MiLAB Oxygen Control

MANUAL & INSTALLATION

MOC-100 Ver 3.0

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1 Introduction

MOC-100 is a regulation and control unit for a lambda-sensor. It is specially design for controlling the oxygen level in exhaust gases. It includes four alternative functions:

- Regulate the amount of air to achieve the wanted O_2 level.
- Regulate fuel feeding to achieve the wanted O_2 level.
- Regulate a open/close airvalve to achieve the wanted O_2 level.
- Work as O_2 measuring device to other systems.

The choice of function depends on parameter setting.

To maintain safe and reliable combustion MOC-100 contains also the following options:

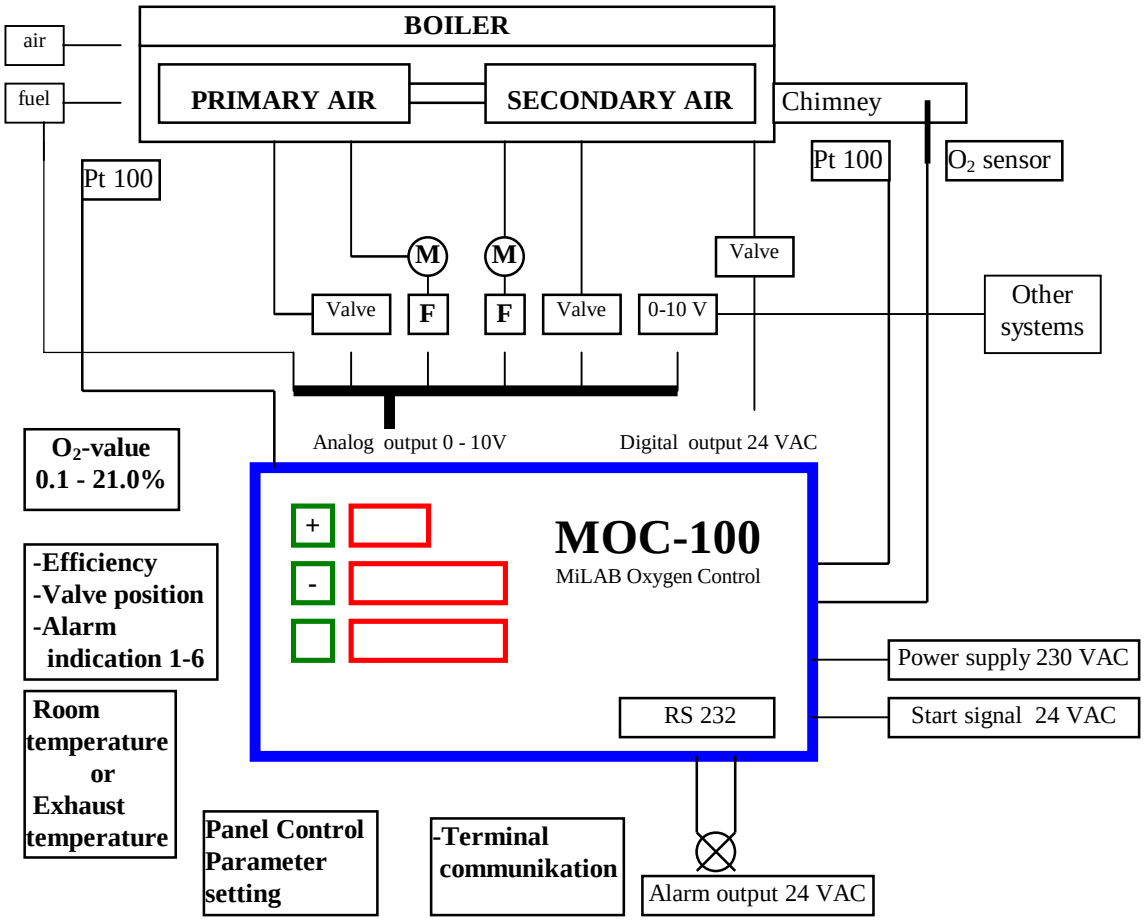
- One alarm output to indicate the following:
    - To high O_2-level
    - To low O_2-level
    - Sensor alarm
    - Electronic unit alarm
- Measure temperature of exhaust gas and temperature of supply air
- Calculate and show efficiency
- Generate a break signal by getting alarm from temperature of exhaust gas

To start the MOC-100 just activate the start signal. The heat of the sensor turns on when this signal is active. During preheat of the sensor and when unit is not active the O_2-level will show -- , and the output of the analog signal depends on the value of parameter 7. Preheating takes about 90 seconds. MOC-100 starts regulating when the sensor is hot.

