner and/or the installer.
- For all the units that have been modified or have options fitted then original accessory equipment only shall be used.
- This unit shall be employed exclusively for the use for which it is meant. Any other use shall be considered as improper and, therefore, dangerous.

The manufacturer shall not be held liable, by agreement or otherwise, for damages resulting from improper installation, use and failure to comply with the instructions supplied by the manufacturer. The occurrence of any of the following circustances may cause explosions, polluting unburnt gases (example: carbon monoxide CO), burns, serious harm to people, animals and things:

- Failure to comply with one of the WARNINGS in this chapter

- Incorrect handling, installation, adjustment or maintenance of the burner
- Incorrect use of the burner or incorrect use of its parts or optional supply

## 2) SPECIAL INSTRUCTIONS FOR BURNERS

- The burner should be installed in a suitable room, with ventilation openings complying with the requirements of the regulations in force, and sufficient for good combustion.
- Only burners designed according to the regulations in force should be used.
- This burner should be employed exclusively for the use for which it

was designed.

- Before connecting the burner, make sure that the unit rating is the same as delivery mains (electricity, gas oil, or other fuel).
- Observe caution with hot burner components. These are, usually, near to the flame and the fuel pre-heating system, they become hot during the unit operation and will remain hot for some time after the burner has stopped.

When the decision is made to discontinue the use of the burner, the user shall have qualified personnel carry out the following operations:

- a Remove the power supply by disconnecting the power cord from the mains.
- b) Disconnect the fuel supply by means of the hand-operated shut-off valve and remove the control handwheels from their spindles.

#### Special warnings

- Make sure that the burner has, on installation, been firmly secured to the appliance, so that the flame is generated inside the appliance firebox.
- Before the burner is started and, thereafter, at least once a year, have qualified personnel perform the following operations:
- a set the burner fuel flow rate depending on the heat input of the appliance;
- b set the flow rate of the combustion-supporting air to obtain a combustion efficiency level at least equal to the lower level required by the regulations in force;
- c check the unit operation for proper combustion, to avoid any harmful or polluting unburnt gases in excess of the limits permitted by the regulations in force;
- d make sure that control and safety devices are operating properly;
- e make sure that exhaust ducts intended to discharge the products of combustion are operating properly;
- f on completion of setting and adjustment operations, make sure that all mechanical locking devices of controls have been duly tightened;
- g make sure that a copy of the burner use and maintenance instructions is available in the boiler room.
- In case of a burner shut-down, reser the control box by means of the RESET pushbutton. If a second shut-down takes place, call the Technical Service, without trying to RESET further.
- The unit shall be operated and serviced by qualified personnel only, in compliance with the regulations in force.

#### 3) GENERAL INSTRUCTIONS DEPENDING ON FUEL USED

#### 3a) ELECTRICAL CONNECTION

- For safety reasons the unit must be efficiently earthed and installed as required by current safety regulations.
- It is vital that all saftey requirements are met. In case of any doubt, ask for an accurate inspection of electrics by qualified personnel, since the manufacturer cannot be held liable for damages that may be caused by failure to correctly earth the equipment.
- Qualified personnel must inspect the system to make sure that it is adequate to take the maximum power used by the equipment shown on the equipment rating plate. In particular, make sure that the system cable cross section is adequate for the power absorbed by the unit.
- No adaptors, multiple outlet sockets and/or extension cables are permitted to connect the unit to the electric mains.
- An omnipolar switch shall be provided for connection to mains, as required by the current safety regulations.
- The use of any power-operated component implies observance of a few basic rules, for example:
  - do not touch the unit with wet or damp parts of the body and/or with bare feet;
    - do not pull electric cables;

- do not leave the equipment exposed to weather (rain, sun, etc.) unless expressly required to do so;

- do not allow children or inexperienced persons to use equipment;

• The unit input cable shall not be replaced by the user.

In case of damage to the cable, switch off the unit and contact qualified personnel to replace.

When the unit is out of use for some time the electric switch supplying all the power-driven components in the system (i.e. pumps, burner, etc.) should be switched off.

# 3b) FIRING WITH GAS, LIGHT OIL OR OTHER FUELS GENERAL

- The burner shall be installed by qualified personnel and in compliance with regulations and provisions in force; wrong installation can cause injuries to people and animals, or damage to property, for which the manufacturer cannot be held liable.
- Before installation, it is recommended that all the fuel supply system pipes be carefully cleaned inside, to remove foreign matter that might impair the burner operation.
- Before the burner is commissioned, qualified personnel should inspect the following:
- a the fuel supply system, for proper sealing;
- b the fuel flow rate, to make sure that it has been set based on the firing rate required of the burner;
- c the burner firing system, to make sure that it is supplied for the designed fuel type;
- d the fuel supply pressure, to make sure that it is included in the range shown on the rating plate;
- e the fuel supply system, to make sure that the system dimensions are adequate to the burner firing rate, and that the system is equipped with all the safety and control devices required by the regulations in force.
- When the burner is to remain idle for some time, the fuel supply tap or taps should be closed.

### SPECIAL INSTRUCTIONS FOR USING GAS

Have qualified personnel inspect the installation to ensure that:

- the gas delivery line and train are in compliance with the regulations and provisions in force;
- b all gas connections are tight;
- c the boiler room ventilation openings are such that they ensure the air supply flow required by the current regulations, and in any case are sufficient for proper combustion.
- Do not use gas pipes to earth electrical equipment.
- Never leave the burner connected when not in use. Always shut the gas valve off.
- In case of prolonged absence of the user, the main gas delivery valve to the burner should be shut off.

#### Precautions if you can smell gas

- a do not operate electric switches, the telephone, or any other item likely to generate sparks;
- b immediately open doors and windows to create an air flow to purge the room;
- c close the gas valves;
- d contact qualified personnel.
- Do not obstruct the ventilation openings of the room where gas appliances are installed, to avoid dangerous conditions such as the development of toxic or explosive mixtures.

#### DIRECTIVES AND STANDARDS

#### Gas burners

# European directives

-2009/142/EC (Gas Directive)

-2006/95/CEC (Low Tension Directive)

-2004/108/EC (Electromagnetic compatibility Directive) -2006/42/EC (Machinery Directive)

#### Harmonized standards

-UNI EN 676 (Automatic forced draught burners for gaseous fuels)

-EN 55014-1 (Electromagnetic compatibility- Requirements for house hold appliances, electric tools and similar apparatus)

-CEI EN 60335-1 (Specification for safety of household and similar electrical appliances);

-EN 50165 (Electrical Equipment of non-electric appliances for house-hold and similar purposes).

-EN 60335-2-102 (Household and similar electrical appliances. Safety. Particular requirements for gas, oil and solid-fuel burning appliances having electrical connections).

### Light oil burners

European directives

-2006/95/EC (Low Tension Directive)

-2004/108/EC (Electromagnetic compatibility Directive)

-2006/42/EC (Machinery Directive)

## Harmonized standards

-UNI EN 267(Automatic forced draught burners for liquid fuels)

-EN 55014-1 (Electromagnetic compatibility- Requirements for house hold appliances, electric tools and similar apparatus)

-CEI EN 60335-1(Specification for safety of household and similar electrical appliances)

-EN 50165 (Electrical Equipment of non-electric appliances for house-hold and similar purposes)

#### National Standard

-UNI 7824 (Atomizing burners of the monobloc type. Characteristics and test methods)

#### Heavy oil burners

#### European Directives

-2006/95/EC (Low Tension Directive)

-2004/108/EC (Electromagnetic compatibility Directive)

-2006/42/EC (Machinery Directive)

#### Harmonized standards

-EN 55014-1 (Electromagnetic compatibility- Requirements for house hold appliances, electric tools and similar apparatus)

-UNI EN 267(Automatic forced draught burners for liquid fuels)

-CEI EN 60335-1 (Specification for safety of household and similar electrical appliances);

-EN 50165 (Electrical Equipment of non-electric appliances for house-hold and similar purposes).

#### Norme nazionali / National Standard

-UNI 7824 (Atomizing burners of the monobloc type. Characteristics and test methods.

#### Gas - Light oil burners

# **European Directives**

-2009/142/EC (Gas Directive)

-2006/95/EC (Low Tension Directive)

-2004/108/EC (Electromagnetic compatibility Directive)

-2006/42/EC (Machinery Directive)

#### Norme armonizzate / harmonized standards

-UNI EN 676 (Automatic forced draught burners for gaseous fuels)

-EN 55014-1 (Electromagnetic compatibility- Requirements for house hold appliances, electric tools and similar apparatus)

-UNI EN 267(Automatic forced draught burners for liquid fuels)

-CEI EN 60335-1(Specification for safety of household and similar electrical appliances);

-EN 50165 (Electrical Equipment of non-electric appliances for house-hold and similar purposes).

Norme nazionali / National Standard

-UNI 7824 (Atomizing burners of the monobloc type. Characteristics and test methods.

#### Gas - Heavy oil burners

## European directives:

-2009/142/EC (Gas Directive)

## -2006/95/EC (Low Tension Directive)

-2004/108/EC (Electromagnetic compatibility Directive) -2006/42/EC (Machinery Directive)

## Harmonized standards

-UNI EN 676 (Automatic forced draught burners for gaseous fuels)

-EN 55014-1 (Electromagnetic compatibility- Requirements for house hold appliances, electric tools and similar apparatus)

-CEI EN 60335-1 (Specification for safety of household and similar electrical appliances)

-EN 50165 (Electrical equipment of non-electric appliances for household and similar purposes. Safety requirements)

#### **National Standard**

- UNI 7824 (Atomizing burners of the monobloc type. Characteristics and test methods.

Industrial burners

#### **European directives**

-2009/142/EC (Gas Directive)

-2006/95/EC (Low Tension Directive)

-2004/108/EC (Electromagnetic compatibility Directive)

#### -2006/42/EC (Machinery Directive) Harmonized standards

-EN 55014-1 (Electromagnetic compatibility- Requirements for house hold appliances, electric tools and similar apparatus)

-EN 746-2 (Industrial thermoprocessing equipment - Part 2: Safety requirements for combustion and fuel handling systems)

-EN 50165 (Electrical equipment of non-electric appliances for household and similar purposes. Safety requirements)

#### Burner data plate

For the following information, please refer to the data plate:

- burner type and burner model: must be reported in any communication with the supplier
- Type Model Year S.Number Output Oil Flow Fuel Category Gas Pressure Viscosity EI.Supply EI.Consump Fan Motor Protection Drwaing n° P.I.N.
- burner ID (serial number): must be reported in any communication with the supplier
  date of production (year and month)
- date of production (year and month)
   information about final time and month)
- information about fuel type and network pressure

WARNING!

DANGER!

WARNING!

## SYMBOLS USED



Failure to observe the warning may result in irreparable damage to the unit or damage to the environment



Failure to observe the warning may result in serious injuries or death.



Failure to observe the warning may result in electric shock with lethal consequences

# **PART I: INSTALLATION**

# Burner model identification

Burners are identified by burner type and model. Burner model identification is described as follows.

1	BURNER TYPE	RBY-PBY1025 - RBY-PBY1030 - RBY-PBY1040
2	FUEL	N - Heavy oil, viscosity <= 50cSt (7° E) @ 50° C
		D - Heavy oil, viscosity <= 400cSt (50° E) @ 50° C
		P - Petroleum, viscosity 89cSt (12° E) @ 50° C
		H = heavy oil, viscosity <= 4000cSt (530°E) a 50°C
3	BLAST TUBE	R = ABS polymer (silenced) air intake
		P = Aluminum air intake
4	OPERATION (Available versions)	MD - Fully modulating
5	BLAST TUBE	S - Standard L - Extended
6	DESTINATION COUNTRY	* - see data plate
7	BURNER VERSION	A - Standard

# **Technical Specifications**

BURNER		RBY-PBY1025	RBY-PBY1030	RBY-PBY1040	
Output	min - max kW	2550 - 8700	2550 - 10000	2550 - 13000	
Fuel			Heavy oil		
Viscosity		See "Bu	rner model identificati	on" table	
Heavy oil rate	min max. kg/h	227 - 775	227 - 891	227 - 1160	
Power supply			400V 3N a.c. 50Hz		
Total power consumption	kW	44,1	59,6	79,6	
Fan motor power consumption	kW	18,5	22,0	30,0	
Pump motor	kW	1,1	1,1	1,1	
Pre-heater resistors	kW	24	36	48	
Protection			IP40		
Protection if provided with light oil pilot			IP21		
Operation	Dperation MD - Fully modulating		]		
Operating temperature	°C	(-10) - (+50)			
Storage Temperature	°C	(-20) - (+60)			
Working service		Continuous			

Total power consumption	kW	44,5	60,0	80,0
Fan motor power consumption	kW	18,5	22,0	30,0
Pump motor	kW	1,5	1,5	1,5
Pre-heater resistors	kW	24	36	48

Heavy oil net calorific value (Hi): 9650 kcal/kg or 40395 kJ/kg (average value).

## **Performance Curves**





To get the input in kcal/h, multiply value in kW by 860. Data are referred to standard conditions: atmospheric pressure at 1013mbar, ambient temperature at 15°C

**NOTE:** The performance curve is a diagram that represents the burner performance in the type approval phase or in the laboratory tests, but does not represent the regulation range of the machine. On this diagram the maximum output point is usually reached by adjusting the combustion head to its "MAX" position (see paragraph "Adjusting the combustion head"); the minimum output point is reached setting the combustion head to its "MIN" position. During the first ignition, the combustion head is set in order to find a compromise between the burner output and the generator specifications, that is why the minimum output may be different from the Performance curve minimum

The burner is designed to work positioned according to the picture below. Set the upper side of the burner flange in a horizontal position, in order to find the correct inclination of the pre-heater tank. For different installations, please contact the Technical Department.



Key

1 Burner flange (upper side indicated)

- 2 Bracket
- 3 Pre-heating tank on the burner



\*AL/BL = measure referred to burner fitted with extended blast tube

RBY1030/1040: It is necessary to place a counterflange between the burner and the boiler.

RBY1025



RBY1030 - RBY1040

## Fig. 5 - (3l2D-03 v5) Hydraulic diagram



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# INSTALLING THE BURNER

# Packing

Burners are despatched in wooden crates whose dimensions are:

• 2280 mm x 1730 mm x 1360 mm(L x P x H)

Packing cases of this kind are affected by humidity and are not suitable for stacking. The following are placed in each packing case:

- burner;
- ceramic fibre plait to be inserted between the burner and the boiler;
- oil flexible hoses:
- oil filter;
- oil pump with motor;
- envelope containing this manual.

To get rid of the burner's packing, follow the procedures laid down by current laws on disposal of materials.

# Handling the burner

ATTENTION! The Ihandling operations must be carried out by specialised and trained personnel. If these operations are not carried out correctly, the residual risk for the burner to overturn and fall down still persists. To move the burner, use means suitable to support its weight (see paragraph "Technical specifications"). The unpacked burner must be lifted and moved only by means of a fork lift truck.

The burner is mounted on a stirrup provided for handling the burner by means of a fork lift truck: the forks must be inserted into the A anb B ways. Remove the stirrup only once the burner is installed to the boiler.



# Fitting the burner to the boiler

To perform the installation, proceed as follows:

- 1 drill the furnace plateas decribed in paragraph ("Overall dimensions");
- 2 place the burner towards the furnace plate: lift and move the burner by means of its eyebolts placed on the top side (see"Lifting and moving the burner");
- 3 screw the stud bolts (5) in the plate holes, according to the burner's drilling plate described on paragraph "Overall dimensions";
- 4 place the ceramic fibre plait on the burner flange;
- 5 install the burner into the boiler;
- 6 fix the burner to the stud bolts, by means of the fixing nuts, according to the picture below.
- 7 After fitting the burner to the boiler, ensure that the gap between the blast tube and the refractory lining is sealed with appropriate insulating material (ceramic fibre cord or refractory cement).





# Keys

- 1 Burner
- 2 Fixing nut
- 3 Washer
- 4 Ceramic fibre plait
- 5 Stud bolt
- 7 Blast tube



## **ELECTRICAL CONNECTIONS**



WARNING! Respect the basic safety rules. make sure of the connection to the earthing system. do not reverse the phase and neutral connections. fit a differential thermal magnet switch adequate for connection to the mains.

WARNING! before executing the electrical connections, pay attention to turn the plant's switch to OFF and be sure that the burner's main switch is in 0 position (OFF) too. Read carefully the chapter "WARNINGS", and the "Electrical connections" section.

ATTENTION: Connecting electrical supply wires to the burner teminal block MA, be sure that the ground wire is longer than phase and neutral ones.

To execute the electrical connections, proceed as follows:

- 1 remove the cover from the electrical board, unscrewing the fixing screws;
- 2 execute the electrical connections to the supply terminal board as shown in the attached wiring diagrams;
- 3 check the direction of the fan motor (see next paragraph);
- 4 refit the panel cover.



WARNING: (only for double stage and progressive burners) The burner is provided with an electrical bridge between terminals 6 and 7; when connecting the high/low flame thermostat, remove this bridge before connecting the thermostat.

## Rotation of electric motor

Once the electrical connection of the burner is executed, remember to check the rotation of the electric motor. The motor should rotate according to the "arrow" symbol on the body. In the event of wrong rotation, reverse the three-phase supply and check again the rotation of the motor.



### CAUTION: check the motor thermal cut-out adjustment

NOTE: the burners are supplied for three-phase 380 V or 400 V supply, and in the case of three-phase 220 V or 230 V supply it is necessary to modify the electrical connections into the terminal box of the electric motor and replace the overload tripped relay.

## Note on elecrtical supply

If the power supply to the burner is 230V three-phase or 230V phase-phase (without a neutral), with the Siemens control box, between the terminal 2 (terminal X3-04-4 in case of LMV2x, LMV3x, LMV5x, LME7x) on the board and the earth terminal, an RC Siemens RC466890660 filter must be inserted.

## Key

 $\label{eq:constraint} \begin{array}{l} C \ - \ Capacitor \ (22nF/250V) \\ LME \ / \ LMV \ - \ Siemens \ control \ box \\ R \ - \ Resistor \ (1M\Omega) \\ M \ - \ Terminal \ 2 \ (LGB,LMC,LME), \ terminal \ X3-04-4 \ ( \ LMV2x, \\ LMV3x, \ LMV5, \ LME7x) \\ RC466890660 \ - \ RC \ Siemens \ filter \end{array}$ 



For LMV5 control box, please refer to the clabeling recommendations available on the Siemens CD attached to the burner

# Connecting the oil heating resistors











# Recommendations to design heavy oil feeding plants

This paragraph is intended to give some suggestions to make feeding plants for heavy oil burners. To get a regular burner operation, it is very important to design the supplying system properly. Here some suggestions will be mentioned to give a brief description.

The term "heavy oil" is generic and summarises several chemical-physical properties, above all viscosity. The excessive viscosity

makes the oil impossible to be pumped, so it must be heated to let it flow in the pipeline; because of the low-boiling hydrocarbons and dissolved gases, the oil must be also pressurised. The pressurisation is also necessary to feed the burner pump avoiding its cavitation because of the high suction at the inlet. The supplying system scope is to pump and heat oil.

The oil viscosity is referred in various unit measures; the most common are: °E, cSt, Saybolt and Redwood scales. Table 3 shows the various unit convertions (e.g.: 132 cSt viscosity corresponds to 17.5°E viscosity).

The diagram in Fig. 9 shows how the heavy oil viscosity changes according to its temperature.

Example: an oil with 22°E viscosity at 50°C once heated to 100°C gets a 3 °E viscosity.

As far as the pumping capability, it depends on the type of the pump that pushes the oil even if on diagram in Fig. 9 a generic limit is quoted at about 100 °E, so it is recommended to refer to the specifications of the pump provided.

Usually the oil minimum temperature at the oil pump inlet increases as viscosity does, in order to make the oil easy to pump. Referring to the diagram on Fig. 10, it is possible to realise that to pump an oil with 50°E viscosity at 50°C, it must be heated at about 80°C.

# Pipe heating system

Pipe heating system must be provided, that is a system to heat pipes and plant components to mantain the viscosity in the pumping limits. Higher the oil viscosity and lower the ambient temperature, more necessary the pipe heating system.

# Inlet minimum pressure of the pump (both for supplying system and burner)

A very low pressure leads to cavitation (signalled by its peculiar noise): the pump manifacturer declares the minimum value. Therefore, check the pump technical sheets.