2 Functions

2.1 O_2 regulation

O_2 regulation is one of MOC-100´s main functions. This function regulates all the time the amount of air alternative fuel based on O_2-level at the O_2-sensor. O_2 regulation and other available functions are illustrated by following picture:



Desired O_2 value is set by parameter 1. To achieve the wanted O_2 level MOC-100 regulates the amount of air or fuel automatically.

2.2 Display board

The front panel includes three displays.

Top : O_2 level in %, Range 0.1 - 21.
Middle: Valve position in % alternative efficiency.
Bottom: Temperature of exhaust gas alternative room temperature.

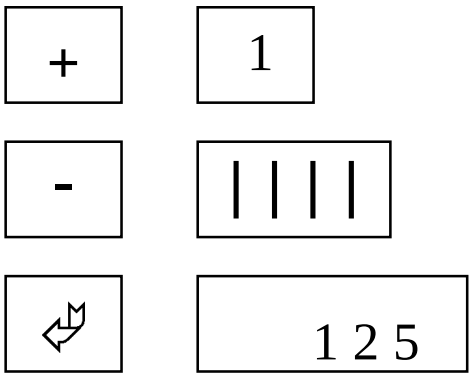
Parameter settings decide what shows in middle and bottom display. Alarm indicates by blinking display and showing an alarm code.

2.3 Communication through panel

To set parameters and reset alarm MOC-100 has tree buttons. By pressing buttons you may communicate directly with MOC-100 and change parameters 1-17.

2.3.1 Set parameters

The buttons are working together with the display. Communication is available by moving from normal mode to ”set parameter mode”. To change mode do the following. Press + and - button together until the display is blank. Release the buttons and the following display will show. MOC-100 is now in ”set parameter mode”.



- **Plus-button** increases the value of a parameter.
- Number on display shows the parameter you are working with. (1-17)

- **Minus-button** decreases the value of a parameter.
- Display beside has no function.

- **Enter-button** is used for setting of a parameter and at the same time jump to next parameter on the list (1-17).
- Display shows the parameter value.

To finish parameter setting and move back to the normal mode do in the same way as the starting. Press + and - button together until the display is blank, release the buttons and MOC-100 is now back in normal mode.
MOC-100 has also a time-out function. MOC-100 automatically chances back to normal mode after 5 minutes, if no button have been pushed.

3 Parameters

Parameters 1-17 are set by buttons or through terminal. This chapter shows which parameters are applicable for each main function. Further ahead shows how to set options. This chapter also gives more details of some parameters. Default value = delivery setting.

OBSERVE !

PARAMETERS WRITTEN WITH BOLD STYLE HAS A MAJOR INFLUENCE TO THE CHAPTER FUNCTIONS.

3.1 O_2 regulation with analog output

When MOC-100 is used to control air, to maintain a wanted O_2 level, the analog output is proportional to the required air volume. This signal can regulate for example a speed controlled fan. If MOC-100 is used to control the amount of fuel this signal can control for example fuel pump, stoker or similar. Connect according to MOC 1301E. (Look at appendix)

Parameter	Scale, code	Default
1: O_2 demand	**Step = 0.1 % O_2**	**50**
2: O_2 alarm limit high	*Step = 0.1 % O_2*	*90*
3: O_2 alarm limit low	*Step = 0.1 % O_2*	*30*
4: Time before O_2-alarm active	*Step 0.1 minute*	*50*
5: Type of analog output	**2 = Air regulation**	**2**
	3 = Fuel regulation	
6: Analog output in stop mode, Scale 0-255	**0=0Volt, 255 =10Volt**	**0**
7: Analog out under preheating and fault	**according to parameter 6**	**120**
8: k-factor O2 regulation	**Scale 0-255**	**50**
9: Open /Close valve regulation		*0*
10: Valve position in stop mode		*0*
11: Valve position under preheating and fault		*50*
12: Temperature measurement		*0*
13: Efficiency		*0*
14: Type of fuel		*1*
15: Temperature limit for exhaust gas alarm	*100=100^{0}C*	*100*
16: Time delay exhaust gas alarm	*Step 0.1 minute*	*50*
17: Use fresh-air test to sensor		*0*

Parameter setting above is used to regulate the amount of air with the analog output. Change parameter 5 to 3 if fuel regulation chosen. This means that the analog output decreases when the O_2 level is decreasing. To trim and make influence to function adjust parameters written with bold style. Parameter 6 defines analog output in stop mode. Parameter 7 defines analog out during preheat and fault condition. Parameter 8 defines how quickly air respective fuel should react to changes in O_2 level. Higher value gives a faster reaction.

The following options may be used together with analog output control:

- O_2 Alarm (chapter 3.4)
- Temperature measurement (chapter 3.5)
- Efficiency (chapter 3.6)
- Alarm for temperature of exhaust gas (chapter 3.7)

3.2 O_2 regulation trough valve

When MOC-100 is used to regulate air respective fuel with a valve, with position feedback potentiometer, parameters must be set according below. Make connection according to MOC 1302E. (Look at appendix)

Parameter	Scale, code	Default
1: O_2 demand	**Step = 0.1 % O_2**	**50**
2: O_2 alarm limit high	*Step = 0.1 % O_2*	*90*
3: O_2 alarm limit Low	*Step = 0.1 % O_2*	*30*
4: Time before O_2-alarm active	*Step 0.1 minute*	*50*
5: Type of analog output	*2 = Air regulation*	*2*
6: Analog output in stop mode, Scale 0-255	*0=0Volt, 255 =10Volt*	*0*
7: Analog out under preheating and fault	*according parameter 6*	*120*
8: k-factor O2 regulation	**Scale 0-255**	**50**
9: Open /Close valve regulation	**0=off,1=air,2=fuel**	**1**
10: Valve position in stop mode	**(0 -100)**	**0**
11: Valve position under preheating and fault	**(0 -100)**	**50**
12: Temperature measurement		*0*
13: Efficiency		*0*
14: Type of fuel		*1*
15: Temperature limit for exhaust gas alarm	*100=100^{0}C*	*100*
16: Time delay exhaust gas alarm	*Step 0.1 minute*	*50*
17: Use fresh-air test to sensor		*0*

Parameter setting above is used to control air by means of a valve, with a position feedback potentiometer. To trim and make influence to function adjust parameters written with bold style. Parameter 8 defines how quickly air respective fuel should react to changes in O_2 level. Higher value gives a faster reaction. Parameter 10 defines valve position in stop mode. Parameter 11 defines valve position during preheating and fault condition. 0 = fully closed valve and 100 = fully opened valve.

The following options may be used together with valve regulation:

- O_2 Alarm (chapter 3.4)
- Temperature measurement (chapter 3.5)
- Efficiency (chapter 3.6)

3.3 O_2 measuring device.

When MOC-100 is used to generate an analog output signal to be used in other systems set parameters according below. Connect according to MOC 1303E. (Look at appendix)

Parameter	Scale, code	Default
1: O_2 demand	*Step = 0.1 % O_2*	*50*
2: O_2 alarm limit high	*Step = 0.1 % O_2*	*90*
3: O_2 alarm limit Low	*Step = 0.1 % O_2*	*30*
4: Time before O_2-alarm active	*Step 0.1 minute*	*50*
5: Type of analog output	**1 = O_2 value**	**1**
6: Analog output in stop mode, Scale 0-255	**0=0Volt, 255 =10Volt**	**0**
7: Analog out under preheating and fault	**according parameter 6**	**120**
8: k-factor O_2 regulation	*Scale 0-255*	*50*
9: Open /Close valve regulation		*0*
10: Valve position in stop mode		*0*
11: Valve position under preheating and fault		*50*
12: Temperature measurement		*0*
13: Efficiency		*0*
14: Type of fuel		*1*
15: Temperature limit for exhaust gas alarm	*100=100^{0}C*	*100*
16: Time delay exhaust gas alarm	*Step 0.1 minute*	*50*
17: Use fresh-air test to sensor		*0*

Parameter setting above means that MOC-100 generates an analog output signal 0-10V that is proportional to the O_2 level. When this function is active, a status signal is available. Status signal is active if the analog output signal is proportional to the O_2 level. This means that during stop mode, preheat and fault condition this output is inactive. For connection information see MOC 1303E in appendix.