By increasing the oil temperature, also the minimum inlet pressure at the pump must increase, to avoid the gassification of the oil lowboiling products and the cavitation. The cavitation compromises the burner operation, it causes the pump to break too. The diagram on Fig. 11 roughly shows the inlet pump pressure according to the oil temperature.

# Pump operating maximum pressure (both for the supplying system and burner)

Remember that pumps and all the system components through which the oil circulates, feature an upper limit. Always read the technical documentation for each component. Schemes on Fig. 12 are taken from UNI 9248 "liquid fuel feeding lines from tank to burner" standard and show how a feeding line should be designed. For other countries, see related laws in force. The pipe dimensioning, the execution and the winding dimensioning and other construcitve details must be provided by the installer.

# Adjusting the supplying oil ring

According to the heavy oil viscosity used, in the table below indicative temperature and pressure values to be set are shown.

**Note:** the temperature and pressure range allowed by the supplying ring components must be checked in the specifications table of the components themselves.

HEAVY OIL VIS	COSITY AT 50 °C	PIPELINE PRESSURE	PIPELINE TEMPERATURE
cSt	(°E)	bar	<b>0</b> °
	< 50 (7)	1- 2	20
> 50 (7)	< 110 (15)	1- 2	50
> 110 (15)	< 400 (50)	1- 2	65
> 400 (50)	< 4000 (530)	1- 2	100
<b>T</b> 1 0			

Tab. 1 - Supply pipeline hydraulic scheme 3ID0024, pump n.4



ATTENTION: Atomizing air pressure is tipically set at 1 bar lower than oil pressure.

## Viscosity units conversion table

Cinematics viscosity Centistokes (cSt)	Engler Degrees (°E)	Saybolt Seconds Universal (SSU)	Saybolt Seconds Furol (SSF)	Redwood Seconds no.1 (Standard)	Redwood Seconds no2 (Admiralty)
1	1	31		29	
2.56	1.16	35		32.1	
4.3	1.31	40		36.2	5.1
7.4	1.58	50		44.3	5.83
10.3	1.88	60		52.3	6.77
13.1	2.17	70	12.95	60.9	7.6
15.7	2.45	80	13.7	69.2	8.44
18.2	2.73	90	14.44	77.6	9.3
20.6	3.02	100	15.24	85.6	10.12
32.1	4.48	150	19.3	128	14.48
43.2	5.92	200	23.5	170	18.9
54	7.35	250	28	212	23.45
65	8.79	300	32.5	254	28
87.6	11.7	400	41.9	338	37.1
110	14.6	500	51.6	423	46.2
132	17.5	600	61.4	508	55.4
154	20.45	700	71.1	592	64.6
176	23.35	800	81	677	73.8
198	26.3	900	91	762	83
220	29.2	1000	100.7	896	92.1
330	43.8	1500	150	1270	138.2
440	58.4	2000	200	1690	184.2
550	73	2500	250	2120	230
660	87.6	3000	300	2540	276
880	117	4000	400	3380	368
1100	146	5000	500	4230	461
1320	175	6000	600	5080	553
1540	204.5	7000	700	5920	645
1760	233.5	8000	800	6770	737
1980	263	9000	900	7620	829
2200	292	10000	1000	8460	921
3300	438	15000	1500	13700	
4400	584	20000	2000	18400	

Tab. 2



Fig. 9

#### Indicative diagram showing the oil temperature at burner pump inlet vs. oil viscosity

Example: if the oil has a 50°E @ 50°C viscosity, the oil temperature at the pump inlet should be 80°C (see diagram).



Indicative diagram showing the oil pressure according to its temperature





Fig. 11

#### HYDRAULIC DIAGRAMS

#### Fig. 12 - Hydraulic diagram 3ID0024

21

22

23

24

25

Manual valve

Pressure gauge

Pressure governor

Manual valve

Needle valve

PRESSURE GOVERNOR UNIT



# Pilot gas train

The connection to the pilot gas train must be done according to the following scheme, valid for LPG. In case of natural gas, connect the pressure goveror (pos. 3) to the natural gas line (maximum input pressure = 1 bar).





The pilot gas train is already installed into the burner, the connection from the filter with stabiliser to the gas supply network must be carried out.



connection to the gas supply network

Once the gas train in installed, execute the electrical connections for all its items (gas valves group, pressure switch).



ATTENTION: once the gas train is mounted according to the diagram on Fig. 13, the gas proving test mus be performed, according to the procedure set by the laws in force.

# Light oil pilot

The burner can be provided with light oil pilot, instead of gas pilot.



light oil pilot nozzle



light oil pilot pump







# Heavy oil pumps

The pump provided with the burner must be installed according to the hydraulic diagram.

# About the use of fuel pumps

- Do not use fuel with additives to avoid the possible formation over time of compounds which may deposit between the gear teeth, thus obstructing them.
- After filling the tank, wait before starting the burner. This will give any suspended impurities time to deposit on the bottom of the tank, thus avoiding the possibility that they might be sucked into the pump.
- On initial commissioning a "dry" operation is foreseen for a considerable length of time (for example, when there is a long suction line to bleed). To avoid damages inject some lubrication oil into the vacuum inlet.
- Care must be taken when installing the pump not to force the pump shaft along its axis or laterally to avoid excessive wear on the joint, noise and overloading the gears.
- Pipes should not contain air pockets. Rapid attachment joint should therefore be avoided and threaded or mechanical seal junctions preferred. Junction threads, elbow joints and couplings should be sealed with removable sg component. The number of junctions should be kept to a minimum as they are a possible source of leakage.
- Do not use PTFE tape on the suction and return line pipes to avoid the possibility that particles enter circulation. These could deposit on the pump filter or the nozzle, reducing efficiency. Always use O-Rings or mechanical seal (copper or aluminium gaskets) junctions if possible.
- An external filter should always be installed in the suction line upstream the fuel unit.

# Suntec TV Pressure governor

## Pressure adjustment

Remove cap-nut 1 and the gasket 2, unscrew the lock nut 4. To increase pressure, twist adjusting screw 3 clockwise.

To decrease the pressure, twist screw counterclockwise. Tight the lock nut 4, refit the gasket 2 and the cap nut 1.

# Key

- 1 Cap nut
- 2 Gasket
- 3 Adjusting screw
- 4 Lock nut
- 5 Gasket

## Light oil pilot pump (for light oil pilot) Suntec AS47-57-67 B

Oil viscosity	2 - 12 cSt
Oil temperature	0 - 60 °C
Max. suction pressure	2 bar max.
Max. return pressure	2 bar max.
Min. suction pressure	- 0.45 barto avoid gasing
Rotation speed	3600 rpm max.

# Key

- 1 Pressure governor
- 2 Manometer
- 3 Vacuum gauge
- 4 Solenoid valve
- 5 Nozzle
- 7 Suction
- 8 Return

# Connecting the pump

According to the pump provided, proceed as follows:

- 1 remove the closing nuts **A** (on the pump inlet) and **B** (from pump to the burner);
- 2 connect the pump being careful to avoid exchanging the lines: see the arrows marked on the pump.

For further information, refer to the technical documentation of the pump.





Fig. 15



The pump provided with the burner must be installed according to the hydraulic diagram.

Pumps	capacity [l/h]	power [kW]	speed [rpm]	connection	max outlet pressure [bar]	max inlet pressure (bar)
Kral KF 32 BCB	1800	1,1	1500	DN32	10	2
Cucchi FMG40	2500	1,1	1400	1"	10	2

For further details see the manifacturer documentation.

# 2.1 Connecting the oil flexible hoses to the burner

To connect the flexible oil hoses to the pump, proceed as follows, according to the pump provided:

- 1 remove the closing nuts **H** (on the heater) and **R** (on the oil pressure governor) of the inlet and return connections;
- 2 screw the rotating nut of the two flexible hoses on the burner **being careful to avoid exchanging the inlet and return lines**: see the arrows marked that show the inlet and the return.



# Connecting the compressed air hoses

To connect the compressed air supply, refer to the following pictures





Compressor

# Hydraulic connections

## Key

- G Gas
- А Compressed Air
- 0 Oil



# ADJUSTING AIR AND FUEL RATE



ATTENTION: before starting the burner up, be sure that the manual cutoff valves are open. Be sure that the mains switch is closed.

.ATTENTION: During commissioning operations, do not let the burner operate with insufficient air flow (danger of formation of carbon monoxide); if this should happen, make the fuel decrease slowly until the normal combustion values are achieved.

Before starting up the burner, make sure that the return pipe to the tank is not obstructed. Any obstruction would cause the pump seal to break.

IMPORTANT! the combustion air excess must be adjusted according to the values in the following chart.

Recommended combustion parameters					
Fuel         Recommended (%) CO2         Recommended (%) O2					
Heavy oil	11 ÷ 12.5	4.7 ÷ 6.7			

The heavy oil flow rate can be adjusted choosing a nozzle that suits the boiler/utilisation output and setting properly the delivery pressure values.

The table below shows indicative values of temperature and pressure to be set on the burner devices, according to the viscosity of the heavy oil used. The oil temperature should be set on TR resistor thermostat in order to get about 1.5°E viscosity at the nozzle.

VISCOSITY AT 50 °C		OIL PRE AF BURNE (N. 2 in 3	ESSURE FER R PUMP 2-D02/03)		OIL PRESSURE AFTER OIL METERING VALVE (N. 17 IN 312-D02/03)
		min	max	min	max
°E		b	ar		bar
	< 50 (7)	5	8	0.5	2 (RBY1025/1030) / 4 (RBY1040)
> 50 (7)	< 110 (15)	5	8	0.5	2 (RBY1025/1030) / 4 (RBY1040)
> 110 (15)	< 400 (50)	5	8	0.5	2 (RBY1025/1030) / 4 (RBY1040)
> 400 (50)	<4000 (530)	5	8	0.5	2 (RBY1025/1030) / 4 (RBY1040)

Tab. 3 - Burner - hydraulic scheme 3l2-D02/03, pump n.2



ATTENTION: Atomizing air pressure is tipically set at  $0.1 \div 0.3$  bar lower than oil pressure (RBY1025/1030). Atomizing air pressure is tipically set at  $0.5 \div 1$  bar lower than oil pressure (RBY1040). The light oil flow rate can be adjusted choosing a nozzle that suits the boiler/utilisation output and setting the delivery and return pressure values according to the ones quoted on the following charts.



# Atomizer 32-Y-A°-8-7 with reverse disc



(Note: the nozzle mounted on RBY1040 is without "reverse disc") *Oil thermostat adjustment* 

## Progressive and fully modulanting oil burners are equipped with electronic multi-thermostat Danfoss MCX, whose operation is controlled by thyristor. (for details refer to the attached technical documentation)



Fig. 20 - Danfoss MCX



Fig. 21 - Probe connections (Danfoss MCX)

				0	Il viscosity at 50 °	C according to the	letter shown in th	e	
N	/lenu pat	th				burner model			
-				P N E D H					
				89 cSt	< 50 cSt	> 50 cSt	> 110 cSt	> 400 cSt	
						< 110 cSt	< 400 cSt	< 4000 cSt	
				12 °E	< 7°E	> 7 °E	> 15 °E	> 50 °E	
						< 15 °E	< 50 °E	< 530 °E	
Par									
rEG	Pb1	tr	Oil heater temperature probe	parameter not visible					
	Pb2	tCI	Plant consent temperature probe	20.90	70.00	70 %	70.00		
			(when installed)	20 C	70 C	70 C	70 C		
	Pb3	Oil	oil heater output temperature	60.70 °C	110 120 %	120 120 %	120 140 °C	140 150 %	
			probe (PID regulation);	00-70 C	110-120 C	120-130 C	130-140 C	140-150 C	
		SP0	Set-point oil heater with oil pump	45.00	120.00	120.00	140.00	150.00	
			stopped (stand-by)	45 C	120 C	130 C	140 C	150 C	
	Pb4	tcn	Oil heater consent temperature	40.00	100 %0	100 %	110.00	120.00	
			probe	40 C	100 C	100 C		120 C	
		trS	Safety temperature tank resistors	100 %0	100 200 %	100.200.90	100 200 %	100 200 %	
			(manual reset)	120 C	190-200 C	190-200 C	190-200 C	190-200 C	

The above temperature values are suggested and refer to a plant designed according to the prescriptions in the burner user manual. The suggested values can change in reference to the fuel oil specifications.

# Burners equipped with double tank

All thermostats are located inside the control panel. To set the temperature use a small screwdriver.

Such temperature must be set during burner operation, checking temperature in the thermometer mounted on the pre-heating tank. We suggest a thermometer with scale up to 200° C.

Adjust this thermostat to the correct value according to the viscosity-temperature diagram and check the temperature by using a thermometer with a scale of up to 200° C mounted on the pre-heating tank.

**Safety resistors thermostat TRS:** it is factory preset and sealed. Don not modify it!

When the set temperature is exceeded, check the reason and reset it by means of the push button PR

**Resistor thermostat TR:** check the best atomising oil temperature and set it on TR.

**Thermostat TCN** (it gives the enabling signal to the oil N.C. valve): set TCN at about  $20^{\circ}$  less than TR.





# Adjusting the pilot gas flow rate: gas valve Brahma EG12xR and pressure governor

To change the pilot gas valve flow rate, proceed as follows:

- 1 remove the protection on the bottom of the valve, moving it counterclockwise (see next picture);
- 2 rotate clockwise the nut 1 as shown in to close the valve or counterclockwise to open.
- To perform a finest adjustment, act directly on the pressure governor as follows (see next picture):
- 3 remove the cap T: to increase the gas pressure at the outlet use a screwdriver on the screw TR as shown in the next picture. Screw to increase the pressure, unscrew to decrease; once the regulation is performed, replace cap T.





Set pilot gas pressure switch at 50 mbar.



# Adjustments - brief description

The air and fuel rates adjustments must be performed at the maximum ouptput first ("high flame"): see the LMV5.. related manual..

- Check that the combustion parameters are in the suggested limits.
- Then, adjust the combustion values by setting the "fuel/air" ratio" curvepoints (see the LMV5.. related manual).
- Set, now, the low flame output, in order to avoid the low flame output increasing too much or that the flues temperature gets too low to cause condensation in the chimney.

## Start-up procedure

- 1 Turn the burner on.
- 2 the LMV control box starts the system test cycle: the AZL display shows the **System Test** message; at the end of the test, it shows the main page and the system stops (the safety chain is open) waiting for the startup enabling signal (standby Program phase no. 12)

Setpoint	80°C
Act.value	78°C
Fuel	GAS
Standby	12

Main page

- 3 check the fan motor rotation (see related paragraph).
- 4 make the safety chain enabling the system to start up
- 5 the combustion cycle starts: the system will show the operating stages
- Prepurging (program phase no.30)
- Driving to ignition position (program phase no.36)
- Ignition position (program phase no.38)
- Fuel (the fuel solenoid valves open)
- Flame (the flame lights up)
- Driving to low flame (the actuator drives to low flame).
- NOTE: the C and A, on the .

Once the ignition cycle ends, the main page is shown:

Setpoint	80°C
Act.value	78°C
Load	24%
Flame	60%

Main page

Set point: temperature set-point

- Act value: actual temperature value
- Load: load percentage (burner output)

Flame: percentage of flame detection current.

By pressing the ENTER key the display shows the second page:

Fuel	0.0	Air	1.8
Ax1		VSD	0.0
Ax2		O2	
Ax3		Ld.	0.0

Second page

Fuel: it shows (in degrees) the fuel actuator position.
Air: it shows (in degrees) the air actuator position.
Ax1..3: auxiliaries.
VSD: % value on the inverter maximum frequency

**O2**: oxygen percentage **Ld**: load percentage (burner output).

Press the ENTER key to go back to the main page. To access the **main menu**, from the main page, press the ESC key tiwce:

OperationalStat	
Operation	
ManualOperation	
Params & Display.	

Main menu

By pressing the ESC key once, the *Operational Status* (first item in the main menu) menu is directly shown:

Normal operation
Status/Reset
Fault History
Lockout History

the Operational Status menu provides the following items:

Normal operation: by selecting this item and pressing the ENTER key, the main page is showed; press ESC to go back to the main menu.

Status/Reset: it shows system errors or faults occuring / it represents the lockout reset function.

**Fault History:** by selecting this item and pressing the ENTER key, the Lockout History will be showed about the last 21 faults occured. **Lockout History:** by selecting this item and pressing the ENTER key, the Lockout History will be showed about the last 9 lockouts occured, and the related date and hour.

Alarm act/deact: enable/disable the horn in case of alarm.

# Fault History

To visualise the Fault History, select it and press the ENTER key. The message will be as:

1 Class:			05Gas
code	BF	Phase:	10
Diag.:	00	Lod:	0.0
Start No.			88

O2 control and limiter automat deactivated

To see the other Fault History pages, press the arrow keys. To exit the Fault History pages, press ESC.

## Lockout History

To visualise the **Lockout History**, choose the related item and press ENTER. The message will be:

1	10.08.07		13.47
C:71	D:00	F:	12
Start No.			88
Load	0.0		Gas

alternating by an error message as:k

No flame at end		
of safety time		

To see the other Lockout History pages, press the arrow keys. To exit the Lockout History pages, press ESC.

## Setting the temperature/pressure set-point value

To set the temperature/pressure set-point value, that is the generator operating temperature/pressure; proceed as follows. From the main page, enter the main menu by pressing the ESC key twice:

OperationalStat	
Operation	
ManualOperation	
Params & Display.	

by means of the arrow keys, select "Params&Display", press ENTER: the system will ask you to enter the proper password

Access w-out PW	
Access Serv	
Access OEM	
Access LS	

by means of the arrow keys, select "Access w-out pass" (access without password - user level), confirm by pressing ENTER. The other levels require password reserved to the Technical Service, to the Manifacurer, etc. The menu shown accessing without password is the following:

BurnerControl
RatioControl
O2Contr./Guard.
LoadController

Choose "LoadController" and press ENTER: the following menu is shown:

ControllerParam	
Configuration	
Adaption	
SW Version	

Choose "ControllerParam" and press ENTER: the following menu is shown:

ContrlParamList	
MinActuatorStep	
SW_FilterTmeCon	
SetPointW1	

Choose "SetPointW1" and press ENTER:

SetpointW1	
Curr:	90°
New:	90°

Curr: it shows the current set-point; use the arrows keys to change.

**NOTE:** the availabel range for this parameter depends on the probe provided; the unit measure of the detected value and its limits are bound up with parameters set at the "Service" level.

Once the new set-point is set, confirm by pressing ENTER, otherwise exit without changings by pressing ESC.

Press ESC to exit the set-point programming mode.

Once the temperature set-point W1 is imposed, set the Switch-on (SDon) and the Switch-off (SDoff) point of the 2-position controller:



To set these values, select the item SD\_ModOn (SDOn), by scrolling down the "Load controller" menu with the arrow keys and press ENTER:

SetpointW1	
SetpointW2	
SD_ModOn	
SD_ModOff	

the display will show:

SD_ModOn	
Curr::	1.0%
New:	1.0%

The deafult value for this parameter is1% that is, the burner will light again at a temperature 1% lower than the set-point. Change value, if needed, by means of the arrow keys; press ENTER to confirm and the press ESC to exit. Press only ESC to exit without changing. Now choose SD\_ModOff always scrolling down theLoad Controller menu, by menas of the arrow keys, and press ENTER.

SetpointW1		
SetpointW2		
SD_ModOn		
SD_ModOff		

SD_ModOff	
Curr::	10.0%
New:	10.0%

The deafult value for this parameter is10% that is, the burner will turn off at a temperature 1% higher than the set-point.

Change value, if needed, by means of the arrow keys; press ENTER to confirm and the press ESC to exit. Press only ESC to exit without changing. Press the ESC key until the following menu is shown:

BurnerControl	
RatioControl	
O2Contr./Guard.	
LoadController	

scroll this menu down until the tiem "AZL" is reached

LoadController	
AZL	
Actuators	
VSD Module	

confirm by pressing ENTER:

Times	
Languages	
DateFormat	
PhysicalUnits	

Times: it sets the "Summer (SUM) Time / Winter (WIN) Time" operation and the continent (EU - Europe; US - United States)

Sum/Winter Time	
Time EU/US	

choose the Summertime/Wintertime mode desired and cofirm by pressing ENTER; press ESC to exit. Set the time zone (Time EU/US) in the same way.

Languages: it allows setting the current language

Language	
Curr::	Italiano
New:	English

choose the desired language and cofirm by pressing ENTER; press ESC to exit.