The following options may be used together with this function:

- O_2 Alarm (chapter 3.4)
- Temperature measurement (chapter 3.5)
- Efficiency (chapter 3.6)
- Alarm for temperature of exhaust gas (chapter 3.7)

3.4 O_2 alarm

To use the O_2 alarm function the following parameters have to be set:

Parameter	Scale, code	Default
2: O_2 alarm limit high	**Step = 0.1 % O_2**	**90**
3: O_2 alarm limit low	**Step = 0.1 % O_2**	**30**
4: Time before O_2-alarm active	**Step 0.1 minute**	**50**

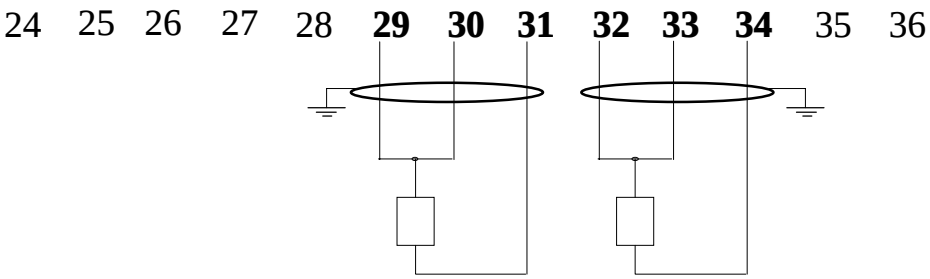
O_2 alarm function is only active when the unit is measuring an O_2 level. This means that this function is not operating in stop mode during preheat or in case of a fault condition. The O_2 value is compared to limits that are given by parameters 2 and 3. When the O_2 value is higher than parameter 2 or lower than parameter 3 a timer starts which after defined time, parameter 4, gives an alarm. Observe that this kind of alarm output is normally active, in other words the output signal is deactivate by alarm. This also means that MOC-100 generates an alarm in case of power supply failure.

3.5 Temperature measurement.

Parameter that defines this function is:

Parameter	Scale, code	Default
12: Temperature measurement	**0 = Off** **1 = Temperature of exhaust gas** **2 = Temperature of air**	**0**

This function requires one or two temperature sensors type PT-100 be connected to each triple-pole input. Make connection according below:



EXHAUST GAS PT100:1 ROOM TEMP PT100 :2

If parameter 12 has a code 0 (=Off) there will be no temperature measurement. By setting code 1 or 2 both temperatures will be measured. Number of code decides which temperature shows on display.

3.6 Efficiency

To show and calculate efficiency temperature measurement must be turned on and two PT100 temperature sensors must be connected. (See chapter 3.5)
The applicable parameters are:

Parameter	Scale, code	Default
12: Temperature measurement	*0 = Off*	*1 alt 2*
13: Efficiency	**0 = OFF, 1 = ON**	**1**
14: Type of fuel	**See table below**	**1**

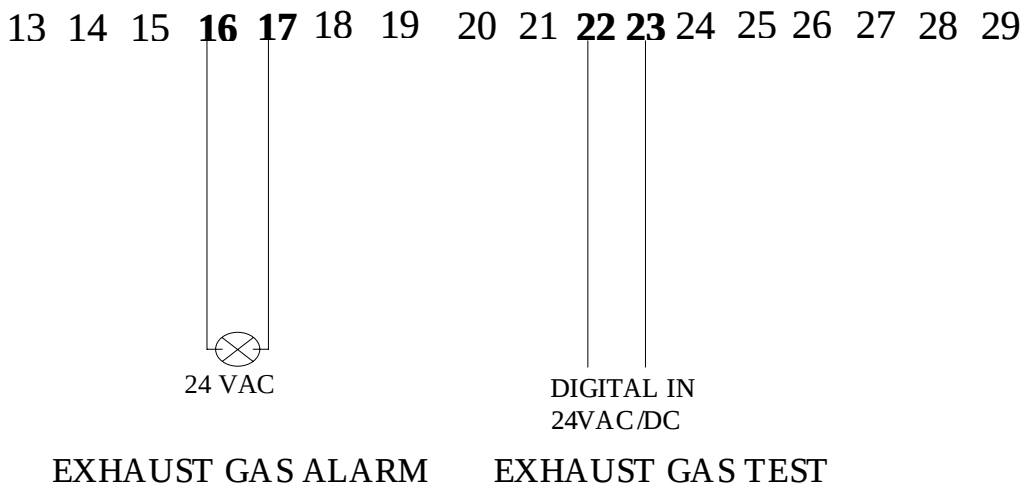
To activate this function set parameter 13 = 1. Parameter 14 decides which energy constant to be use to calculate efficiency. Beside these standard constants there is a possibility to save and use own energy constants on the assumption that a terminal or PC is available. (See chapter 3.9 communication through terminal) Parameter 14 chooses an energy constant from following table:

1. **Heating oil**
2. **Natural gas**
3. **City gas**
4. **Coal gas**
5. **Liquid gas**
6. **Own constants according to parameters 35 and 36**

To define own constants do contact retailer or MiLAB for further information.

3.7 Alarm for temperature of exhaust gas

To use this alarm one PT100 sensor must be installed and temperature measurement has to be active according to chapter 3.5. There is one input to activate this function. See connections below.



The parameters that define this function are:

Parameter	Scale, code	Default
9: Open /Close valve regulation		*0*
12: Temperature measurement	*0 = Off*	*1 alt 2*
15: Temperature limit for exhaust gas alarm	**100=100^{0}C**	**100**
16: Time delay exhaust gas alarm	**Step = 0.1 minute**	**50**

Alarm is activate when signal called exhaust gas test is active. Temperature of exhaust gas is compared to parameter 15 and if temperature is below, the timer starts. Exhaust gas alarm will be active after a chosen time set by parameter 16. This kind of alarm output is normally active, in other words the output signal is inactive by alarm. This also means that MOC-100 generates an alarm in case of power supply failure.

3.8 Alarm indication and measure.

MOC-100 include six different alarms. Alarm is indicated by a blinking display. Reason of alarm shows in middle display with a number. Following reasons may show:

1. To high O_2-level
2. To low O_2-level
3. Temperature alarm for exhaust gas
4. Sensor heating alarm
5. Electronic unit alarm
6. Sensor signal alarm

The only alarm that must be reset manually is number 3, temperature alarm for exhaust gas. The other alarms reset automatically when the alarm situation is not valid any more.

3.8.1 Alarm 1: To high O_2-level.

Alarm high O_2-level is generated when O_2-level passes above parameter 2, and stays above this limit for a longer time then have been set by parameter 4. This alarm can not be reset with buttons.
To do something about this alarm the process must be investigated for the cause of the problem. It can be to trim some parameters in the MOC-100.

3.8.2 Alarm 2: To low O_2-level.

Alarm low O_2-level is generated when O_2-level passes below parameter 2, and stays below this limit for a longer time then have been set by parameter 4. This alarm can not be reset with buttons.
To do something about this alarm the process must be investigated for the cause of the problem. It can be to trim some parameters in the MOC-100.

3.8.3 Alarm 3: Temperature alarm for exhaust gas.

Alarm active according to chapter 3.7. Alarm must be reset manually by pressing the ⏎ button.
This alarm is normally given when the burning has stopped by some reason. That is, no real burning. This can be dangerous because unburned gases can still be generated.

3.8.4 Alarm 4: Sensor heating alarm

Alarm is activate when MOC-100 can not measure a valid resistance in the sensor heating element. This alarm disqualifies all measurements from O_2-sensor and O_2 value shows --. Alarm may be reset by ⏎ button.
Typical reason for this alarm is a damaged sensor or cabling to the sensor. Alarm deactivates automatically when failure is repaired. After checking the cabling carefully, do change sensor, if this fault remains after several reset.