DateFormat: it allows setting the date format as DD-MM-YY (day-month-year) or MM-DD-YY (month-day-year)

DateFormat	
Curr::	DD-MM-YY
New:	MM-DD-YY

choose the desired format and cofirm by pressing ENTER; press ESC to exit. **PhysicalUnits:** it allows setting the measuring units for temperature and pressure

UnitTemperature UnitPressure

Settable temperature units: °C or °F

Settable pressure units: bar or psi.

- choose the desired unit and cofirm by pressing ENTER; press ESC to exit.
- choose the temperature and pressure unit and cofirm by pressing ENTER; press ESC to exit.

# System lockout

If the system locks out, the following message will appear:

1	10.08.07		13.47
C:71	D:00	F:	12
Start No.			88
Load	0.0		Gas

call the Technical Service and tell the message data.

# Cold start thermal shock (CSTP)

If the generator cannot suffer thermal shocks, the CSTP (Cold Start Thermal Schock) function can be enabled. This function is already set by the Technical service (access by reserved password).

if this function is enabled, when the burner starts upthe "Thermal shock protection activated" message will be showed.

If this function is not enabled, after startup, the burner will rapidly increase the load according to the requested value and, if necessary, to the maximum output.

# Manual mode

To by-pass the thermal protection or not to let the buner operate in high flame stage (maximum output) after ignition, the manual mode is provided.

To choose the manual mode (Manual Operation), use the SELECT arrow keys

OperationalStat	
Operation	
ManualOperation	
Params & Display.	

Items to be set are the following:

SetLoad
Autom/Manual/Off

SetLoad: to set the required load percentage

SetLoad	
Curr::	0.0%
New:	20.0%

set the required percentage and confirm by pressing ENTER; press ESC to exit. choose "Autom/Manual/Off:

SetLoad	
Autom/Manual/Off	

Autom/Manual/Off	
Curr::	Automatic
New:	Burner On

three modes are provided: Automatic: automatic operation Burner on: manual operation Burner off: burner in stand-by

If the BurnerOn mode is choosen, the burner does not follow the modulator and probe settings, but operates at the set load.

 Caution: if BurnerOff mode is selected, the burner stays in stand-by.

 Caution: in the BurnerOn mode, the safety thresholds are set by the Technical Service.

For further details, see the LMV5x annexed manuals.

## Calibration of air pressure switch

To calibrate the air pressure switch, proceed as follows:

- Remove the transparent plastic cap.
- Once air and heavy oil setting have been accomplished, startup the burner.
- During the pre-purge phase o the operation, turn slowly the adjusting ring nut VR in the clockwise direction until the burner lockout, then read the value on the pressure switch scale and set it to a value reduced by 15%.
- Repeat the ignition cycle of the burner and check it runs properly.
- Refit the transparent plastic cover on the pressure switch.

# EVL air valve for gun cleaning

After the flame is off, an automatic system provides the compressed air to clean the gun.



Fig. 23



EVL

33

LIMITATIONS OF USE

THE BURNER IS AN APPLIANCE DESIGNED AND CONSTRUCTED TO OPERATE ONLY AFTER BEING CORRECTLY CONNEC-TED TO A HEAT GENERATOR (E.G. BOILER, HOT AIR GENERATOR, FURNACE, ETC.), ANY OTHER USE IS TO BE CONSIDE-RED IMPROPER AND THEREFORE DANGEROUS.

THE USER MUST GUARANTEE THE CORRECT FITTING OF THE APPLIANCE, ENTRUSTING THE INSTALLATION OF IT TO QUALIFIED PERSONNEL AND HAVING THE FIRST COMMISSIONING OF IT CARRIED OUT BY A SERVICE CENTRE AUTHORI-SED BY THE COMPANY MANUFACTURING THE BURNER.

A FUNDAMENTAL FACTOR IN THIS RESPECT IS THE ELECTRICAL CONNECTION TO THE GENERATOR'S CONTROL AND SAFETY UNITS (CONTROL THERMOSTAT, SAFETY, ETC.) WHICH GUARANTEES CORRECT AND SAFE FUNCTIONING OF THE BURNER.

THEREFORE, ANY OPERATION OF THE APPLIANCE MUST BE PREVENTED WHICH DEPARTS FROM THE INSTALLATION OPERATIONS OR WHICH HAPPENS AFTER TOTAL OR PARTIAL TAMPERING WITH THESE (E.G. DISCONNECTION, EVEN PARTIAL, OF THE ELECTRICAL LEADS, OPENING THE GENERATOR DOOR, DISMANTLING OF PART OF THE BURNER).

NEVER OPEN OR DISMANTLE ANY COMPONENT OF THE MACHINE.

OPERATE ONLY THE MAIN SWITCH, WHICH THROUGH ITS EASY ACCESSIBILITY AND RAPIDITY OF OPERATION ALSO FUNCTIONS AS AN EMERGENCY SWITCH, AND ON THE RESET BUTTON.

IN CASE OF A BURNER SHUT-DOWN, RESET THE CONTROL BOX BY MEANS OF THE RESET PUSHBUTTON. IF A SECOND SHUT-DOWN TAKES PLACE, CALL THE TECHNICAL SERVICE, WITHOUT TRYING TO RESET FURTHER.

WARNING: DURING NORMAL OPERATION THE PARTS OF THE BURNER NEAREST TO THE GENERATOR (COUPLING FLANGE) CAN BECOME VERY HOT, AVOID TOUCHING THEM SO AS NOT TO GET BURNT.

## OPERATION

 $\triangle$ 

*ATTENTION:* before starting the burner up, be sure that the manual cutoff valves are open. Be sure that the mains switch is closed.

- Turn the burner on by means of its main switch S1 (see next pictures).
- Check that the burner is not locked; if so, reset it (see LMV5x related manual).
- Check that the series of thermostats/pressure switches (terminals 3 and 4 see Wiring diagrams), the TCI thermostat and the pilot
  gas pressure switch enable the burner to start up.
- At the beginning of the start-up cycle, the fan mtor starts up and the compressed air valve (EVA) opens. (If the oil atomising pressure is not enough, the PAC pressure switch closes the oil valve causing the burner to lock out). The pre-purge phase begins (the air damper is closed).
- After the post-ignition time, the transformer is de-energised and the pilot truns off some seconds later.
- When the oil valve open, the burner is working: the actuator starts opening. The burner drives to high flame or to low flame according to the plant requirements.
- When the burner turns to off, even in case of lock out, the EVL valve performs the oil gun cleaning (page 39).

# **Control panel**



- A High flame lamp
- B Low flame lamp
- C Ignition transformer lamp
- D Fan motor thermal cutout lamp
- E Burner lockout lamp
- G Solenoid valve lamp
- H Atomisation air pressure switch lamp
- I Compressed air solenoid valve lamp
- L Heating resistors safety thermostat lamp
- M Plant enabling thermostat lamp
- MD LMV Burner Management system
- N Oil pump in operation
- O Pilot solenoid valve lamp
- PL Light oil operation lamp
- PH Heavy oil operation lamp
- Q Pilot gas pressure switch
- R Reset pushbutton for control box
- S Pre-heating in operation lamp
- S1 Burner main switch
- S2 Pump operation selector MAN-AUTO
- S3 Heavy oil/light oil operation switch
- S4 Auxiliary resistors switch
- S5 Operation mode manual switch /0-Off, 1-

## **PART III: MAINTENANCE**

At least once a year carry out the maintenance operations listed below. In the case of seasonal servicing, it is recommended to carry out the maintenance at the end of each heating season; in the case of continuous operation the maintenance is carried out every 6 months.



# WARNING: ALL OPERATIONS ON THE BURNER MUST BE CARRIED OUT WITH THE MAINS DISCONNECTED AND THE FUEL MANAUL CUTOFF VALVES CLOSED!

ATTENTION: READ CAREFULLY THE "WARNINGS" CHAPTER AT THE BEGINNIG OF THIS MANUAL..

# **ROUTINE MAINTENANCE**

- Clean and examine the gas filter and replace it if necessary (next paragraph).
- Clean and examine the oil filter cartridge and replace it if necessary.
- Examine the flexible hoses and check for possible leaks.
- Check and clean if necessary the oil heaters and the tank, according to the fuel type and its use; remove the heaters flange fixing
  nuts and remove the heaters from the tank: clean by using steam or solvents and not metallic things.
- Remove and clean the combustion head (page 38).
- Examine and clean the ignition electrode, adjust and replace if necessary (see page 39).
- Examine and clean the detection probe, adjust and replace if necessary (see page 42).
- Examine the detection current (see page 41).
- Remove and clean (page 42) the heavy oil nozzle (*Important: use solvents for cleaning, not metallic tools*) and at the end of the maintenance procedures, after replacing the burner, turn it on and check the shape of the flame; if in doubt replace the nozzle. Where the burner is used intensively it is recommended to replace the nozzle as a preventive measure, at the begin of the operating season.
- Clean and grease joints and rotating parts.
- IMPORTANT: Remove the combustion head before checking the ignition electrode.
- Remove and clean the compressed air governor **A** in Fig. 24
- Remove and clean the oil governor **B** in Fig. 24



CAUTION: avoid the contact of steam, solvent and other liquids with the electric terminals of the resistor. On flanged heaters, replace the seal gasket before refitting it. Periodic inspections must be carried out to determine the frequency of cleaning.



Fig. 24
#### Maintenance of the pressure governor with filter (for ignitor gas train)

Before disassmbling the device, be sure that there is no pressurised gas inside it.

- To check the filtering part (1) on threaded bodies (see picture Fig. 25):
- remove the bottom cover, unscrewing the fixing screws;
- remove the filtering part (1), clean it with water and soap, blow it with compressed air or replace it if necessary;
- reassemble the filtering part in its initial position checking that it is placed in its own slots (see picture Fig. 25);
- reassemble the bottom cover (3), being sure that the main bolt is centered in the bottom cover slot.



Fig. 25 - threaded body



Fig. 26 - threaded body without bottom cover

### Removing the combustion head

- Remove the cover H.
- Slide the photoresistor out of its housing.
- Unscrew the flexible hoses from the gun (burner side) and remove the whole assembly as shown on Fig. 27.





Fig. 27

### Removing the oil gun, replacing/adjusting the nozzle and the ignition electrode



ATTENTION: avoid the electrode to get in touch with metallic parts (blast tube, head, etc.), otherwise the boiler operation would be compromised. Check the electrode position after any intervention on the combustion head.

To remove the oil gun, proceed as follows:

- 1 remove the combustion head as described on the prevoius paragraph;
- 2 after removing the oil gun, to clean the nozzle remove it from its place after uncsrewing V;
- 3 unscrew cap **C** and clean the nozzle body **CU**; replace the nozzle if necessary;
- 4 in order to replace the electrode, unscrew the fixing screw and remove it: place the new electrode being careful to observe the measures (in mm) shown on next pictures and reassemble following the reversed procedure.
- 5 To adjust the nozzle position, unscrew the fixing screw, move the nozzle backwards or forwards, then fix the screw on the new position. In the example from "1" to "2" see picture below.



#### To change the nozzle position, please contact the Technical Dpt.



#### Cleaning and replacing the flame detector

- Remove the detector from its seat (see picture);
- to clean the detector's lens, use a soft, clean cloth (free from oil and solvents);
- check wiring and all safety functions each time a flame detector has been replaced.



#### Checking the detection current

To check the detection signal follow the scheme in Fig. 29.

If the signal is lower than the value quoted, check the position of the UV detector (photocell), the electrical contacts and, if necessary, replace the UV detector.



Fig. 29: Detection by photocell QRA..

#### Minimum detection signal: 3.5Vdc

#### Seasonal stop

To stop the burner in the seasonal stop, proceed as follows:

- 1 turn the burner's main switch to 0 (Off position)
- 2 disconnect the power mains
- 3 close the fuel cock of the supply line

#### Burner disposal

In case of disposal, follow the instructions according to the laws in force in your country about the "Disposal of materials".

# WIRING DIAGRAMS

Refer to the attached wiring diagrams.

#### WARNING

- 1 Electrical supply 230V 50Hz 1 a.c./400V 50Hz 3N a.c.
- 2 Do not reverse phase with neutral3 Ensure burner is properly earthed
- 4 Refer to the attached document "RECOMMENDATIONS FOR LMV5x CONNECTIONS"

# TROUBLESHOOTING

Heavy oil operation

	THE BURNER DOESN'T START	THE BURNER REPEATS PRE- PURGE	NOISY FUEL PUMP	THE BURNER DOESN'T START AND STOPS	THE BURNER STARTS AND STOPS	THE BURNER DOESN'T SWITCH TO HIGH FLAME	THE BURNER STOPS DURING OPERATION	THE BURNER STOPS AND REPEATS THE CYCLE DURING OPE- RATION
MAIN SWITCH OPEN	ightarrow							
LINE FUSE INTERVENTION	ightarrow							
MAX. PRESSURE SWITCH FAULT	•							•
FAN THERMAL CUTOUT INTERVENTION	•							
AUXILIARY RELAIS FUSES INTERVENTION	●							
CONTROL BOX FAULT	●	•		•			•	
SERVOCONTROL FAULT						•		
SMOKEY FLAME							•	
IGNITION TRANSFORMER FAULT				•				
IGNITION ELECTRODE DIRTY OR WRONG POSITIONED				•				
DIRTY NOZZLE				•			•	
FUEL SOLENOID VALVE DEFECTIVE				•			•	
PHOTORESISTOR DIRTY OR DEFECTIVE					•		•	
HI-LO FLAME THERMOSTAT DEFECTIVE						•		
WRONG POSITION OF SERVOCONTROL CAMS						•		
FUEL PRESSURE TOO LOW				•				
DIRTY FUEL FILTERS			•	•			•	

POS.	DESCRIPTION	POS.	DESCRIPTION
1	AIR INLET CONE	9.1	PRESSURE GOVERNOR
2.1	BURNER HOUSING	9.2	RESISTOR
2.2	CERAMIC FIBRE PLAIT	9.3	COVER
2.3.1	SILENCER	9.4	PRESSURE GAUGE
2.4.4.2	ACTUATOR	9.5	TANK
2.4.5	AIR INTAKE DAMPER	10	BLAST TUBE
2.5	AIR PRESSURE SWITCH	11.1.1	OIL MANIFOLD
3	PUMP	11.1.10	PRESSURE GAUGE
4.2	FAN WHEEL	11.1.11	PNEUMATIC OIL VALVE
4.3	MOTOR	11.1.16	COMPRESSED AIR SOLENOID VALVE
5	PHOTOCELL	11.1.23	SOLENOID VALVE
6.1	NOZZLE	11.1.34	PRESSURE GOVERNOR
6.3	COMBUSTION HEAD	11.2.9	ACTUATOR
6.4.1	IGNITOR	12.1	BOARD
6.4.2	IGNITION ELECTRODE	12.4	COVER
6.5	IGNITION CABLE	13.1	LIGHT
6.6	GAS FLEXIBLE HOSE	13.2	LIGHT
6.7	FLEXIBLE HOSE	13.3	LOCK-OUT RESET BUTTON
6.8	FLEXIBLE HOSE	13.4	PROTECTION
6.9	FLEXIBLE HOSE	13.5	SWITCH
7.1	ONE-WAY VALVE	13.6	FRONT CONTROL PANEL
7.2	SOLENOID VALVE	13.7	CONTROL PANEL
7.3	FILTER	14.2	IGNITION TRANSFORMER
7.4	PRESSURE GAUGE	14.3.1	THERMOSTAT
7.5	PRESSURE SWITCH BRACKET	14.3.2	THERMOSTAT
8.1	GAS PRESSURE	15.2	POWER PACK
8.2	GAS SOLENOID VALVE	15.3	CONTROL BOX
8.3	GAS GOVERNOR WITH FILTER		





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Note: specifications and data subject to change. Errors and omissions exceptd.

# Siemens LMV5x



# **Service Manual**

M12920CC rev 2.1 08/2017

#### Warnings:

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

#### **Qualified personal**

In the sense of this documentation, qualified personal are those who are knowledgeable and qualified to install, mount, commission, operate and service / maintain LMV5 system together with burner & boiler products.

The personal must have the appropriate qualifications to carry out these activities, for example:

Trained and authorized to energize and de-energize, ground and tag circuits and equipment according to applicable safety standards.

Trained or instructed according to the latest related standards (e.g. EN298, EN676, EN267, ..).

#### Notes of caution:

The equipment must be installed in compliance with the regulations in force, following the manufacturer's instructions, by qualified personnel.

Qualified personnel means those having technical knowledge in the field of components for civil or industrial heating systems, sanitary hot water generation and particularly service centres authorised by the manufacturer.

Improper installation may cause injury to people and animals, or damage to property, for which the manufacturer cannot be held liable.

Remove all packaging material and inspect the equipment for integrity.

In case of any doubt, do not use the unit - contact the supplier.

The packaging materials (wooden crate, nails, fastening devices, plastic bags, foamed polystyrene, etc), should not be left within the reach of children, as they may prove harmful.

Before any cleaning or servicing operation, disconnect the unit from the mains by turning the master switch OFF, and/or through the cut- out devices that are provided.

Make sure that inlet or exhaust grilles are unobstructed.

In case of breakdown and/or defective unit operation, disconnect the unit. Make no attempt to repair the unit or take any direct action. Contact gualified personnel only.

Units shall be repaired exclusively by a servicing centre, duly authorised by the manufacturer, with original spare parts.

Failure to comply with the above instructions is likely to impair the unit's safety.

To ensure equipment efficiency and proper operation, it is essential that maintenance operations are performed by qualified personnel at regular intervals, following the manufacturer's instructions.

When a decision is made to discontinue the use of the equipment, those parts likely to constitute sources of danger shall be made harmless.

In case the equipment is to be sold or transferred to another user, or in case the original user should move and leave the unit behind, make sure that these instructions accompany the equipment at all times so that they can be consulted by the new owner and/or the installer.

For all the units that have been modified or have options fitted then original accessory equipment only shall be used.

This unit shall be employed exclusively for the use for which it is meant. Any other use shall be considered as improper and, there- fore, dangerous. The manufacturer shall not be held liable, by agreement or otherwise, for damages resulting from improper installation, use and failure to comply with the instructions supplied by the manufacturer.

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# **1 WIRING RECOMMENDATIONS**

### 1.1 Earthing

#### 1.1.1 TN earthing system

For the LMV5x-System it is preconditioned that a TN earthing system is used.

In a TN earthing system, one of the points in the generator or transformer is connected with earth, usually the star point in a three-phase system.

TN-S: PE and N are separate conductors that are connected together only near the power source. This arrangement is the current standard for most residential and industrial electric systems in North America and Europe.

TN-C-S: Combined PEN conductor from transformer to building distribution point, but with separate PE and N conductors in fixed indoor wiring.



 LMV system must be connected to earth (PE). △Volt must be 0 V between N-PE.

 NOTE:
 PE = protection earth, it is not FE

 FE = functional earth

# 1.1.2 Protective Earth (PE) and Functional Earth (FE)

#### Protective Earth (PE):

Known as an equipment grounding conductor, avoids hazards by keeping the exposed conductive surfaces of a device at earth potential. To avoid possible voltage drop no current is allowed to flow in this conductor under normal circumstances, but fault currents will usually trip or blow the fuse or circuit breaker protecting the circuit.

For example: burner body or the third wire in a 3 wire cable (N L E)



Functional Earth (FE):

Is not intended for shock protection. It is used for a common reference potential. For example: cable shields.

# 1.2 .Frequency inverter / Variable Speed Drive (VSD)

A VSD is one of the strongest EMC sources in a boiler house, so the following is recommended:





Use only VSD with EMC- filter!

Cable from VSD to the fan motor (Line voltage)

Use a <u>complete separate and shielded cable</u> from the VSD to the fan motor! Connect the shield at VSD- <u>and</u> at the motor- side with PE. Details and further information see related VSD- documentation.

Cable from LMV5 to VSD (Low voltage)

Use a shielded cable from LMV5 to VSD. The shield of this cable has to be connected only at LMV5 side with X73.6 (FE), not at the VSD side:

#### 1.3 Ignition electrodes and transformers

The Ignition is also one of the strong EMC sources, so the following is recommended:

- Keep the cable loop/length in the high voltage ignition circuit as short as possible.
- Use special EMC-ignition cable
- Avoid capacitive and inductive coupling to other signal paths.
- Use separate wiring for the ignition high voltage cable, with max. possible distance to other cables and to the burner housing.
- e.g.: use a electrical insulating conduit or distance parts (e.g. plastic material), see also Appendix "Example for wiring, earthing and shielding the LMV5-System"
- Prefer a double pole ignition (see drawings below).
- When using a double probe ignition, the cables should be run close together to ensure that the area of emissions is as small as possible.



If a single pole ignition must be used, it is very important to have a low impedance at the mechanical connections (no insulation material, e.g. paint), because than you get a <u>good</u> current path from the ignition spark back to the ignition transformer, that results in <u>low</u>EMC-emissions:

If you have high impedance at the mechanical connections, e.g. caused by paint, you get **<u>bad</u>** multiple current paths from the ignition spark back to the ignition transformer, that results in <u>high</u> EMC-emissions

#### 1.3.1 Recommendations

It is recommended to use a metal "mounting plate" for the LMV5 Base Unit and the TransformerAGG5.220. Use this plate to provide the Functional Earth (FE), see also <u>/EARTH connection example</u>

The connection of the FE to the LMV5 has to be made by connecting the X52.4 terminal with FE!

X52.4



In some cases connecting the terminal X52.2 with FE results in an improved EMC- immunity of the LMV5. Make this connection and check the result, if there is no improvement, remove this connection.

1234

The FE is wired LMV- internal to the terminals for the shields (e.g. for Temperature- & Pressure- Sensors, ...), see "4. Shielding"

Function earth

To have a good connection of FE to the actuators SQM4/9, make certain that there is a proper electrical contact between the housing of the actuators and FE.

If necessary connect the actuators SQM45/48/91 with a separate cable with the maximum possible diameter to FE, see also Appendix "Example for wiring, earthing and shielding the LMV5-System"

#### 1.3.2 Shielding

The LMV5-FE-terminals for the snields are LMV5 internally connected with X52.4, this terminal must be connect external with FE!, see also "3.3". The shield terminals for the CAN-Bus (X50.1, X51.1) are connected direct with X52.4, the other shied terminals are connected via capacitors to prevent DC- current.





12

DFO (02-I)

For the cables listed below use shielded cables:

For the CAN-Bus cable use AGG5.631 and/or AGG5.641 together with AGG5.110 = CAN bus connection shield, for connecting the CAN bus to the basic unit. More details see page 36 "Installation Guide CC1J7550.1"

- Cables for the VSD:
- Line voltage cable VSD Fan motor

<sup>t</sup>Op

FE

- Low voltage cable LMV5 VSD (terminals X73)
- Cables for Temperature or Pressure sensors, set points, load output at the LMV5 Base Unit: X60, X61, X62, X63
- Cables for the Fuel Counters at the LMV5 Bas Unit: X71, X72
- Cable for the Speed sensor: X70
- Cable for the QGO20 sensor at the PLL52: X81
- Cables for Temperature sensors at PLL52: X86, X87

(only if present) Cable for QRA7- Signal wires no. 3, 4 and 5, for cable length > 10m and < 100m; consider reinforced insulation to signal cable and connect it to PE at the cabinet PE- rail.

# 1.4 Wireway and electrical conduit

The following cables are recommended for separate wiring;

Complete separate from all other cables:

- Cable for "VSD to Fan motor" Line voltage, see also "1. Frequency inverter / Variable Speed Drive (VSD)"
- Cable for ignition high voltage, see also "2. Ignition"
- Cable for the Flame sensors

Together in cable duct 1 for Low voltage, e.g.:

- Cable for CAN-Bus
- Cable for VSD speed sensor, LMV5 X70
- Cable for VSD Release & Set point , LMV5 X73
- Cables for the Load controller: Temperature or Pressure sensor, set point, load output at the LMV5 X60, X61, X62, X63

Together in cable duct 2 for Line voltage, e.g.:

- Cable for Ignition transformer
- Cables for other Line voltage signals, e.g. Gas pressure switches, Air pressure switches, ....
- Cable for Gas valves SKP/VGD



The cables from the LMV5 to the SKP/VGD -Gas vales shall be connected at the LMV5 side with X9-01: L-Valve1, L-Valve2 and with X9-02, N, PE) and connected at the SKP side separate to each SKP.

Example of wiring, see next paragraph Wireway and electrical conduit



NOTE: KEEP SEPARATE SIGNALS CABLES, OUTPUT CABLES, PHOTOCELL CABLE AS SHOWN IN THE BELOW PICTURE



# 1.4.1 Servomotor wiring example



1.4.2 Bus cable wiring on LMV5x and AZL doors.





# 1.4.3 EARTH connection example



# 2 AZL display/programming unit

Users can set only the LMV parameters that can be accessed without password: (see "Adjusting the temperature set-point"). The Siemens AZL User Interface allows programming the Siemens LMV control box and monitoring the system data.



The user interface is made of: display: it shows menus and parameters **ESC** key (previous level): it goes back to the previous level menu or exits the programming mode without changing data. **ENTER** key (next level): it confirms the data changing and jumps to the next menu/parameter.

**SELECT** is they select a menu item and change the parameter values.



AZL5x provides three sockets to interface with other devices:

 $\rm X70$  socket for CAN bus connection: it provides power supply to display also.

COM1 (X71) for connection to PC/laptop by RS232 connector CMO2 (X72) for connection to building automation system by RJ45 connector.

Note: COM1 and COM2 ports do not work at the same time.



Caution: when MODBUS in active, it is not possible to execute the backup via ACS450; if backup is executed the set-point will be missing and the burner will immediately turns off.

### 2.1 LMV5x program operating phases

Phase number	Description	Sequence
10		Home run
12		Stand by
20,21	Waiting to start realase	Startup
22	Start fan on	Startup
24	Driving to pre-purge	Startup
3034	Pre purging	Startup
36	Driving to ignition pos	Startup
38	Ingnition pos	Startup
40,42,44	Fuel release 1	Startup
50,52	Fuel release 2	Startup
54	Driving to low flame	Startup
60,62	Shut-down low fire	Operation
70,72	Driving to prepurge	Shutdown
7478	Post-prepurging	Shutdown
79	Test Air PressSwitch	Shutdown
8083		Valve proving
01		Safety Phase
00		Lockout

At burner startup, the AZL display shows, one by one, the various phases of the start-up program, until it reaches normal operation phase (Phase 60). LMV5x controller is factory preset. Changing are possible according to the password input

By closing the "thermostat series" and once the start-up sequence is accomplished (from phase 12 to pahse34), the burner is driven to the factory-set ignition position (phase 38).

The burner remains in that position because this is the only one work point in memory.

The fuel/air ratio curve must be set, until the maximum load limit (100% output).

During the setting, the actuators move according to the curve points. While the actuators move, always check the combustion analysis, point by point, and the flame stability.

The fuel/air curve points must be set during the commissioning, by a qualified operator.





#### NOTE:

(1) only for LMV52.400, LMV51.300 without temperature compensation

(2) only for LMV5.200 (controlling the oxygen level in the exhaust gas flue) and LMV52.400 (monitoring the oxygen level in the exhaust gas flue, a lock out occur if a limit value is overcoming)

(3) Only for LMV51.300 (in this case VSD cannot be used), LMV52.xxx



ATTENTION: IT IS RECOMMENDED TO NOT USE 02 MONITORING IF FGR IS INSTALLED AND ACTIVE

#### 2.3 Burner ID number

The burner ID number corresponds to the burner serial number.

**NOTE:** in case of call to the Service Center, always tell the burner type and serial number (see burner data plate). **NOTE:** burner ID number must be set.

Following the below route access to the programming levels of the menu:

1st level	2nd level	3rd level	4th level	5th level	6th level	Description
OperationalStat						
	BurnerID					Identification of burner

the product ID number is an OEM parameter, entered by the burner manufacturer and it can not be changed; it consist of minimum 4 and maximum 15 characters.

# 2.4 Password

#### 2.4.1 Access to service levels by password

Depending on password (service or OEM), different parameters are visible.

"Service" parameters, as per the actuator curves and the set-point values, are password protected. The operator must logon using the "9876" password.

If a password shall be entered, line Enter password is selected by means of decrementing (pointer points to the first character of that line) and then finally selected by pressing Enter.

Then, the pointer jumps to the first position of the password entry line. Now, through incrementing or decrementing, a character (digit or letter) can be selected. A character is confirmed by pressing Enter. If a wrong entry has been made, the last character can be edited again by pressing Esc.

The other password positions can be selected, edited and entered in a similar way. Hence, when making an entry, only 1 character is visible. When the last character of the password is reached, the entry is to be confirmed by pressing Enter.

Display before the first password character is entered:

Enter F	assw	ord							
: *	*	*	*	*	*	*	*		

The example displays when entering the third password character:

En	ter P	assw	ord							
:	*	*	S	*	*	*	*	*		

If the check of the password entered is positive, the change to the next menu level takes place. Otherwise, the display returns to the main menu level. To go back to the main menu, press "Esc" 📩 until the first level menu is reached, then press the "right arrow" ()† till the first item is reached, then press "Enter" twice.

#### 2.4.2 Password Logout

To avoid customer changes on parameter settings and consequently changes in regulation, the password must be logged out. The "password logout" functions on the first level menu: press to choose "PW Logout" then press "Enter".

**Note:** if no key is pressed within a settable period, the password is deactivated automatically. **Note:** if a power supply drop occurs to the unit, the password will be automatically deactivated.

#### 2.4.3 Changing password.

Following the below route access to the programming levels of the menu by means the Esc

1st level	2nd level	3rd level	4th level	5th level	6th level	Description
Updating						
	Password					To change password
		ServicePassword				For service only
		OEM Password				For OEM only

# 3 Thermostatic series and safety loop

The burner shuts down properly when the thermostatic series (X5-03.1 and X5-03.4 - terminals 3 and 4 of the burner terminal block) opens. In this way, before shut-down, the burner drives to the minimum load, then the fuel valve will close. The post-purging phase will be performed if set. By re-closing the thermostatic series, the burner will start-up again.



In the plant other safety devices are provided (levels, pressure switches, thermostats, air damper). All these contacts are connected in series to the 318-319 terminals of the burner supply terminal block. When the safety loop closes, the burner is ready to restart. The actuators move to "home position" (standby position), and if terminals 3-4 are closed the start-up cycle resumes; otherwise the burner enters the standby phase.

In the plant the safety thermostat is provided as well. If this thermostat switches (terminals X3-04.1 e X3-04.2 corresponding to terminals 318 and 319 of the burner supply terminal block - see below), the system will lead to an immediate burner lockout.



In case of burner designed with automatic pull-out system from the generator, the burner flange end switch is connected to terminalsX3-03.1 e X3-03.2. If the contact open, the burner automatically shuts down.



**NOTE:** When the safety loop opens, the burner will immediately turns off, skipping the low flame stage. It's important to distinguish between "safety loop" and "thermostatic series"

The maximum number of emergency shut-downs is 16. When this number is reached a lockout will occur AZL will show the message: "Open safety loop".

Following the below route access to the programming levels of the menu:

1st level	2nd level	3rd level	4th level	5th level	6th level	Description
Params & Display						Menu level for making the parameter settings
	BurnerControl					Setting the burner control parameters
	Ð	Configuration				
			RepetitCounter			It sets the maximum number of possible repetitions
				SafetyLoop	116	Default is set on 16

# 4 Actuators

# 4.1 Addressing the actuators

The addressing assigns to each actuator its proper function. The addressing is factory set by the burner manufacturer.

If an actuator must be replaced, it is necessary to address it, otherwise the system will not work. The parameter that sets the actuator function is protected by the Service level password. Remember to check that the jumper "Bus termination" of the last actuator on the CAN bus is set to "On", before starting addressing.

Following the below route access to the programming levels of the menu by means the Esc

1st level	2nd level	3rd level	4th level	5th level	6th level	Description
Params & Display						
	Actuators					
	Ŀ	Addressing				Addressing unad- dressed actuators
		(1)	AirActuator GasActuat (Oil) OilActuator AuxActuator 1 AuxActuator 2 AuxActuator 3 (**)			(**) used with FGR

To address an actuator, choose the corresponding actuator and follow the instructions on display:

When the actuator green LED flashes, it means that one of the following function is set according to the number of blinks:

Blinks	Actuator function					
1 blink	air damper actuator					
2 blinks	gas butterfly valve actuator					
3 blinks	oil pressure governor actuator					
4 blinks	auxiliary actuator AUX1					
5 blinks	auxiliary actuator AUX2					
6 blinks	auxiliary actuator AUX3					

If the burner is equipped with FGR, AUX3 must be used



CAUTION: it is recommended not to adjust the actuators. Anyway, never press the actuator red button, otherwise the fundamental parameters, necessary for the burner operation, will be cancelled. The burner will therefore continuously lock out

In case P1 was pressed for a long time, it will be necessary to perform a new addressing of the actuator.





ATTENTION: when the actuator LV green LED is always lit, it means that the actuator has not been addressed yet or it has been reset and needs to be addressed again.

# 4.2 Actuator doors configuration

After the adressing of the actuators, it is necessary to activate and to configure the operation way for each servomotor.

ATTENTION: Activate only the actuators that are really present, otherwise an error will occur.

1st level	2nd level	3rd level	4th level	Possible choices
Params&Display				
Ŀ	RatioControl			
	•	Gas/OliSetting		
			AuxActuator	Deactivated
			AirActuator	Activated
			AuxActuator1	Air influencing (only with LMV52x if O2 control is present)
			AuxActuator2	
			AuxActuator3	(values available Only with LMV51.300)
			VSD	VSD = VSD only
			GasActuator	AUX3 = FGR only, without temperature compensation
				VSD+AUX3 = VSD and FGR



LMV 51.300 has the possibility to operate with VGD+FGR without temperature compensation

### 4.3 Setting the actuator speed

LMV sees VSD as an actuator, that's why the speed ramp up and the stop times must not be higher than the actuator stroke time. If it is necessary to increase the VSD times, change the actuator stroke time also, according to the next procedure. By following the next table, set both parameter "OperatRampMod" and "TimeNoFlame" to set the ramp up/stop times for the VSD and the actuator opening speed (from 0° to 90°).

Following the below route access to the programming levels of the menu by means the Esc

1st level	2nd level	3rd level	4th level	5th level	6th level	Description
Params&Display						Menu level for making the parameter settings
Ŀ	RatioControl					Parameter settings for fuel/ air ratio control
		Times				
			OperatRampMod	Service	40 s	Operating ramp modulating is the maximum speed of the actuators during operation (phase 60 ÷ 62).
						A setting of 30 seconds generates a maximum speed of 90° in 30 seconds (3°/s).
						The LMV5 calculates an individual speed for each actuator, so that all actuators reach their target positions at the same time.
						Range 1060s
			TimeNo- Flame	Service	40 s	Drive ramp is the speed of the actuators when traveling to the home, prepurge, ignition, and postpurge positions.
						A setting of 10 seconds generates a maximum speed of 90° in 10 seconds (9°/s).
						Range 10120s

ATTENTION: It is suggested to set the ramp up and stop time to a value about 35% lower then the slowest actuator.

# 5 Setting the load controller

LMV5 TEMPERATURE/PRESSURE CONTROLLER Function earth for X60.5	Door X60 is used for IntLC choice and a temperature modulationg probe is used.
Temperature detector X60.3 Pt/NI 1000 (input 4) Temperature detector X60.1 Pt 100 (input 1) Line compensation X60.2 Pt100 Signal reference X60.4 TEMPERATURE	ATTENTION: in case of FGR, it is not possible to connect a modulating temperature probe at the X60 door of the LMX5 See the proper chapter for configuration.
Function earth for shield connection X61.5 Power supply for temperature/pressure X61.1 Voltage input 010 V (input 2) X61.2 Current input 420 mA (input 2) X61.3 Signal reference X61.4 TEMPERATUR/PRESSURE INPUT	Door X60 is used for IntLC choice and a pressure probe is used.         It can be used also if the temperature probe has an analogue exit or a converter from Ohm to mA /V is used.         In this case the right input must be set.         Image: ATTENTION: in case of FGR, it is possible to connect a modulating temperature probe at the X61 door of the LMX5
Function earth for shield connection     X62.5       Power supply for setpoint changeover     X62.1       Voltage input 010 V (input 3)     X62.2       Current input 420 mA (input 3)     X62.3       Signal reference     X62.4	Door X62 is used for ExtLC The input signal come from an external load modulator. Door X62 is also used to switch from one setp oint to onother one when IntLC is used, by measn the opening and closing of the contact between X62.1 and X62.2 terminals
Function earth for shield connection Current output 420 mA burner output Signal reference LOAD OUTPUT	Door X63 is used to remote a load % signal output from the LMV to the client DCS or PLC Output Value Selection are: Load / Load 0 / O2 / Pos Air / Pos Fuel / Pos Aux1 /Pos Aux2 / Pos Aux3 / Speed VSD / Flame / Temp Pt1000 / TempNi1000 / Temp Pt100 / Temp X61 / Press X61)

IntLC....must be set together with a modulating probe (temperature or pressure). The probe and its signal must be configured. Doors allowed are X60 for temperature probe and X61 for pressure probes or analogue output probes.

ExtLC... must be set together with an external input signal of modulation (analogue or bus) coming from an external output modulator. The input must be configured. Doors allowed are X62 for the type of signal choice.

Following the below route access to the programming levels of the menu

1st level	2nd level	3rd level	4th level	5th level	6th level	Description
Params & Display						Menu level for making the parameter settings
	LoadController					Settings for the internal load controller
	Ŀ	Configuration				General con- figuration of the load con troller
			LC_OptgMode			Operating mode with load control- ler
				ExtLC X5-03 Int LC Int LC Bus Int LC X62 Ext LC X62 Ext LC Bus		See below.

#### ExtLC X5-03 = three-point external controller (X5-03 terminals)

Int LC = internal controller (LMV5x) (it switches between 2 set points, W1,W2 set thought AZL. the switch from W1 and W2 is realized opening/closing the LMV5x... terminals X62.1, X62.2).

Int LC Bus = internal controller and set point setting via bus connection

Int LC X62 = internal controller (LMV), but set point is externally controlled by means of a voltage/current signal on X62 terminals

Ext LC X62 = external controller, the burner output is controlled by means of a voltage/current signal on X62 terminals

Ext LC Bus = external controller, the burner output is controlled via bus



ATTENTION: in case of FGR, it is not possible to connect a modulating temperature probe at the X60 door of the LMX5... See the proper chapter for configuration.

# 6 Setting the probes and set-points

If the LMV5x internal load controlled is used, a temperature or pressure probe can be connected to the terminal X60 or X61. In this case, set the type of probe and its operating range.

# 6.1 Configuration of a temperature probe at X60 door



ATTENTION: If the external load controller is set do not connected to terminals X60 or X61.

ATTENTION: If the burner is equipped with FGR with temperature compensation a Pt1000 must be set.

ATTENTION: Depending on the sensor, the value is visualized as °C or bar.

Following the below route access to the programming levels of the menu by means the Esc

1st level	2nd level	3rd level	4th level	5th level	6th level	Description
Params & Display						Menu level for making the parameter set- tings
	LoadController					Settings for the internal load controller
	Ŀ	Configuration				General configuration of the load controller
			Sensor Select			Select actual value input
			•	Pt100 Ni1000 Temp sensor Press sensor Pt100Pt1000 Pt100Ni1000 NoSensor		See the table below for the meaning of the choice.

#### Possible settings are:

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



ATTENTION: If a boiler second probe is to be connected to terminals (1000 Ohm only), internal functions TL\_ThreshOff and DiffIntervTL\_SD\_On are activated automatically (see paragraph <u>SETTING FUNCTIONS "TL\_ThreshOff" AND "TL\_SD\_On"</u>).

# 6.2 Configuration of a pressure or a temperature probe type at X61 door

 $\Lambda$ 

ATTENTION: If the external load controller is set do not connected to terminals X60 or X61.

1st level	2nd level	3rd level	4th level	5th level	6th level	Description
Params & Display						Menu level for making the parameter set- tings
	LoadController					Settings for the internal load controller
		Configuration				General configuration of the load controller
		Ŀ	Ext Inp X61 U/ I			Configuration of external input X61
			•	420 mA 210 V 010 V		Set the proper value according to the probe output.