3.8.5 Alarm 5: Electronic alarm

This alarm is active when MOC-100´s heating output does not work. This alarm disqualifies all measurements from O_2-sensor and O_2 value is --. Alarm may be reset by ⏎ button.
Check connections between MOC-100 and sensor. If this fault remains after several reset, and after checking cables and connectors, change electronic unit. Alarm deactivates automatically when failure is repaired.

3.8.6 Alarm 6: Sensor signal alarm.

To use this alarm set the following parameter:

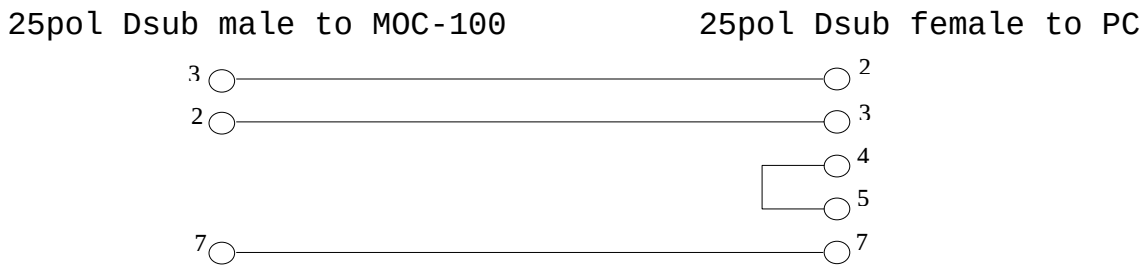
Parameter	Scale, code	Default
17: Use fresh-air test to sensor		**1**

This option is not possible in all applications. The following will explain why.
This alarm function tests the O_2-sensor by checking that it reacts correctly to fresh-air that is supposed to come to sensor after combustion cycle. It is not possible to use this function without a guarantee that fresh air is blowing to the sensor, when start signal is inactive. This alarm disqualifies all measurements from O_2-sensor and O_2 value is --. Alarm may be reset with the ⏎ button.
Check that gases are correctly passing the sensor, and that the sensor is not blocked. After that check connections between MOC-100 and sensor. Alarm deactivates automatically when failure is repaired. If this fault remains after several reset, change sensor.

3.9 Communication through terminal/PC

3.9.1 Connection diagram

MOC-100 has an RS232 for communication. Communication cable must be connected as below:



3.9.2 Connection

To be able to communicate with MOC-100 through PC/terminal you have to use the following settings:

Baud rate:		2400
Data bits:		7
Stop bits:		1
Parity:		Even
Flow control:	None	
Connector:		Choose a free comport

3.9.3 Process data

All available process data is printed on the terminal, when the startsignal is active, as follows:

Time	O_2%	Valve%	Gastemp.	Roomtemp.	Eff%	Alarm
0,02	8.5	12	123	23	70%	0
0,04	8.2	12	123	23	70%	0
0,06	7.9	12	125	23	70%	0

The time is minutes and seconds from start. There will be a header printed every 40 line when the start signal is active.
Otherwise a short menu shows according below:

c: calibration
s: set parameters

3.9.4 Commands.

The commands included in the system are:

c: calibration
s: set parameters

c: is the command to calibrate a valve with feedback potentiometer. Just type a 'c' and the valve will be calibrated and the calibration values will be stored in EEPROM. This function must be done if you install a system or if you change MOC-100 or a valve.
s: is the set command that will be used to adjust one or several parameters. Here you can set all parameters. See chapter **3.10, List of parameters,** for explanation of parameters.
With a PC/terminal all MOC-100 parameters can be changed.