If a modulation probe is connected to the X61 terminal, proceeding as follows:

# 6.2.1 Configuration of a pressure or a temperature probe signal at X61 door

Once the pressure sensor signal type is set, the sensor range must be set as well, proceeding as follows:

1st level	2nd level	3rd level	4th level	5th level	6th level	Description
Params&Display						Menu level for making the parameter settings
	LoadController					Settings for the internal load controller
	Ŀ	Configuration				General configuration of the load controller
			MRange PressSens			End of pressure measuring range for input X61
				099.9 bar 02000 °C	099.9 bar 02000 °C	Set the probe value

**Example:** if a max 10bar Siemens sensor is used, the voltage output signal will be 0 V at 0 bar, while the 10 V signal will correspond to its maximum pressure 10 bar. If the sensor is replaced with a max 16bar one, the 0 V output signal will correspond to 0 bar, while the 10 V output signal will correspond to 16bar pressure: the parameter "MRange Press-Sens" has to be set at 16bar.

# 6.3 Configuration of the X62 door input signal

Following the below route access to the programming levels of the menu by means the Esc

1st level	2nd level	3rd level	4th level	5th level	6th level	Description
Params & Display						Menu level for making the parameter settings
	LoadController					Settings for the internal load controller
		Configuration				General configuration of the load controller
			Ext Inp X62 U/I			Configuration of external input X62: input signal on X62 can change setpoint or control the load
				420 mA		According to the external modulator output.
				210 V		
				010 V		
				0…20 mA		

If a boiler second probe is to be connected to terminals (1000 Ohm only), internal functions TL\_ThreshOff and DiffIntervTL\_SD\_On are activated automatically (see paragraph <u>SETTING FUNCTIONS "TL\_ThreshOff" AND "TL\_SD\_On"</u>).

# 6.4 Setting the setpoint and the burner and the PID operative band.

#### 6.4.1 Set-point

To set the temperature set-point value, that is the generator operating temperature; proceed as follows.

1st level	2nd level	3rd level	4th level	5th level	6th level	Description
Params & Display						Menu level for making the parameter settings
	LoadController					General configuration of the load controller
		ControllerParam				Controller parameters

It appears the below screen:

SetPointW1	Curr: it shows the current set-point; use the arrows keys to change it. New: it is the new set value. Enter to confirm, otherwise exit without changing by
Curr: 90°	pressing ESC.
New: 90°	Press ESC one more time to exit the set-point programming mode.

After setting the set-point it is necessary t oset the operation range of the burner. See paragraph SD\_ModON e SD\_Mod Off

#### 6.4.2 SD\_ModON e SD\_Mod Off

Once the temperature set-point W1 is stored, set the burner switch-on (SDon) and the switch-off (SDoff) point:



To set these values, choose the item SD\_ModOn (SDOn), by scrolling down the "Load controller" menu with the arrow keys and press ENTER:

1st level	2nd level	3rd level	4th level	5th level	6th level	Description
Params & Display				Menu level for making the	Params & Display	
	SD:ModOn			General configuration of the load	Ð	SD:ModOn
Ŀ	SD:ModOff			General configuration of		SD:ModOff

the display will show:

SD_ModOn	SD_ModOff	
Curr: 1.0%	Curr: 10.0%	
New: 1.0%	New: 10.0%	

The **SD\_ModOn** default value for this parameter is1% that is, the burner will light again at a temperature 1% lower than the set-point. Change value, if needed, by means of the arrow keys; press ENTER to confirm and the press ESC to exit. Press only ESC to exit without changing.

Now choose SD\_ModOff always scrolling down the Load Controller menu, by means of the arrow keys, and press ENTER.

The default value for this parameter is10% that is, the burner will turn off at a temperature 1% higher than the set-point. Press the ENTER to confirm, the press ESC to exit. Otherwise press ESC to exit without changing data. Press the ESC to exit

#### 6.4.3 PID control parameters

The controller's memory contains 5 standard parameter sets.

If required, 1 of these 5 PID triple values can be copied to the storage locations for the actual values so that it becomes active.

PID standard values for the following applications:

1st level	2nd level	3rd level	4th level	5th level	6th level	Description
Params & Display						Menu level for making the parameter settings
Ŀ	LoadController					Settings for the internal load controller
		ControllerParam				Settings for internal load controller
		Ð	ContrlParamList			Settings of controller parameter for internal load controller
				StandardParam	Adaption very fast fast normal slow very slow	

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

See the LMV5x Siemens manual for instructions. Generally the choice of the proper pre-set PID that LMV5x suggest (very fast / fast / normal / slow / very slow) are enough for a proper operation.

Adaption	The values acquired by the LMV5 adaption function are				
	Xp [%]	Tn [s]	Tv [s]		
Very fast (e.g. for small boiler)	42,5	68	12		
Fast	14,5	77	14		
Normal	6,4	136	24		
Slow	4,7	250	44		
Very slow (e.g. for large boiler)	3,4	273	48		

Table shows the pre set parameter of the PID regulator according to the internal modulator reaction choice.

The parameter Xp is the proportional band in % of the set-point

# 6.5 Setting functions "TL\_ThreshOff" and "TL\_SD\_On"

These functions enable the settable threshold for the immediate shutdown, if value set on TL\_ThreshOff is exceeded. The automatic restart is performed for values lower than the one set on TL\_SD\_On.

On display, values detected by temperature/pressure probe are shown at the same time.

TL\_ThreshOff turns the burner off if temperature exceeds the set value. Gas/Oil valves are suddenly closed.

TL\_SD\_On automatically restart the burner if the temperature is lower than the set value.

SD\_ModOff automatically turns the burner to low flame and then shut down the burner if temperature exceeds the set value.

SD\_ModOn automatically restart the burner if the temperature is lower than the set value.

P-Part (Xp) proportional band of modulation.

Note: this function is available if a Pt100 Ni1000 or Pt 1000 temperature sensor is connected to X60.3 and X60.4 terminals.

ATTENTION: basically, these parameters provide a function similar to the safety thermostat one, but can not replace it. The boiler must always operate with its safety thermostat connected properly.

**NOTE:** the parameter TL\_ThreshOff for the immediate shutdown, must always be set to a value higher than the SD\_ModOff threshold for the normal shutdown. TL\_SD\_On must be set at a higher temperature than SD\_ModOn.



Following the below route access to the programming levels of the menu by means the Esc

1st level	2nd level	3rd level	4th level	Range	Default	Description
Params & Display						Menu level for making the parameter set- tings
	LoadController					Settings for the internal load controller
	Ŀ	TempLimiter				Settings for the temperature limiter function
		Ŀ	TL_ThreshOff	02000 °C	95°C	Temperature limiter OFF threshold, in °C
			TL_SD_On	-500% TL_Thresh_Off	- 5%	Temperature limiter switching differential ON

# 7 VSD Standardization

Motor standardization (speed acquisition) allows the LMV unit to control the motor rounds at the maximum frequency signal coming from the VSD. A temporary standardization is factory set only for test purpose. The definite standardization must be performed on site by the Service Center (only if the fan is supplied), before the plant test.



ATTENTION: To perform standardization, the burner must be in stand-by mode, not it lockout stage. The Safety loop must be closed (X3-04).

Following the below route access to the programming levels of the menu by means the Esc

1st level	2nd level	3rd level	4th level	5th level	Range	Description
Params & Display						Menu level for making the parameter settings
Ð	VSD Module					Settings for the VSD module
		Configuration				
		Ŀ	Speed			
			Ŀ	Standardization	Deactivated Activated	Standardization process for fan speed

By activating the standardization, without starting the burner up, the air actuator drives to ites maximum opening. Then the fan motor stars and the VSD drives the motor to its maximum speed. The speed sensor, mounted on the motor, detects the rpm value. LMV stores the data and the motor stops.

ATTENTION: do not enter manually the rpm value of the motor data plate on parameter "StandardizedSp".

 ATTENTION: the power cable that connects VSD to motor must be screened.

# 8 SPECIAL POSITIONS

# 8.1 Ignition position

The ignition point is independent from the other curve points of the air/fuel ratio curve.

As far as dual fuel burners, the ignition point set for the gas operation does not depend on the one set for the oil operation. LMV5x allow two different ignition position for gas mode and oil mode.

The burner is provided with a factory-set ignition point, to make easier the first ignition procedure by the Service Centre.

The air actuator at the ignition point, is factory set at a 6°/7° opening, while the gas actuator is set at 12°/15°. In case of burner provided with VSD, it is suggested to set ignition at 100% VSD frequency.

Following the below route access to the programming levels of the menu by means the Esc

1st level	2nd level	3rd level	4th level	5th level	6th level	Description
Params & Display						Menu level for making the para- meter set- tings
Ŀ	RatioControl					
	Ð	GasSettings OilSettings				Choose according to the fired fuel.
			Special Positions			
				IgnitionPos		
				HomePos		
				PrepurgePos		
				PostpurgePos		
				٩	IgnitionPosGas	Set the proper position
				Ŀ	IgnitionPosAir	Set the proper position
				Ŀ	IgnitionPosAux 1	Set the proper position
					IgnitionPosAux 2	Set the proper position
					IgnitionPosAux 3	Set the proper position
					IgnitionPosVSD	Set the proper position

# 8.2 Prepurge position

Following the same route up to the 4th level, choose the pre-purge position of the servomotors

# 8.3 Home position

Following the same route up to the 4th level, choose the home position of the servomotors

#### 8.4 Postpurge position

Following the same route up to the 4th level, choose the postpurge position of the servomotors

# 9 ADJUSTING THE AIR/FUEL RATIO CURVES



ATTENTION: when burners are provided with VSD, before setting the air/fuel ratio curves, the Standardization of the motor speed must be performed (see chapter "Standardization").

1st level	2nd level	3rd level	4th level	5th level	6th level	Description
Params & Display						Menu level for making the parameter settings
	RatioControl					Parameter settings for fuel/ air ratio control
		GasSettings OilSettings				Parameter settings for firing on gas or on oil
		Ŀ	CurveParams			

# 9.1 Fuel burner settings - curve-points

Two curve points are factory set (default settings) corresponding to a hypothetic low flame stage

Note: points P1 and P2, are temporally mentioned 10% and 100% load, independently from the actual load. The operator can name the load on each point, without respecting the actual load value in that point. LMV5x will order those points automatically according to the load values set by the operator.



With this setting, by closing the thermostat series, the burner drives to minimum load position P1, after ignition. Then it drives to position P2 without increasing the output, as both the points are set with actuators minimum opening.



ATTENTION: For burners with FGR and LMV52.400, the parameter is set to "deactivated".

# 9.2 Setting the load points output (burners with no FGR)

Following the below route access to the programming levels of the menu

1st level	2nd level	3rd level	4th level	5th level	6th level	Description
Params & Display						
	RatioControl					Parameter settings for fuel/ air ratio control
		GasSettings GasSettings				Parameter settings for firing on Gas or on Oil
		Ŀ	CurveParams			At this level, the air/fuel ratio during operation is to be set.



Now it is possible to change Point2 with the next procedure

Checking continuously the air excess means of the combustion analyzer, increasing by few degrees\* the air damper opening and the VSD if provided. Then increase by few degrees\* the gas butterfly valve (or the fuel actuator). Go on step by step, until the butterfly valve complete opening is reached (actuator at 90° - see diagram).

The target is to reach the gas butterfly valve maximum with a sufficient excess of air. While progressively increasing the actuator positions, besides increasing the air quantity the fuel rate must be controlled by means of the valve pressure governor, in order to not exceed the requested maximum flow rate.

Once the gas butterfly valve maximum opening is reached, adjust the fuel **rate** only acting on the gas valve pressure governor (or on the oil pressure governor in case of oil).



ATTENTION: as for "increasing by few degrees" it means that the increasing must be performed in order to avoid great excess of air or defect of air.

Therefore the increasing operation must be performed always checking the flue gas analysis by means of the combustion analyzer. It is recommended to make increasing while maintaining O2 % between max 7,5% and min 3%.

It is recommended to save new points increasing the burner output at step odf10÷20% load. Measuring the burner output at the flow meter. In this way, if for any reason, you must interrupt the commissioning and restart it later, you would help yourself.



Checking parameters by means of the combustion analyzer go on increasing the Air (and/or VSD if provided) and the Fuel actuators. At the end the last point will be set.

Point :10 O2	Load Fuel Air VSD	100 90 50 85		Act on the pressure governor to adjust the fuel pressure at the proper value in order to reach the real 100% load of the generator/boiler. Act only on the AIR or VSD actuators, to adjust the combustion.
	Point :10 O2	Load Fuel Air VSD	100 90 90 100	An example of final point will be as per the display aside, imaging to set 10 curve-points.
$\wedge$	ATTEN	TION: Set	t the % o	utput load values, for every curve-point
٨				

ATTENTION: Adjust actuators position by small changes, always checking combustion parameters.

Caution! For safety reasons, once the maximum load point P2 is set, never go down to the minimum load point P1, without having set the other intermediate points before (see next paragraph).
Caution! In case it is necessary to immediately shut the burner down while working at high flame and the maximum load point is not already set observing the combustion parameters, decrease gas by means of the pressure governor as to drive the burner to a sufficient excess of air, then shut the burner down by the main switch.

At next start-up, start again with point P2 to the minimum load (factory-setting - see previous paragraph) and go on setting the curve points.



ATTENTION: When the maximum load is reached (100%), check again the curve-points. The pressure at the governor has changed and therefore also the gas flow rate to the other points. So, it is necessary to check the adjustment of the points already set.

ATTENTION: for proper operation, it is necessary that the curve of each actuator does not reverse its slope.

ATTENTION: When % load value is changed by user, LMV recalculates all the curve-points according the new load value. It may happen that the point you are adjusting, once saved, is moved to another position.



## **10** Configurations for burner with FGR

### 10.1 Recommendations

	Note!
	Reduction of maximum burner output
٨	Use of the flue gas recirculation (FGR) function or the flue gas mass introduced to the supply air duct might lower the burner's maximum output.
	This means that the maximum amount of combustion air that can be introduced will be reduced.
	It is recommended to consider a proper air excess during the regulation of the burner in order to have to the right O2 content in the smoke, after the flue gas recirculation.
	Hence, the amount of fuel for high-fire operation must be reduced to ensure correct combustion values.
	Caution!
•	Temperature-compensated flue gas recirculation (FGR) can be correctly set only when selecting with DriveLowfire in operation!
	A change in the curve point without the corresponding flue gas recirculation temperature (e.g. <i>without driving</i> in operation or in standby) results in an incorrect <i>pairing</i> of the values <i>Flue gas recirculation position</i> and <i>Flue gas recirculation temperature</i> .
	This can lead to excessive amounts of recirculated flue gas, which might cause the flame to lift: Stability limit of flame.
	Caution!
$\wedge$	A subsequent change of the curve point without an associated flue gas recirculation (FGR) temperature (e.g. without DriveLowfire in operation or standby) leads to an incorrect pairing of flue gas recirculation-position and flue gas recirculation- temperature.
	This can lead to excessive amounts of recirculated flue gas, which might cause the flame to lift: Stability limit of flame.
	Note!
	Flue gas recirculation (FGR) in combination with O2 trim control Recommendation: Do not use flue gas recirculation (FGR) in combination with O2 trim control.
	This has no impact on the use of the O2 alarm.
•	The physical effects are the following:
	1. Pressures have reciprocal effects.
	2. The reduction of O2 can lead to a significant increase of NOx levels.
	As a result of these reciprocal effects, it is difficult, if not impossible, to adjust fuel-air ratio control, O2 trim control, and the flue gas recirculation (FGR) function.
	Even if an adjustment was possible, the flame may become instable during operation, or the required NOx levels might not be reached.
	Note!
•	The full scope of setting <i>TCautoDeact</i> is possible only when the flue gas temperature is acquired via the load controller input (X60).
	When the temperature is acquired via the PLL52 input (X86) and the O2 trim controller / alarm is active (not CtrlAutoDeac), flue gas recirculation (FGR) mode temperature-compensated cannot be used (would lead to error C:F6 D:2).
	When operating mode O2 Control is deactivated ( <i>man deact</i> ), operating mode <i>TCautoDeact</i> can be used if the flue gas temperature is acquired via PLL52 (X86…).
	Attention!
	If at an dual-fuel burner the FGR function is used for only one fuel (e.g. gas operation with FGR and oil operation without FGR) pay attention to the following:
•	When the fuel selection is switched over to the fuel without FGR it must be assured that the FGR actuator is closed and is supervised kept in the closed position.
	This is accomplished by making the following settings for the fuel without FGR:
	- Activation of the AUX3 actuator
	- Parameterization of the positions Home, Prepurge , Ignition and Postpurge to <i>closed</i>
	- Parameterization of all AUX3 actuator positions at all curve points to closed
	- Parameterization of the FGR operating mode to Aux3onCurve

Before to activate the FGR system, it is mandatory to complete the air/fuel ratio curve for each point, up to the maximum burned output. Check the previous chapter for instructions.



WARNING: Activating or increasing the FGR butterfly valve opening, it is mandatory to check the combustion by means a properly and calibrated smoke analyzer.

### 10.2 Address and activate the AUX3 servomotor.

Usually these operations are already set in the manufacturer factory.

They would be necessary in same cases as: the substitution of the servomotor, in case the FGR mode were not activated yet or the LMV5x were be supplied loose...



WARNING: for LMV52.400 device, in case of FGR servomotor addressing: the only possible choice is AuxActuator3. Don't set the FGR servomotor for a different one.

1st level	2nd level	3rd level	4th level	5th level	6th level	Description
Params & Display						
G	Actuators					Parameter settings for fuel/ air ratio control
	Ŀ	Addressing				Parameter settings for firing on Gas or on Oil
		<u>ل</u>	AirActuator GasActuat OilActuat AuxActuator AuxActuator 2 AuxActuator 3		AuxActuator 3	AuxActuator 3 MUST be chosen

After the addressing, activate the FGR servomotor.

1st level	2nd level	3rd level	4th level	5th level	6th level	Description
Params & Display						
G	RatioControl					Parameter settings for fuel/ air ratio control
	()	GasSettings OilSettings				Parameter settings for firing on Gas or on Oil
			AuxActuator	deactivated damper act VSD active AUX3 VSD+Aux3	Deactivated for LMV52.xxx AUX3 for LMV51.300	Deactivated for LMV52.xxx AUX3 for LMV51.300
		(L)	AirActuator	deactivated activated air influen	activated	
			AuxActuator 1			
			AuxActuator 2			
		<b>_</b>	AuxActuator 3		Activated for LMV52.xxx	
			VSD			
		()	GasActuator OilActuator		Activated Activated	Choice according to the Operation mode gas setting or oil setting.

### 10.3 Setting the special positions

1st level	2nd level	3rd level	4th level	5th level	6th level	Description
Param & Display						
⊡•	RatioControl					
	<b>⊡</b>	GasSettings OilSettings				
			SpecialPosition			

Suggested positions are below. They can be modify during the commissioning according to right needs.

#### Special Position: AUX3 POS

- Home position0°(Closed)Prepurge position90°(Open)Ignition position0°(Closed)Postpurge position90°(Open) ٠
- ٠
- ٠
- •

### 10.4 Setting the load controller mode: see the previous chapter (regolazione senza FGR)

$\triangle$	WARNING: If one of the intLC (internal Load Controller) option must be choice, a temperature sensor cannot be connected to the terminal X60. A temperature sensor with analogue output or a converter Ohm $\rightarrow$ mA or V must be used. They must be connected to the terminals X61.
$\bigwedge$	WARNING: If one of the extLC (External Load Controller) options must be used, set "no sensor", "Temperature sensor" or "Pressure Sensor" on the choice for the modulation probe.
$\mathbf{\Lambda}$	WARNING: The X61 door must be configured in according to the used sensor or signal.

### 10.5 FGR mode choice

1st level	2nd level	3rd level	4th level	5th level	6th level	Description
Param & Display						
( let	Flue Gas Recirc					
	Ð	FGR-Mode	AUX3onCurve time temperature temp. contr. TCautoDeact deactMinpos auto deact			According to the preference and instruction in the table below.

### Description of the FGR mode.

FGR-Mode	Description	LMV50 LMV51.3 LMV52.2	LMV52.4
Aux3onCurve	Flue gas recirculation (FGR) function is deactivated. Auxiliary actuator 3 is driven along its parameterized ratio control curve	•	•
deactivated	After the ignition position, auxiliary actuator 3 is always held at the minimum position for flue gas recirculation (indicated with #) and the flue gas recirculation temperature is not evaluated (display XXX). This ensures that the system is operated in a safe state if the flue gas recirculation setting could not be fully realized. We recommend performing burner start-up using this setting prior to setting the flue gas recirculation curve		•
time	Auxiliary actuator 3 maintains the ignition position until an adjustable time is reached (parameter "DelaytimeFGR"). During the operation, the burner regulate its load as per the set curve points, without flue gas recirculation.	•	•
temperature	Auxiliary actuator 3 maintains the ignition position until an adjustable temperature is reached (parameter "FRG On Temp"). During the operation, the burner regulate its load as per the set curve points, without flue gas recirculation.	•	•
temp.contr.	The position of auxiliary actuator 3 is determined depending on the flue gas temperature and the ratio control curve. In addition, the actuator can maintain the ignition position until an adjustable time (parameter FGR On Time) is reached		•
TCautoDeact	Same manner of operation as temp.contr., but the function is automatically deactivated should the flue gas sensor become faulty. The actuator is driven to the minimum flue gas recirculation (FGR) position and a warning is issued		•
deactMinpos	After the ignition position, auxiliary actuator 3 always maintains the minimum flue gas recirculation (FGR) position (indicated by #) and the flue gas recirculation (FGR) temperature is not evaluated (display of XXX). The system can thus be driven to a secure state, if it was not possible to fully complete the flue gas recirculation (FGR) settings. It is recommended to use this setting for commissioning the burner before adjusting the flue gas recirculation (FGR) curve		
auto deact	Flue gas recirculation (FGR) with temperature compensation was automatically deactivated. Same operation mode as deactMinpos, but a warning is issued		•

### **10.6** Main parameter of the FGR function

Parameter	Description	LMV50 LMV51.3 LMV52.2	LMV52.4
DelaytimeFGR Gas DelaytimeFGR Oil	Setting of delay time for auxiliary actuator 3 to be kept in the ignition position after entering phase OPERATION	•	•
ThresholdFGR Gas ThresholdFGR Oil	Setting of temperature that must not be exceeded so that auxiliary actuator 3 can be kept in the ignition position	•	
FGR-sensor (X86 PtNi1000 / X60 Pt1000 / X60 Ni1000)	Selection of temperature sensors for temperature-compensated flue gas recirculation (FGR)	•	•
	Readjustment of calculated temperature-dependent position of auxiliary actuator 3. The setting is made in steps of 1%.		
Factor FGR Gas	Settings <100% reduce the amount of recirculate flue gas (moving the damper toward the fully closed position).		
Factor FGR Oil			
	This means that when reaching the initially acquired flue gas recirculation (FGR) temperature, the stored position is approached, independent of the flue gas recirculation (FGR) factor. See the <i>Examples of tables showing the damper positions with FGR</i>		
FGR MinPos	The setting is made as an absolute value and ensures that flue gas recirculation (FGR) always operates with at least a minimum amount of flue gas.		•
	automatically deactivated flue gas recirculation (FGR)		
	Maximum limitation of the required position of auxiliary actuator 3 calculated from the current temperature and the warm position.		
FGR MaxPos Fact	The setting is made in steps of 1% and refers to the relevant curve-point.		•
	Interpolation between the curve-points is linear		

### The parameter are in side the AZL menu with following structure:

1

1st level	2nd level	3rd level	4th level	5th level	6th level	Description
Param & Display						
	Flue Gas Recirc					
		FGR-sensor	X60 Pt1000 X60 Ni1000			According to the available probe
		ThresholdFGR Gas ThresholdFGR Oil	0850 °C			According to the regulation needs
		DelaytimeFGR Gas DelaytimeFGR Oil	063 min			According to the regulation needs
		Factor FGR Gas Factor FGR Oil	10100%			According to the regulation needs
		FGR MinPos				According to the regulation needs
		FGR MaxPos Fact	0100%			According to the regulation needs

WARNING: Only in case of FGR temperature compensation function.

If the detected temperature value is lower than the value recorded during the curve setting, the AUX3 servomotor doesn't reach the set position, but it will be closer. In this condition flue gas recirculation flow could be not sufficient or too much.

NOx value could be different from the expected or the flame could be instable. Try to reduce the correction factor ("Factor FGR Gas" or "Factor FGR Oil"). In case readjust the FGR curve. Probably the point was saved also if the flue gas temperature were too far from the regime condition.

### 10.7 Example of FGR factor and FGR Maps Factor on the burner regulation.

We consider to set the AUX3 for FGR with the "*temp.contr.*" *Mode* The curve is as per the below table.

Point	1	2	3	4	Note
Load %	37,5 %	62,5 %	75 %	100 %	
AUX3 FGR Curve	19,3 °	25,0 °	28,5 °	37,0 °	
FGR temperature	72 °C	105 °C	121 °C	150 °C	The flue gas value increase from low to high flame. The temperature is with burner in operative condition.

LMV52.400 will calculate a "Zero Curve" referred to flue gas 0°C temperature. The "Zero Curve" is calculated in reference to the effect of the temperature on the smoke density.

If "FGR factor" is set at 100% LMV will not make any additional correction.

Point	1	2	3	4	Note
Pos. FGR con T = 0 °C zero curve	15 °C	18 °C	19,7 °C	23,8 °C	FGR Factor set on 100%

If "FGR factor" is set at lower value than 100% LMV will apply an additional correction to calculate the "Zero Curve".

If "FGR factor" is 50%, the new "zero Curve" will be

Point	1	2	3	4	Note
Pos. FGR con T = 0 °C zero curve	7,6°	9,0°	9,8°	11,9°	<b>FGR Factor set on 50%</b> The above example shows that – with the <i>zero curve</i> – a flue gas recirculation (FGR) factor of 50% leads to a 50% reduction of the damper positions.

If the temperature value of the smoke during the operation of the burner is higher than the temperature value during the commissioning, the AUX3 position will be bigger than the set values.

To avoid a wide opening of the FGR butterfly valve it could be necessary to limit the automatic correction LMV52.400.

This could be necessary if the AUX3 opening become bigger than 90°, if a flame instability happen, or the flue gas recirculation is too big...

To limit the correction due to a higher temperature value, it become necessary to set the parameter "FGR MaxPOS Factor".

Point	1	2	3	4	Note
Pos. FGR	21,2°	27,5°	31,4°	40,7°	FGR MaxPOS Factor set on 10% I valori sono il 10% in più rispetto ai corrispondenti settati inizialmente.



## 11 Cold start thermal shock (CSTP)

If there is a steam boiler or a boiler that must start up cold in the plant and to avoid thermal shocks a slow heating is required for the boiler by maintaining the burner at the minimum output, the automatic function "Cold start thermal shock" can be performed instead of the manual operation at minimum load.

The CSTP (Cold Start Thermal Schock) function can be enabled by the Technical service only (access by reserved password). if this function is enabled, when the burner starts up the "Thermal shock protection activated" message will be shown.

If this function is not enabled, after start-up, the burner will rapidly increase the load according to the requested value.

The CSTP function is a Service level paramter, to enable this function proceed as follows:

1st level	2nd level	3rd level	4th level	5th level	6th level	Description
Params & Display						Menu level for making the parameter settings
	LoadController					Settings for the internal load controller
	Ŀ	ColdStart				Settings for the cold start (thermal shock protection)
		Ð	ColdStartOn	Deactivated Activated		The parameter <b>ColdStartOn</b> deactivates or activates the Cold start protection function, the other parameters are factory set and can be changed following the next programming rows (see diagram)
		•	ThresholdOn	0100%Wcurren	20%	
			StageLoad	0100%	15%	
			StageSetp_M od	1100% Wcurrent	5%	
		<b>_</b>	Stage- Setp_Stage	1100% Wcurrent	5%	
		Ŀ	MaxTme- Mod	163 min	3 min	
		•	MaxTmeStage	163 min	3 min	Cold start thermal shock protection, maximum time per step (multistage)
			ThresholdOff	1100% Wcurrent	80%	Cold start thermal shock protection deactivation level referred to the current set-point (Wcurrent)
		÷	Additional-Sens	Deactivated Pt100 Pt1000 Ni1000	Deactivated	Select extra sensor for cold start thermal shock protection
		Ð	Temp Cold- Start	02000 °C		Display of temperature acquired by extra sensor for the cold start thermal shock protection function
		<b>•</b>	Setpoint AddSensor	0450 °C	60°C	Set-point for extra sensor for cold start thermal shock protection
		Ŀ	Release Stages	no release/ release	release	Cold start thermal shock protection load step stage mode (multistage operation)
		•	MaxTmeStage	163 min	3 min	Cold start thermal shock protection, maximum time per step (multistage)
			ThresholdOff	1100% Wcurrent	80%	Cold start thermal shock protection deactivation level referred to the current set-point (Wcurrent)
			AdditionalSens	deactivated Pt100 Pt1000 Ni1000	deactivated	Select extra sensor for cold start thermal shock protection
		<b>•</b>	Temp Cold- Start	02000 °C		Display of temperature acquired by extra sensor for the cold start thermal shock protection function
			Setpoint Add- Sensor	0450 °C	60 °C	Set-point for extra sensor for cold start thermal shock protection
			Release Stages	no release/ release	release	Cold start thermal shock protection load step stage mode (multistage operation)



Note: by enabling the manual operation (this function can be set at user level also -see chapter "manual operation") the CSTP function is momentary excluded, when enabling the automatic operation again, the CSTP function (previously set at Service level) will be enabled as well.

### **12 BURNER MANUAL OPERATION**

The operator can decide if choosing burner manual operation at a settable fixed load or modulating operation through the automatic load controller, then can also set the burner shutdown by means of the "burner off" function.

Choose the type of operation (Au-tom / Manual / Off).

1st level	2nd level	3rd level	Password	Description
ManualOpe- ration				Menu level for activating manual operation with the preselected load
٩	Au-tom/ Manual/Off			Selection of manual or automatic operation
		Automatic/ Burner on / Burner off	User	

Setting the load percentage for the manual operation

To set the load percentage at which the burner must operate in manual mode, proceed as described below.

1st level	2nd level	3rd level	Password	Description
ManualOpe- ration				Menu level for activating manual operation with the preselected load
<b>-</b>	SetLoad			Set target load
		0100%	User	



Terminal group	Connec	ction symbol	Input	Output	Description of connection termi- nals	Electrical rating
	PIN1			x	Fan motor contactor	AC 230 V +10 % / -15 %, 5060
	<b>D</b> 1110	L-C MOTOR				Hz, 1 A, cos.0.4
X3-01	PIN2	I -TS7 ALARM		×	Alarm	AC 230 V +10 % / -15 %, 5060
			~		Air process quitch (LD)	HZ, 1 A, COS.U.4
	PINI		X		All pressure switch (LP)	AC 230 V + 10 % / - 15 %, 5060
V2 02				v	Power signal for air pressure switch (LP)	HZ, $HIAX 1.5 HA$
A3-02	1 1112			^		Hz Imay 500 mA
	DINI1		v		End switch burner flange	AC 230 V + 10 % / -15 % 50 60
			^			Hz Imax 5 $\Delta$
X3-03	PIN2			x	Power signal for end switch burner flange	AC 230 V +10 % / -15 % 50 60
70-00	1 11 12	. ■L→ — *>		^		Hz Imax 5 A
	PIN1	• • • • • • • • • • • • • • • • • • •	x		Safety loop	AC 230 V +10 % / -15 % 50 60
			~			Hz Imax 5 A
	PIN2	SAFETY		x	Power signal for safety loop	AC 230 V +10 % / -15 % 50 60
				~		Hz Imax 5 A
	PIN3		х		Protective earth (PE)	
X3-04	PIN4	PE	x		Supply voltage neutral conductor (N)	
		VOLIAGE				AC 230 V +10 % / -15 %, 5060
	PIN5	L	х		Supply voltage live conductor (L)	Hz, fuse 6.3 AT (DIN EN 60 127
						2 / 5)
		т			Fuel selection "internal" if pin 1-2 is not used	
	PIN1		х		Fuel selection gas	AC 230 V +10 % / -15 %, 5060
						Hz, Imax 1.5 mA
	PIN2	GAS —	х		Fuel selection oil	AC 230 V +10 % / -15 %, 5060
X4-01						Hz, Imax 1.5 mA
	PIN3		x		Fan contactor contact (FCC) or flue gas	AC 230 V +10 % / -15 %, 5060
					recirculation pressure switch	Hz, Imax 1.5 mA
	PIN4		х		Reset / manual lockout	AC 230 V +10 % / -15 %, 5060
						Hz, Imax 1.5 mA
	PIN1			х	Protective earth (PE)	
	PIN2	PE IGNITION		x	Neutral conductor (N)	
X4-02	PIN3			x	Ignition	AC 230 V +10 % / -15 %, 5060
						Hz, 2 A, cos.0.2
	PIN1			x	Protective earth (PE)	
	PIN2			x	Neutral conductor (N)	
		이 가 좋기				
X4-03	PIN3			x	Start signal or pressure switch relief (air pressure switch test valve)	AC 230 V +10 % / -15 %, 5060 Hz, 0.5 A, cos.0.4

Terminal group	Connecti	on symbol	Input	Output	Description of connection terminals	Electrical rating
	PIN1			х	Protective earth (PE)	
X5-01	PIN2		x		Pressure switch min-oil (DWmin-oil)	AC 230 V +10 % / -15 %, 5060 Hz, Imax 1.5 mA
	PIN3			x	Power signal for pressure switch-min- oil (DWmin-oil)	AC 230 V +10 % / -15 %, 5060 Hz, Imax 500 mA
	PIN1			х	Protective earth (PE)	
X5-02	PIN2	PE ■ max → ↓ →	x		Pressure switch-max-oil (DWmax-oil)	AC 230 V +10 % / -15 %, 5060 Hz, Imax 1.5 mA
	PIN3			x	Power signal for pressure switch-max- oil (DWmax-oil)	AC 230 V +10 % / -15 %, 5060 Hz, Imax 500 mA
	PIN1		x		Controller (ON / OFF)	AC 230 V +10 % / -15 %, 5060 Hz, Imax 1.5 mA
	PIN2		x		Controller closes / stage 3	AC 230 V +10 % / -15 %, 5060 Hz, Imax 1.5 mA
X5-03	PIN3		x		Controller opens / stage 2	AC 230 V +10 % / -15 %, 5060 Hz, Imax 1.5 mA
	PIN4			x	Power signal for control of con- troller	AC 230 V +10 % / -15 %, 5060 Hz, Imax 500 mA
	PIN1	START	x		Start release oil	AC 230 V +10 % / -15 %, 5060 Hz, Imax 1.5 mA
	PIN2			x	Power signal start release oil	AC 230 V +10 % / -15 %, 5060 Hz, Imax 500 mA
X6-01	PIN3		x		Direct heavy oil start	AC 230 V +10 % / -15 %, 5060 Hz, Imax 1.5 mA
	PIN4	LI		x	Power signal direct heavy oil start	AC 230 V +10 % / -15 %, 5060 Hz, Imax 500 mA
	PIN1			х	Protective earth (PE)	
	PIN2	PE		x	Neutral conductor (N)	
X6-02	PIN3			x	Oil pump / magnetic coupling	AC 230 V +10 % / -15 %, 5060 Hz, 2 A, cos.0.4
	PIN1			x	Protective earth (PE)	
	PIN2	PE		x	Neutral conductor (N)	
X6-03	PIN3	■ N → SV			Fuel valve (shutoff valve-oil)	AC 230 V +10 % / -15 %, 5060 Hz, 1 A, cos.0.4

Terminal group	Connecti	on symbol	Input	Output	Description of connection termi- nals	Electrical rating
	PIN1			x	Protective earth (PE)	
	PIN2	PE		x	Neutral conductor (N)	
X7-01	PIN3	■ N V2			Fuel valve 2 (oil)	AC 230 V +10 % / -15 %, 5060 Hz, 1 A, cos.0.4
	PIN1			х	Protective earth (PE)	
	PIN2	PE		x	Neutral conductor (N)	
X7-02	PIN3				Fuel valve 3 (oil)	AC 230 V +10 % / -15 %, 5060 Hz, 1 A, cos.0.4
	PIN1			х	Protective earth (PE)	
X7-03	PIN2	PE	x		Start release gas CPL (LMV52)	AC 230 V +10 % / -15 %, 5060 Hz, Imax 1.5 mA
	PIN3			x	Power signal (reserve)	AC 230 V +10 % / -15 %, 5060 Hz, Imax 500 mA

Terminal group	Connection symbol		Input	Output	Description of connection termi- nals	Electrical rating
		PIN2		x	Firing on oil	AC 230 V +10 % / -15 %, 5060 Hz, 1 A, cos.0.4
X8-01		PIN1		x	Firing on gas	AC 230 V +10 % / -15 %, 5060 Hz, 1 A, cos.0.4
		PIN4		х	Protective earth (PE)	
	PE 🗖	PIN3		х	Neutral conductor (N)	
X8-02		PIN2		x	Wiring point for valves connected in series	
		PIN1		x	Fuel valve 1 (oil)	AC 230 V +10 % / -15 %, 5060 Hz, 1 A, cos.0.4
		PIN4		х	Protective earth (PE)	
	PE 🗖	PIN3		x	Neutral conductor (N)	
X8-03		PIN2		x	Wiring point for valves connected in series	
X0-03		PIN1		x	Fuel valve 1 (oil)	AC 230 V +10 % / -15 %, 5060 Hz, 1 A, cos.0.4
		PIN4		x	Fuel valve 1 (gas)	AC 230 V +10 % / -15 %, 5060 Hz, 2 A, cos.0.4
	V1 <u>⊁</u> L ■ V2 ⊁L ■	PIN3		x	Fuel valve 2 (gas)	AC 230 V +10 % / -15 %, 5060 Hz, 2 A, cos.0.4
X9-01	₽V ∑L ■	PIN2		х	Fuel valve (gas)	AC 230 V +10 % / -15 %, 5060 Hz, 2 A, cos.0.4
	SV 🖓 🗔 – L 💻	PIN1		x	Fuel valve (shutoff valve-(gas)	AC 230 V +10 % / -15 %, 5060 Hz, 2 A, cos.0.4
		PIN2		х	Protective earth (PE)	
X9-02	PE  N	PIN1		x	Neutral conductor (N)	
		PIN4	x		Pressure switch-min-gas, start rele- ase gas	AC 230 V +10 % / -15 %, 5060 Hz, Imax 1.5 mA
	min min	PIN3	x		Pressure switch-max-gas (DWmax- gas)	AC 230 V +10 % / -15 %, 5060 Hz, Imax 1.5 mA
X9-03		PIN2	x		Pressure switch-valve proving-gas / leakage test or valve closing con- tact (CPI)	AC 230 V +10 % / -15 %, 5060 Hz, Imax 1.5 mA
	└──── <b>┥</b> └┣	PIN1		x	Power signal for pressure switch	AC 230 V +10 % / -15 %, 5060 Hz, Imax 500 mA

Termi- nal group	Connection symbol		Input	Output	Description of connect	ion termi- nals	Electrical rating
		PIN4		x	Neutral conductor (N)		AC 230 V +10 % / -15 %, 5060 Hz, max 1 mA
	LINE N	PIN3		x	Power signal transform	ner	
X10-01		PIN2	x		AC power signal GO		AC 12 V +10 % / -15 %, 5060 Hz, max 1.2 mA
	☐ 12VAC G	PIN1	x		AC power signal fan m	notor (G)	
		PIN6	x		QRI (IR detector) / C voltage	RA7 signal	Umax DC 5 V
		PIN5		х	Protective earth (PE)		
	PE	PIN4		х	Neutral conductor (N)		
X10-02	FLAME	PIN3		x	Power signal		AC 230 V +10 % / -15 %, 5060 Hz, Imax 500 mA
	POWER QRI	PIN2		x	QRI (IR detector) / C supply	RA7 power	DC 14 / 21 VC Imax 100 mA
	QRB =	PIN1	х		QRB signal voltage		Max. DC 8 V
X10-03	ION -	PIN1		x	lonization probe (ION) QRA2/ QRA4.U/QR section <i>Description of</i> <i>puts</i> )	(alternati- vely A10, refer to <i>inputs and out-</i>	Umax (X3-04-PINS) Imax. 0.5 mA
		PIN6		x	Reference ground (PE	LV)	
	GND -	PIN5		x	Communication signal	(CANL)	DC U <5 V, Rw = 120 Ù, level to ISO-DIS 11898
	CANL	PIN4		х	Communication signal	(CANH)	
	CANH 12/4C2	PIN3		x	AC power supply for a and operating unit AZL	ctuators / display _5	AC 12 V +10 % / -15 %, 5060 Hz, Fuse max. 4 A
X50	12VAC1	PIN2		x	AC power supply for a and operating unit AZL	ctuators / display _5	
	Shield	PIN1		x	Shield connec- tion (fur	nctional earth)	
		PIN6		x	Reference ground (PE	LV)	
	GND -	PIN5		x	Communication signal	(CANL)	DC U <5 V, Rw = 120 Ù, level to ISO-DIS 11898
	CANL	PIN4		x	Communication signal	(CANH)	
		PIN3		x	AC power supply for actuators / display and operating unit AZL5		AC 12 V +10 % / -15 %, 5060 Hz, Fuse max. 4 A
X51		PIN2		x	AC power supply for a and operating unit AZL	ctuators / display _5	
	Shield -	PIN1		x	Shield connec- tion (fur	nctional earth)	

				(functional earth)	
	4 ee 🗖	PIN4	x		
				AC power supply from transformer to	
¥52		PIN3	х		AC 12 V +10 % / -15 %, 5060 Hz
//32	м 🗖	PIN2	х	Reference ground (PELV)	
	12VAC1			AC power supply from transformer to	
		PIN1	х		AC 12 V +10 % / -15 %, 5060 Hz

Terminal group	Connection symbol		Input	Output	Description of connection termi- nals	Electrical rating
Temperature	pressure controller					
		PIN5	x		Functional earth for shield connec- tion	
		PIN4	x		Reference ground	
		PIN3	x		Temperature sensor input Pt / LG- Ni 1000	
X60		PIN2	x		Line compensation temperature sensorPT100	
	Pt/Ni 1000	PIN1	x		Temperature sensor input PT100	
		PIN5	x		Functional earth for shield connec- tion	
	(- FE =	PIN4	x		Reference ground	
	0	PIN3	x		Current input for temperature / pressure signal 0/420 mA	DC 0/420 mA
	4-20 mA	PIN2	x		Voltage input for temperature / pressure signal DC 010 V	DC 010 V
X61	0-10 V 💻					
	Power Supply Sensor	PIN1		x	Power supply for temperature / pressure transmitter	approx. DC 20 V Max. 25 mA
		PIN5	x		Functional earth for shield connec- tion	
	I FE	PIN4	х		Reference ground	
	0 =	PIN3	х		Current input for setpoint or load	DC 020 mA
X62	4-20 mA 🔳	PIN2	x		Voltage input for setpoint or load	DC 010 V
A02	0-10 V ■ └ <b></b> -■	PIN1		x	Power supply for setpoint changeo- ver	approx. DC 24 V Max. 2 mA
		PIN3	x		Functional earth for shield connec- tion	
	¶⊢ FE  ■	PIN2		x	Reference ground	
X63	0 = 4-20 mA =	PIN1		x	Current output for burner(LOAD OUTPUT)	DC 420 mA, RLmax = 500 £[

Note: Specifications and data subject to change. Errors and omissions excepted.