3.10 List of parameters

Place:	Date:

Parameter	Scale, code	Default	Own setting
1: O_2 demand	Step = 0.1 % O_2	50	
2: O_2 alarm limit high	Step = 0.1 % O_2	90	
3: O_2 alarm limit low	Step = 0.1 % O_2	30	
4: Time before O_2-alarm generate	Step 0.1 minute	50	
5: Type of analog output	1 = O_2 value 2 = Air regulation 3 = Fuel regulation	1	
6: Analog output in stop mode, 0-255	0=0V, 255 =10V	0	
7: Analog out under preheat and fault	According parameter 6	120	
8: k-factor O_2 regulation	Scale 0-255	50	
9: Open /Close valve regulation		0	
10: Valve position In stop mode		0	
11: Valve position under preheating and fault		50	
12: Temperature measurement		0	
13: Efficiency		0	
14: Type of fuel		1	
15: Temp.limit for exhaust gas alarm	100=100^{0}C	100	
16: Time delay exhaust gas alarm	Step 0.1 minute	50	
17: Use fresh-air test to sensor		0	
18: Blocking buttons	Blocking = 0	1	
29: K-value for O_2	Parameters 29-34 are written	0,068	
30: M-value for O_2	behind a lock. Default values may	0	
31: K-value for T1	use if right values are loose.	0,128	
32: M-value for T1		80,10	
33: K-value for T2		0,128	
34: M-value for T2		80,10	
35: Energy constant A	(Suitable value)		
36: Energy constant B	(Suitable value)		

4 Technical data.

MOC-100 include a microprocessor, PROM, RAM and EEPROM. To be able to communicate and measure it has four analog inputs, one analog output, two digital inputs and four digital outputs.

- Analog inputs are of different type: one for potentiometer and the rest for temperature and O_2
- MOC-100 generate an analog output 0-10 V DC
- Digital inputs are for 24V AC/DC
- Digital outputs 24V AC are for preheating, valve and alarm

4.1 Voltage supply

MOC-100 is supplied by normal main voltage (230/110 V AC 50/60Hz) and supplies 24V AC for valve and alarm equipment.

4.2 Technical specification

Inputs:

1: Analog inputs for lambda sond.	Lambda sensor
2: Position feedback potentiometer	1kOhm connected between 24,25,26
3: Two PT100 bridge inputs	PT100 sensor , three wires
4: Two digital inputs.	24 V AC or DC , < 25mA
5: Supply for electronics and sensor	230 V AC 50/60Hz, max. 50 VA. Voltage range: -20% - +15%. OR 110 V AC 50/60Hz, max. 50 VA. Voltage range: -20% - +15%.

Outputs:

1: Heating for lambdasond.	Lambda sensor
2: Analog output 0-10V DC.	Max. load 10 mA.
3: Three digital outputs for valve control and warning output	Max. 48 V AC, max. 500 mA,

Communication:	RS232 serial port.
Range:	Oxygen 0.1 - 21%
Mechanical case:	Plastic box , IP65. Dimensions 213 x 185 x 113 mm
Operating temperature range MOC-100:	-20 to +50 ^{o}C.
Operating temperature range sensor housing	< +500 ^{o}C
Operating temperature range at cable bushing	< +200 ^{o}C
Operating temperature range at connecting cable	< +150 ^{o}C
Operating temperature range at connector	< +120 ^{o}C

5 Installation

5.1 Mechanical Installation

5.1.1 MOC-100

1. Find a place to mount the electronic box. It should be easy to read the display and to connect a terminal/PC to communicate with the unit.
2. MOC-100 must be mounted as close to the sensor as possible. Do not to use any longer cable then the one supplied with the unit.
3. Surroundings temperature must be between -20 ^{o}C - +50 ^{o}C

5.1.2 Sensor

1. The sensor is mounted by drilling a hole, corresponding to the thread, in a steel chimney. The hole should be placed on the upper side of the chimney as close to the boiler as possible.
2. Thread with M18 x 1.5 and mount the sensor.
3. Be sure that the sensor has the same earth connection as the electronic unit (MOC-100).

If the O_2 level will not be stable even when you think it should be this can depend on the mounting of the sensor or that there is a leakage of air into the combustion. There are several ways to mount the sensor depending on the type of chimney and temperatures. Call supplier for help and advice. A typical problem is that the unit is always displaying 1.0 % O_2, this depends in many cases on a missing earth connection either at the sensor or at the electronic unit.