### USER MANUAL OF MULTI-THERMOSTAT MCX06C

MCX06C is a multi-thermostat with four 100k NTC inputs. It can control up to 4 temperatures showing them (not more than 2 at the same time) on a couple of displays. It is used to check and adjust oil heater temperatures.

### User interface:

Device:



### Note :

In normal operation, the display A shows the oil tank resistor temperature (probe Pb1). In normal operation, the display B shows the oil output temperature (probe Pb3).



### Connections from terminal side:

### **Probe connection:**

input Al1 = probe Pb1 = set-point "tr" = oil heater temperature probe;

input AI2 = probe Pb2 = set-point "tCI" = plant consent temperature probe (when installed); input AI3 = probe Pb3 = set-point "OIL" = oil heater output temperature probe (PID regulation);

input AI4 = probe Pb4 = set-point "tcn" = oil heater consent temperature probe.

### Menu:

To enter the menu below, keep pushing ENTER for more than 3 s.

Menu code	Sub-menu code	Function	Notes
Prb		Probes values	You can see in sequence the 4 probe values (UP and DOWN keys): the probe code is on display A (Pb1,, Pb4) and the probe value is on display B (not fitted or out of work probes show "").
Log		Login	It defines the access level to menu and parameters (password)
	PAS	Password	Password input
Par		Parameters menu	Access to parameters (you have to login first)
	CnF	Configuration menu	Parameter configuration
	rEG	Regulation menu	Set to set-point, probe, thresholds etc.
ALA		Alarm menu	Access to alarm management
	Act	Active alarms	Show the active alarms
	rES	Reset alarms & Warning	Reset of the manual reset alarms and warning
Loc		Lock/Unlock functions	Not used
InF	rEL	Software version	Installed software version
tUN		Autotuning	Activation On, deactivation ESC PID parameter autotuning

### Alarms & Warning:

When the red triangle on the top left lights, one or more alarms are activated.

When the red key on the left lights, the output N05-C5 is active and the relay **KTRS** switches the resistors OFF. Check the reason, correct the failure and, as soon as the temperature is lower than **trS**, reset it through **ALA/rES**. In order to show active alarms and warnings, select the relevant menu through **ALA/Act**.and, using the **UP** and **DOWN** buttons, scroll the lines.

In order to perform the manual reset, select ALA/rES.

Code	Description	Sourse	Active simbol	Reset type
trS	High temperature resistors alarm	probe Pb4 > value trS	red key	Manual
EP1	Probe Pb1 fault	Probe Pb1 fault	red triangle	Automatic
EP2	Probe Pb2 fault	Probe Pb2 fault	red triangle	Automatic
EP3	Probe Pb3 fault	Probe Pb3 fault	red triangle	Automatic
EP4	Probe Pb4 fault	Probe Pb4 fault	red triangle	Automatic

### Set point adjustment:

All the parameters inside the Par menu are locked by a password.

The user can modify only set points (menu rEG), without using any passwords.

The oil viscosity at the nozzle, should be about 1,5°E, which guarantees correct and safe functioning of the burner. The temperature values in the table, guarantee the respect of that parameter and are valid when the pre heating tank is installed on the burner. For different configurations, please refer to the chapter "Recommendations to design heavy oil feeding plants" in the burner manual.

Here below recommended set points:

				Oil viscosity at 50 °C according to the letter show n in the							
M	enu pa	ath				burner model					
				Р	N	E	D	Н			
				89 cSt	< 50 cSt	> 50 cSt < 110 cSt	> 110 cSt < 400 cSt	> 400 cSt < 4000 cSt			
				12 E	<7°E	> 7 ℃ < 15 ℃	> 15 ℃ < 50 ℃	> 50 ℃ < 530 ℃			
Par											
rEG	Pb1	tr	Oil heater temperature probe	parameter not visible							
	Pb2	tCI	Plant consent temperature probe (when installed)	20 °C	70 °C	70 °C	70 °C				
	Pb3	Oil	oil heater output temperature probe (PID regulation);	60-70 °C	110-120 °C	120-130 ℃	130-140 °C	140-150 °C			
		SP0	Set-point oil heater with oil pump stopped (stand-by)	45 °C	120 °C	130 °C	140 °C	150 °C			
	Pb4	tcn	Oil heater consent temperature probe	40 °C	100 °C	100 °C	110 °C	120 °C			
		trS	Safety temperature tank resistors (manual reset)	120 °C	190-200 °C	190-200 ℃	190-200 °C	190-200 °C			

The above temperature values are suggested and refer to a plant designed according to the prescriptions in the burner user manual. The suggested values can change in reference to the fuel oil specifications.

## MANUALE USER SUPPORT

# MULTI-THERMOSTAT MCX06C

MCX06C is a multi-thermostat with four 100k NTC inputs. It can control up to 4 temperatures showing them (not more than 2 at the same time) on a couple of displays.

It is used to check and adjust oil heater temperatures. it works as follows:

as soon as the burner control gives the GO to the digital 1 input (terminals DI1-COM), the adjustment program runs (the relevant LED is ON). Reading the outlet temperature through the probe **Pb3** (terminals AI3-COM), a PID signal is produced. This signal becomes the set-point for the electric resistors. The electric resistors temperature is read through the probe **Pb1** (terminals AI1-COM) so that a second PID signal is produced. This second PID drives a couple of SCR by means of 0-10 V impulses in order to control the electric resistors temperature.

When the burner is in stand-by, resistor set-point is kept at the temperature set in parameter "p30" (see parameter group REG).

Probe **Pb4** (terminals Al4-COM) controls the inner heater temperature. As soon the relevant set-point is got, it drives the output number 4 (terminals C4-NO4) linked to the relais KTCN. This allows the oil pump to start and also the burner control proceeds with its cycle.

When set-point **trS** is got to, output number 5 is ON (terminals C5-NO5) linked to the relais KTRS. It switches the resistors off and activates an alarm on the device.

Probe **Pb2** (terminals AI2-COM), when fitted, drives output number 2 (terminals C2-NO2) linked to the relais KTCI. This allows the burner control to proceed with ignition.

See below the set-point recommended figures.

### User interface:



### Note :

In normal operation, the display A shows the oil tank resistor temperature (probe Pb1). In normal operation, the display B shows the oil output temperature (probe Pb3).



### **Probe connection:**

input AI1 = probe Pb1 = set-point "tr" = oil heater temperature probe;

input **AI2** = probe **Pb2** = set-point "**tCI**" = plant consent temperature probe (when installed); input **AI3** = probe **Pb3** = set-point "**OIL**" = oil heater output temperature probe (PID regulation);

input **AI4** = probe **Pb4** = set-point **Ch2** = oil heater consent temperature probe (r







(tCl - Pb2 probe only for mechanical atomizing burners)

### Menu :

To enter the menu below, keep pushing **ENTER** for more than 3 s.

Menu code	Sub-menu code	Function	Notes
Prb		Probes values	You can see in sequence the 4 probe values (UP and DOWN keys): the probe code is on display A (Pb1,, Pb4) and the probe value is on display B (not fitted or out of work probes show "").
Log		Login	It defines the access level to menu and parameters (password)
	PAS	Password	Password input
Par		Parameters menu	Access to parameters (you have to login first)
	CnF	Configuration menu	Parameter configuration
	rEG	Regulation menu	Set to set-point, probe, thresholds etc.
ALA		Alarm menu	Access to alarm management
	Act	Active alarms	Show the active alarms
	rES	Reset alarms	Reset of the manual reset alarms
Loc		Lock/Unlock functions	Not used
InF	rEL	Software version	Installed software version
tUN		Autotuning	Activation On, deactivation ESC
			PID parameter autotuning

### Login:

All the parameters inside the **Par** menu are locked by a password.

Without password, only set-points can be modified.

To login, on the log menu, press **ENTER** for more than 3 s. Input your password (level 2 or 3) inside **PAS** With password for level 3 all the data can be set.

### submenu CnF - configuration parameters group :

Мерц	Parameter	Description	Additional description	Min	Max	Default	ЦМ	Visibility	Password	Modbus
Wenu	Tarameter	Description		WIIII	IVIAA	Delault	0.141.	condition	level	Index
CnF		CONFIGURATION							0	
Al1		Analog Input 1							1	
			This parameter enables or disables the							
	A1P	Probe 1 Presence	probe	0	1	1			2	1
	A1C	Calibration Probe 1	Don't modify it	-20,0	20,0	0,0	°C	A1P >0	3	2
Al2		Analog Input 2							1	
			This parameter enables or disables the							
	A2P	Probe 2 Presence	probe	0	1	1			2	3
	A2C	Calibration Probe 2	Don't modify it	-20,0	20,0	0,0	°C	A2P >0	3	4
Al3		Analog Input 3							1	
			This parameter enables or disables the							
	A3P	Probe 3 Presence	probe	0	4	1			2	5
	A3L	Min. Value conversion Al3	Don't modify it	-999,9	999,9	0,0		A3P >2	3	6
	A3H	Max. Value conversion Al3	Don't modify it	-999,9	999,9	30,0		A3P >2	3	7
	A3C	Calibration Probe 3	Don't modify it	-20,0	20,0	0,0	°C	A3P >0	3	8
Al4		Analog Input 4							1	
			This parameter enables or disables the						_	_
	A4P	Probe 4 Presence	probe	0	4	1			2	9
	A4L	Min. Value conversion Al4	Don't modify it	-999,9	999,9	0,0		A4P >2	3	10
	A4H	Max. Value conversion Al4	Don't modify it	-999,9	999,9	30,0		A4P >2	3	11
.11	A4C	Calibration Probe 4	Don't modify it	-20,0	20,0	0,0	°C	A4P >0	3	12
ai	-11.4	Digital Input		-	4	4			1	40
-	dl1	Input 1 polarity (Pump)	Change type of digital input (NC o NO)	0	1	1			3	13
	di2	Alarm polarity from input 2	Change type of digital input (NC o NO)	0	2	2			2	14
	dl3	Alarm polarity from input 3	Change type of digital input (NC o NO)	0	2	2			2	15
	d14	Alarm polarity from input 4	Change type of digital input (NC o NO)	0	2	2			2	16
		Alarm polarity from input 5	Change type of digital input (NC o NO)	0	2	2			2	17
	016	Alarm polarity from input 6	Change type of digital input ( NC o NO)	0	2	2			2	18
d		Digital output							1	
ai	405	Alarmand Warning	Change type of digital input (NC e NO)	0	1	0			2	10
-	406	Polarity output Varning	Change type of digital input (NC o NO)	0	1	0			2	19
SIC	u00	Safaty probo		0	1	0			1	20
310		Salety probe	Probe which also activates the relay						1	
	SIn	Selection of safety probe	Warning (ns. KTRS)	0	Α	4			3	21
SvS		Svistem			-				0	21
		Gyistom	Probe temperature or set-point to be							
	dSA	display A output	displayed in the left display	0	8	1			3	22
			Probe temperature or set-point to be			-				
	dSb	display B output	displayed in the right display	0	8	3			3	23
PAS		Password	, ,		-	-			1	
	PL1	Password level 1		0	9999	0			1	32
	PL2	Password level 2		0	9999				2	33
	PL3	Password level 3		0	9999				3	34

Menu	Parameter	Description	Additional description	Min	Мах	Default	U.M.	Visibility condition	Level	Modbus index
tUN		Autotuning					-		3	
	tU1	Output temperature hysteresis	Don't modify it	0	50,0	0,5	°C		3	35
	tU2	Startup number	Don't modify it	0	5	2			3	36
	tU3	Measurement cycles number	Don't modify it	1	4	2			3	37
		Max. differential command	Don't modify it							
	tU4	exit		0,01	10,00	10,00	V		3	38
	tU5	Differential reduction exit command (%)	Don't modify it	0	100	15			3	39
	tU6	Calculating mode: 0= Symmetrical; 1=Asymmetrical; 2=Simple	Don't modify it	0	2	2			3	40
	tU7	Enabling	Don't modify it	0	1	1			3	40

### Submenu **REG – regulation parameters group :**

Monu	Baramatar	Description	Additional description	Min	Mox	Default	LL M	Visibility	Loval	Modbus
REG	Farameter	REGULATION		IVIII	IVIAX	Delault	0.111.	condition		IIIUEX
Pb1		Probe 1							0	
		Set-point Probe 1	Don't modify it						Ŭ	
	rES	(Tank resistor)	2011110211911	-50,0	200,0	0.0	°C		3	42
		Probe 1 - Low Temperature Alarm	Don't modify it							
	AL1	Threshold	-	-50,0	200,0	-50,0	°C		3	43
		Probe 1 - High Temperature Alarm	Don't modify it							
	AH1	Threshold		-50,0	200,0	200,0	°C		3	44
	d01	Probe 1 differential		0,0	20,0	3,0	°C		3	45
Pb2		Probe 2							0	
		Set-point Probe 2	Plant consent according to table							
	tCI	(Plant Consent)	"Set point adjustment"	-50,0	200,0	120,0	°C		0	46
		Probe 2 - Low Temperature Alarm	Don't modify it							
	AL2	I hreshold		-50,0	200,0	-50,0	-C		2	47
	AU 10	Probe 2 - High Temperature Alarm	Don't modify it	50.0	200.0	200.0			2	40
		Infeshold Drobe 2 differential		-50,0	200,0	200,0			2	48
Dh2	002	Probe 2 differential		0,0	20,0	3,0	C		2	49
FD3		Type of regulation of probe 3	Type of regulation						0	
	rE3	(Oil tank exit)	$\Omega = \text{thermostat: } 1 = \text{PID}$ (don't modify)	0	1	1			3	50
	125		Nozzle oil temperature according to the	0		1			<u> </u>	50
	OII	Set-point Probe 3 (Oil tank exit)	table "Set point adjustment"	-50.0	200.0	130.0	°C		0	51
	012	Probe 3 - Low Temperature Alarm	Don't modify it	00,0	200,0	100,0	Ū		Ŭ	01
	AL3	Threshold (Oil tank exit)	2011110211911	-50,0	200,0	-50,0	°C		2	52
		Probe 3 - High Temperature Alarm	Don't modify it	,		,				
	AH3	Threshold (Oil tank exit)		-50,0	200,0	200,0	°C		2	53
		Proportional band for PID Probe 3	Proportional band for first PID regulation							
	Pb3	(Oil tank exit)		0,0	200,0	60,0			3	54
		Dead Zone for PID Probe 3	Dead zone for first PID regulation							
	db3	(Oil tank exit)		0,0	20,0	0,0	°C	rE3 =1	3	55
		Integral Time (Ti) for PID Probe 3	Integral time for first PID regulation							
-	rt3	(Oil tank exit)		0,0	1000,0	120,0	S	rE3 =1	3	56
		DerivativeTime (Td) for PID Probe 3	Derivative time for first PID regulation							
	dt3	(Oil tank exit)	(~ ¼ di rt3)	0,0	300,0	30,0	S	rE3 =1	3	57
		Dead Zone for PID Probe 3	Dead zone for first PID regulation					<b>F0</b> (		
	db3	(Oil tank exit)		0,0	20,0	0,0	υ°C	rE3 =1	3	55

Мори	Parameter	Description	Additional description	Min	Мах	Default	11 M	Visibility		Modbus
Menu	Farameter	Overshooting for Integral action	Don't modify it		IVIAX	Delault	0.111.	condition	Levei	IIIUEX
	pi1	(Oil tank exit)	Don't mouny it	100	1000	200		rE3 =1	3	58
	P11	Derivative action enabling	Don't modify it	100	1000	200		120 1	Ű	
	pi2	(Oil tank exit)	20111110211911	0	1	1		rE3 =1	3	59
		Filtering factor for derivative action	Don't modify it						-	
	pi3	(Oil tank exit)	,	1	100	20		rE3 =1	3	60
		Duty cicle PWM for output DO3	Don't modify it							
	pi4	and/or AO1 (0-10V)		1	300	5	s	rE3 =1	3	61
		Output selection DO3 and/or AO1	Digital selection output for control							
	SL3	(0-10V)	thyristors; Don't modify it	0	2	AO1			3	62
		Proportional band for PID Probe 1	Proportional band for second PID							
	p21	(Tank resistor)	regulation	0,0	200,0	50,0		rE3 =1	3	63
		Dead Zone for PID Probe 1	Dead zone for second PID regulation							
	p22	(Tank resistor)		0,0	20,0	0,0	°C	rE3 =1	3	64
		Integral Time (Ti) for PID Probe 1	Integral time for second PID regulation		4000.0	110.0		50 4		05
	p23			0,0	1000,0	110,0	S	rE3 =1	3	65
		Derivative Lime (1d) for PID Probe 1	Derivative time for second PID regulation		000.0	00.0			0	00
	p24	(Tank resistor)	Dan't madify it	0,0	300,0	23,0	s	rE3 =1	3	00
	n25	(Tank register)	Don't modify it	100	1000	200		rE2 -1	2	67
	p25	Derivative action enabling	Don't modify it	100	1000	200		153 - 1	3	07
	n26	(Tank resistor)	Don't modify it	0	1	1		rE3 =1	3	68
	μ20	Filtering factor for derivative action	Don't modify it	0	1	1		123 - 1	5	00
	n27	(Tank resistor)	Don't mouny it	1	100	20		rE3 =1	3	69
	P21	Min Output PID Probe 3	Minimum value, tank resistor set-point	•	100	20		120 1	Ŭ	
	p28	(Oil tank exit)	(delta of 100°C above p29)	0.0	1000.0	80.0	°C	rE3 =1	3	70
		Max Output PID Probe 3	Maximum valuetank resistor set-point	-,-					-	
	p29	(Oil tank exit)		0,0	1000,0	180,0	°C	rE3 =1	3	71
		Set-point Tank Resistor with oil	Set-point of maintaining resistance during		, í					
	SP0	pump stops (stand by)	stand by "Set point adjustment"	-50,0	200,0	140,0	°C	rE3 =1	0	72
Pb4		Probe 4							0	
		Setpoint Probe 4	Oil consent according table "Set point							
	tcn	(Oil consent)	adjustment"	-50,0	200,0	110,0	°C		0	73
	AL4	Low Threshold Probe 4		-50,0	200,0	-50,0	°C		2	74
		Probe 4 - High Temperature Alarm	Tank resistor safety temperature according							
		Threshold	table "Set point adjustment"							
	trS	(Safety Thermostat)		-50,0	200,0	190,0	°C		0	75
1	d04	Probe 4 differential		0,0	20,0	3,0	°C		2	76

### Alarms & Warning:

When the red triangle on the top left lights, one or more alarms are activated.

When the red key on the left lights, the output N05-C5 is active and the relay KTRS switches the resistors OFF. Check the reason, correct the failure and, as soon as the temperature is lower than trS, reset it through ALA/rES. In order to show active alarms and warnings, select the relevant menu through ALA/Act.and, using the UP and **DOWN** buttons, scroll the lines.

In order to perform the manual reset, select ALA/rES.

Code	Description	Sourse	Active simbol	Reset type
trS	High temperature resistors alarm	probe Pb4 > value trS	red key	Manual
EP1	Probe Pb1 fault	Probe Pb1 fault	red triangle	Automatic
EP2	Probe Pb2 fault	Probe Pb2 fault	red triangle	Automatic
EP3	Probe Pb3 fault	Probe Pb3 fault	red triangle	Automatic
EP4	Probe Pb4 fault	Probe Pb4 fault	red triangle	Automatic

### Set point adjustment:

All the parameters inside the **Par** menu are locked by a password. The user can modify only set points, without using any passwords.

The oil viscosity at the nozzle, should be about 1,5°E, which guarantees correct and safe functioning of the burner. The temperature values in the table, guarantee the respect of that parameter and are valid when the pre heating tank is installed on the burner. For different configurations , please refer to the chapter "Recommendations to design heavy oil feeding plants" on the burner manual

Here below recommended set points:

	Oil viscosity at 50 °C according to the letter shown in the										
Me	enu pa	th		burner model							
				Р	N	E	D	Н			
				89 cSt	< 50 cSt	> 50 cSt	> 110 cSt	> 400 cSt			
						< 110 cSt	< 400 cSt	< 4000 cSt			
				12 °E	< 7°E	> 7 °E	> 15 °E	> 50 °E			
						< 15 °E	< 50 °E	< 530 °E			
Par											
rEG	Pb1	tr	Oil heater temperature probe		par	ameter not vis	ible				
	Pb2	tCI	Plant consent temperature probe (when installed)	20 °C	70 °C	70 °C	70 °C				
	Pb3	Oil	oil heater output temperature probe (PID regulation);	60-70 °C	110-120 °C	120-130 °C	130-140 °C	140-150 °C			
		SP0	Set-point oil heater with oil pump stopped (stand-by)	45 °C	120 °C	130 °C	140 °C	150 °C			
	Pb4	tcn	Oil heater consent temperature probe	40 °C	100 °C	100 °C	110 °C	120 °C			
		trS	Safety temperature tank resistors (manual reset)	120 °C	190-200 °C	190-200 °C	190-200 °C	190-200 °C			

The above temperature values are suggested and refer to a plant designed according to the prescriptions in the burner user manual.

The suggested values can change in reference to the fuel oil specifications.

# **KOSTAL INVERTER**

Connection and programming for electronically controlled burners with

## LMV2x/3x, LMV5x, ETAMATIC and INVERTER regulation



Service Manual TECHNICAL INSTRUCTIONS

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### IDENTIFICAZIONE INVERTER

<b>INVEOR Mx</b>	IVxx	<b>PWxx</b>	LPxx	APxx	GHxx	DKxx	COxx 1	1
								Ι

	1	2	3	4	5		6	7	8	9	10
	Key						Key				
1	Drive contro	oller series:	INVEOR			6	Applicatio AP12 - St AP13 - CA	n circuit board andard ANopen			
2	Installation B, C, D	location/siz	e: motor-inteç	grated - M,size	: α, Α,	7	Control: DK01 - St DK04 – W	andard (withou /ith membrane	it membrane keypad	keypad)	
3	Input voltag : IV02 - 230	ge )V				8	Housing : GH10 – st	andard heat sir	nk (black pain	ited)	
4	Recommer : kW: 0.55; 0 18.5; 22.0	nded motor i 1.75; 1.1; 1.5	rating 5; 2.2; 3.0; 4.0	0; 5.5; 7.5; 11.(	); 15.0;	9	Firmware : CO00 - St CO01 - St	version andard pecific			
5	Printed circ : LP01 / LP0 LP02 / LP0	uit boards 3 – Standar 4 – Standar	d (without bra d (with brake	ake chopper); e chopper);		10	Equipmen	it generation: 1	– current ve	rsion	

The LMV5x device controls fan motor rpm via a sensor and commands it via the inverter with a 4÷20mA signal. The LMV3x/LMV2x device controls fan motor rpm via a sensor and commands it via the inverter with a 0÷10V signal. Generally, the inverter curve goes from 50% to 100% of motor rpm. As well as improving burner regulation, this allows for a saving in terms of fan motor consumption.

### INVEOR M INVERTER SIZES



### User interface COMMUNICATION (on request)

The drive controller can be put in operation in the following ways:



Attention: Contact the manufacturer to order the most suitable device.

USB adaptor for PC	
Via the INVERTER PC software	
INVEOR MMI remote display:	
INVEOR MMI is a portable display on which all inverter parameters can be viewed and changed. Manual available on the KOSTAL website.	CO OC
Bluetooth connection:	
Using the Bluetooth adaptor you can connect via app from any device. Download the app for Android / iOS from the Google Play Store / App Store.	Available on the App Store
The Bluetooth adaptor is required to create a Bluetooth connection with the inverter. To view and change the inverter parameters, use an external interface device – tablet or mobile phone. Download the app for Android / iOS from the Google Play Store / App Store.	

### **ELECTRICAL CONNECTIONS**

### Motor connection variants for INVERTERS sizes A, B and C

Star or delta connection for speed controller integrated on the motor


### Motor connection variants for INVERTER size D



X1 terminal no.	Designation	Assignment
1	L1	Mains phase 1
2	L2	Mains phase 2
3	L3	Mains phase 3
4	PE	Protective conductor

Tab. 1 - X1 terminal assignment - 3 x 400 VAC

X4 terminal no.	Designation	Assignment
1	PE	Protective conductor
2	U	Mains phase 1
3	V	Mains phase 2
4	W	Mains phase 3

#### Tab. 2 - X1 terminal assignment - 3 x 400 VAC

Fig. 2 - Assembly sequence: Connection box - adapter plate size D



#### Key:

- 1 Adapter plate option (variant)
- 2 Holes depending on motor
- 3 Seal
- 4 Retaining bolts with spring elements
- 5 O-ring seal
- 6 INVEOR / adapter plate support
- 7 Terminal heightening option
- 8 Original terminal (not included)
- 9 Extended screw option (for pos.7)
- 10 Retaining bolts with spring elements option
- 11 INVEOR/support retaining bolts



### Electrical connections and parameter configuration

There are 2 relays on the INVERTER. Connecting terminals X7-1-2-3 and X6-1-2-3 are used for:

LMV2/3x: Relay 1 is used as a safety contact on the safety loop series of the equipment. Relay 2 is used as a fault indicator on the burner panel front.

LMV5x / ETAMATIC: Relay 1 is used as a contact for control of fan motor start. Relay 2 is used as a fault indicator of the INVERTER to the LMV5x / ETAMATIC equipment.



Parame	ter	
1.181	Automatic reset function	Automatic reset of faults. The INVERTER resets the fault after the set time. Set value = 30 seconds
1.182	Automatic reset numbers	With the reset function the maximum number of automatic resets can be limited. Set value = 0 (maximum number of automatic resets)
4.190	Relay 1 functions	Select the operating mode of relay 1. Set value = LMV2x/3x= 11 (NC inverted error) Set value = LMV5x / ETAMATIC = 19 (motor is in NO function)
4.210	Relay 2 functions	Select the operating mode of relay 2. Set value = LMV2x/3x= 11 (NC inverted error) Set value = LMV5x / ETAMATIC = 11 (NC inverted error)
4.210	V O operation	Set value = 10 (NO error)

### 0-10V / 4-20mA analogue input configuration



Input AIn1 can be configured as voltage or current input. It is configured as 4-20mA input current for LMV5-Etamatic, and 0-10V input voltage for LMV2x/3x.

		Specifies the input type, whether voltage or current.
4.020	Input type AI1	1= Voltage input 0-10V (LMV2x/3x)
		2= Current input 0/4-20mA (LMV5 ETAMATIC)
		Specifies the minimum value of the analogue input as a percentage of the range.
		E.g.:
4.021	AI1 Standard low	010 V or 020 mA = 0 %100 %
		210 V or 420 mA = 20 %100 %
		Set value = 20% for LMV2x/3x, LMV5x, ETAMATIC
		Specifies the maximum value of the analogue input as a percentage of the range at
4.022	Al1 Standard high	10V or 20mA.
4.023	AI1 Response time	Specifies the deadband on the input signal.
		An input change is taken into consideration after this time. If it is too short, a wire
		break error may appear if the 4-20 mA signal goes to 0 for a short time.
4.024	Al1 Filter time	Set value = 4 seconds
4 030		Specifies whether the input is 0 = analogue / 1 = digital input.
4.030		Set value = 0 analogue
4.033	Al1 Measure unit input 1	Specifies the unit of measurement of input 1.
		Set value = 0 (%)
4.034	Al1 Lower limit	Specifies the lower limit of input 1.
		Set value = 0 (%)
4.035	AI1 Upper limit	Specifies the upper limit of input 1.
		Set value = 100 (%) Specifics the time after which the fault appears if input A11 is interrupted (wire break)
4 036	Al1 Wire break time 5s	Set value = 5 seconds
4.000	A T Wire break line, 05	
		Inverte the signal of input 1
4.037	Al1 Inversion	Set value = $0$ (disabled)



Terminal	
X5-3 (24V Out) X5-6 (Digit In1)	Bringing 24V to terminal <b>X5-6</b> enables INVERTER operation and the contact that switches it on/off. On LMV2/3x <b>X5-3</b> (24V Out) also powers the motor speed encoder.
X5-5 (24V Out) connected with X5-10 ( En.HW)	Required to enable braking ramp xxxx

# Configuration of INVERTER start / stop parameters and operating mode

Parame	Parameter			
1.020	Min. frequency (Hz)	Minimum input frequency in Hz. Set value = 0 Hz (LMV2x-3x / LMV5x) Set value = > 35 Hz (ETAMATIC)		
1.021	Max. frequency (Hz)	Maximum input frequency in Hz. Set value = 51,5 Hz (LMV2x-3x / LMV5x) Set value = 50 Hz (ETAMATIC)		
1.050	Ramp 1 Braking time 1	Braking time at switch-off to reach the speed of 0 Hz after the start/stop contact has opened (not used). Set value = 10 seconds		
1.051	Ramp 1 Acceleration time 1	Acceleration time 1 is the time necessary for the drive controller to accelerate from 0 Hz to maximum frequency (not used). Set value = 10 seconds		
1.052	Ramp 2 Braking time 2	Braking time at switch-off to reach the speed of 0 Hz after the start/stop contact has opened. Set value = 10 seconds		
1.053	Ramp 2 Acceleration time 2	Acceleration time 2 is the time necessary for the drive controller to accelerate from 0 Hz to maximum frequency. Set value = 10 seconds		
1.054	Selects ramp used	Digital input 1 (dig In1 / X5-6) selects the ramp used. Set value = 1 (parameters 1.052 and 1.053)		
1.088	Quick stop	Not used but set. Set value = 10 seconds		
1.100	Operating mode	Frequency control mode: specifies the operating mode of the INVERTER. In our case it is always frequency control (0). Set value = 0		
1.130	Reference set point	Determines the source from which the reference value is read. In our case it is always analogue input AI1. Set value = 1 (analogue input 1)		
1.131	Enabling software	Depending on the change made, the motor may start immediately. Selection of the source for enabling control. Set value = 0		
1.132	Start-up protection	Selection of behaviour in response to enabling software. Set value = 1 (Start only with rising edge at input of control enable)		
1.150	Motor rotation direction	Do not change this parameter. To invert the direction of rotation, invert 2 of the 3 INVERTER / MOTOR cabling wires, so that the INVERTERS always have the same setting. Set value = 1 forwards only / clockwise rotation (no changes to direction of rotation are possible)		

### Motor data

The motor data depend on the type of motor used. Refer to the data shown on the motor nameplate. Follow the steps below:

- Enter the motor data;

- Activate the motor recognition function;

- If the operation ends successfully, enter the remaining parameters.

During the recognition phase, the INVERTER measures some parameters and changes some settings.

N.B.: At each start-up of the recognition programme, recheck all the parameters in this manual.

Parame	ter			
33.001	Motor type	Selection of motor type. Set value = 1 (asynchronous motor)		
33.010	Motor I <sup>2</sup> t factor	Not used. Only for encoders. Set value = 100%		
33.011	I <sup>2</sup> t time	Not used. Only for encoders Set value = 30 seconds		
33.015	R optimisation	If necessary, this parameter can be used to optimise the start-up behaviour. Not used <b>Set value = 100%</b>		
33.016	Motor phase control	The "Motor connection interrupted" error monitoring (error 45) can be enabled/disabled with this parameter. Set value = 1 (enabled control)		
33.031	Motor current	Maximum motor current. Set value = motor nameplate current value in amps		
33.032	Motor rating	Motor shaft rating. Set value = motor nameplate rating value in watts		
33.034	Motor rpm	Motor rpm. Set value = motor nameplate speed in rpm		
33.035	Motor frequency	Nominal motor frequency. Set value = motor nameplate frequency in Hz		
33.050	Stator resistance	Recognised by INVERTER. Set value = automatically detected, value in Ohm		
33.105	Leakage inductance	Recognised by INVERTER. Set value = automatically detected, value in henry		
33.110	Motor voltage	Nominal motor voltage. Set value = 400V		
33.111	Motor cos phi	Data on motor nameplate. Set value = 0,xx		
33.138	Holding current time	Needed to stop the motor!! After braking it is held at continuous current for a specified time interval. Ensure that there is no overheating in this phase. Recommended time: max 5 s. Set value = 0 seconds		

Activate the "Motor identification" function and follow the instructions proposed by the INVERTER, then change the parameters described below. The image shows the software screen on the PC.

Aprire	F Salva	Co	llegamento Sc	ittura	û Lettura	Parametro	Valori istantanei	Errori / Avvertimento	Sistema di controllo	Oscilloso
Compiti X		1				1				
Cockpit									N 1	
Parametro	4	🖨 🛛 Dati mot	tore						Identificazione motor	re
III Tutti i parametri										
Param.base		Numero	Nome			Valore		Acquisiz	ione	
🖽 Modalità oper.		33.001	Tipo di motore	Contraction of the	1: Motore asincrono			Pronto		
Regol.processo		33.010	Fat. 12T motore		100 %			Sempre		
		33.011	I2T Tempo		30 s			Sempre		
Controllo mors.		33.015	Ott.rest.stat.		100 %			Pronto		
Funz.aggiuntive		33.016	Monit.fasi mot.		1: Attivo			Pronto		
Param.campo Bus		33.031	Corrente motore		4.4 A			Pronto		
Detimentary		33.032	Potenza motore		2 200 W			Pronto		
Dati motore		33.034	Velocità motore		2 910 rpm			Pronto		
🗠 Param. regolaz.		33.035	Frequen.motore		50 Hz			Pronto		
E Chopper fren.		33.050	Resist.statore		0.22 Ohm			Pronto		
		33.105	Indut.dispers.		0.001 312 256 H			Pronto		
Hunz.protezione		33.110	Tensione motore		400 V			Pronto		
Valori istantanei		33.111	cosphi motore		0.84			Pronto		
Errori / Avvertimento		33.138	Tem.cor.riten.		0 s			Sempre		
Sistema di controllo Oscilloscopio										

Parame	ter		
34.010	Control type	Open-loop asynchronous motor. Set value = 100 (open-loop asynchronous motor)	
34.020	Flying restart	Set value = 1 (enabled)	
34.021	Flying restart time	Calculated by Inverter. Set value = value calculated by INVERTER in ms	
34.090	Speed controller KP	Calculated by the inverter during the motor recognition phase. Reset it to 2000 after motor recognition. Set value = 2000 mA/rad/sec	
34.091	Speed controller T <sub>N</sub>	Calculated by the inverter during the motor recognition phase. Reset it to 7.5 seconds after motor recognition. Set value = 7.5 seconds	
34.110	Slip trimmer	If set to <b>1</b> the function is enabled. If set to <b>0</b> the motor performs as if connected to the mains. If compensation is enabled, the system aligns the stator frequency with the rotor. As a result, the actual motor rpm increase and are brought in line with the theoretical motor nameplate rpm. The motor is supplied with the same voltage and frequency, but the current increases and the rpm are brought to the nameplate data. <b>Set value = 1 (compensation for slippage)</b>	

## Output signal variant for reading motor rpm (optional)

To have a 4-20 mA analogue output that indicates the motor rpm to the terminals X5-13 (Aout 0-20 mA) and X5-16 (A GND), set the parameters below:

Param	eter			
4.100	Analogue output AO1	Selection of analogue output options. In our case, to have an output proportional to the rpm, set 19. Set value = 19 (actual rpm)		
4.101	Minimum value of analogue output AO1	Output signal at 0-20 mA. To obtain a 4-20 mA signal with (4 mA = 0 motor rpm), follow the example: if motor rpm are a maximum 2900, calculate: 2900 / 20 x 4 = <b>580</b> , which is the negative value corresponding to 0 mA from which to start. Therefore: 0 mA = - 580, 20 mA = 2900 Set value = - xxx (-580 in the example)		
4.102	Maximum value of analogue output AO1	Maximum rpm value for 20 mA. Set value = xxxx (2900 in the above example)		

NOTE 1	If the system enters pendulum mode with LMV / ETAMATIC, adjust parameters <b>34.090</b> and <b>34.091</b> by increasing them, in particular parameter <b>34.090</b> , in steps of 100mA/rad/sec.
NOTE 2	With LMV 2x/3x with INVERTER control, the device controls the standby rpm with <b>param. 653</b> . If, after the fan is switched off, the device LMV 2x/3x sees that the motor continues to run, error <b>83</b> diagnostic <b>32</b> appears. This occurs if there is significant fan inertia (e.g. on burners with very heavy forward curved blades), then always disable parameter 653, setting it to <b>0</b> .
NOTE 3	With LMV 2x/3x the signal 0-10V for motor rpm control during standardisation is brought to approximately 9.7 V and the fan motor rpm is saved. According to the LMV manual, the INVERTER should be set to max 52.5 Hz During standardisation, the INVERTER is driven at approximately 51 ÷ 51.5 Hz and may go out of absorption range with the motor. For this reason, set the INVERTER to max 51.5 Hz. During standardisation, the INVERTER will reach 50Hz and the over-absorption problem will be reduced.
NOTE 4	If the <u>analogue wire break fault</u> is displayed on the INVERTER and the 4-20 mA inverter signal continues to oscillate between $1 \div 6$ mA, it does not always mean that the LMV $2x/3x$ or ETAMATIC equipment is faulty. It could be due to the old firmware of the INVERTER and should therefore be updated. If this is the case, contact the Service Centre.

FAULTS / PROBLEMS SOLUTIONS			
Parameter 36.020	If error 36 appears	Problems detected in the mains supply. By setting this parameter to 0, the INVERTER no longer checks the mains and the error message disappears. It is recommended to leave the parameter set to 1.	
Parameter 33.105	If mains voltage drops during operation	When the mains voltage drops, the INVERTER decreases the motor rpm. To reduce this change, set the parameter to 0, which should solve the problem.	

## Brake chopper connections



### Brake chopper connections

Terminal no.	Designation	Assignment
1	B+	Braking resistor connection (+)
2	В-	Braking resistor connection (-)

### Optional assignment of brake chopper

Parameter	
Braking resistor	Enabled or disabled

Braking resistors	

### Burner terminal block with interface INVERTER



### Versioni bruciatore con LMV5x o ETAMATIC





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Note: specifications and data subject to change. Errors and omissions excepted.