5.2 Electrical installation

The electrical supply is 230/110 V AC single phase. This supply should not be taken from any type of speed controller without necessary filters. During the installation keep all 230/110 Volt wires as far as possible from the signal wires. Also use shielded cables for the analog output and temperature input signals. Connect MOC-100 to same earth as the sensor.

5.2.1 Electrical installation drawing.

See appendix.

5.2.2 If MOC-100 does not work

Check the following things if the unit does not measure and regulate correctly:
1. Check sensor mounting and that there is not a leakage of air.
2. Check that all cables are connected correctly. (Compare connection diagram)
3. Check that sensor has a proper earth connection to the same earth as MOC-100.
4. Check that calibration parameters 29-34 are equal with the values behind the plastic cable cover.
5. Fault code is blinking. See further explanation and advice in chapter 3.8.

5.2.3 Repair report.

MiLAB expects that the user checks the product according to chapter 5.2.2., before a return for guarantee or service is made. Read instructions for repair report and fill the form.

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582 73 LINKÖPING
SWEDEN

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Test protocol (Filled by MiLAB)

Article name	
Fabrication number	
Test made by (name and date)	

Instruction for repair/guarantee:

MiLAB expects user to contact seller before a return is made.
Make a report of problem by filling this form.
Enclose form and a copy of invoice with return delivery.

Form for repair/guarantee report

Date:

Sender

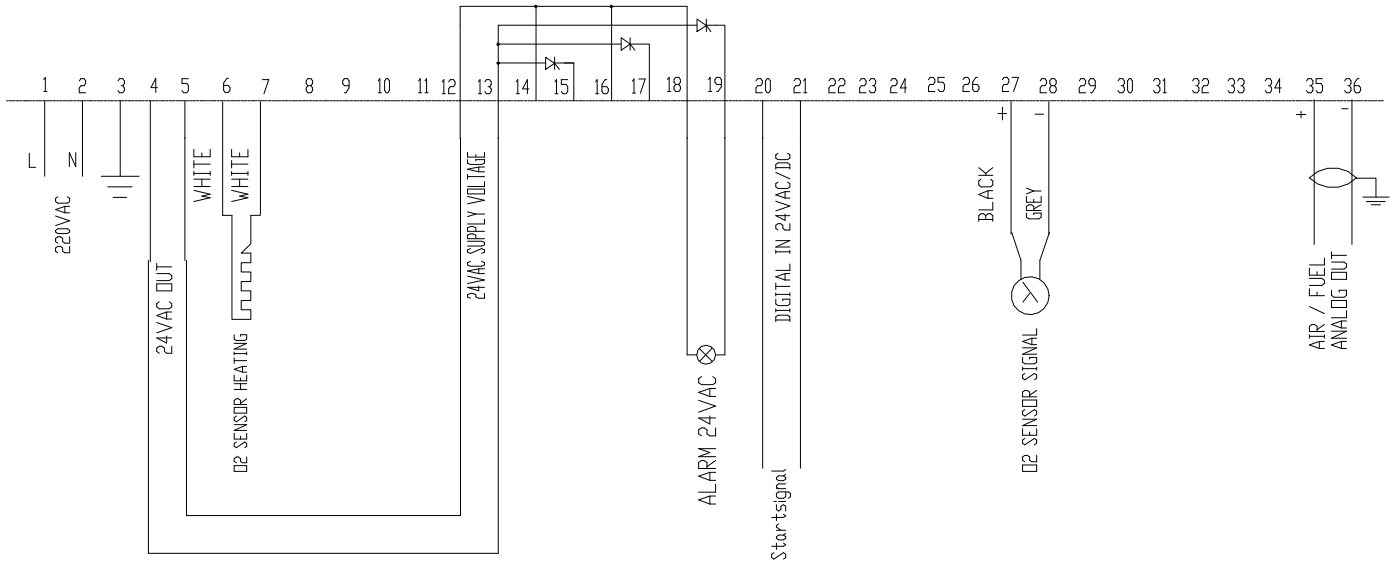
Company	
Ref. person	
Address	
Telephone number	

Product information

Product name	
Date of invoice	
Invoice number	

Fault description

What happened ?	
Place and Date?	
Fault Description	

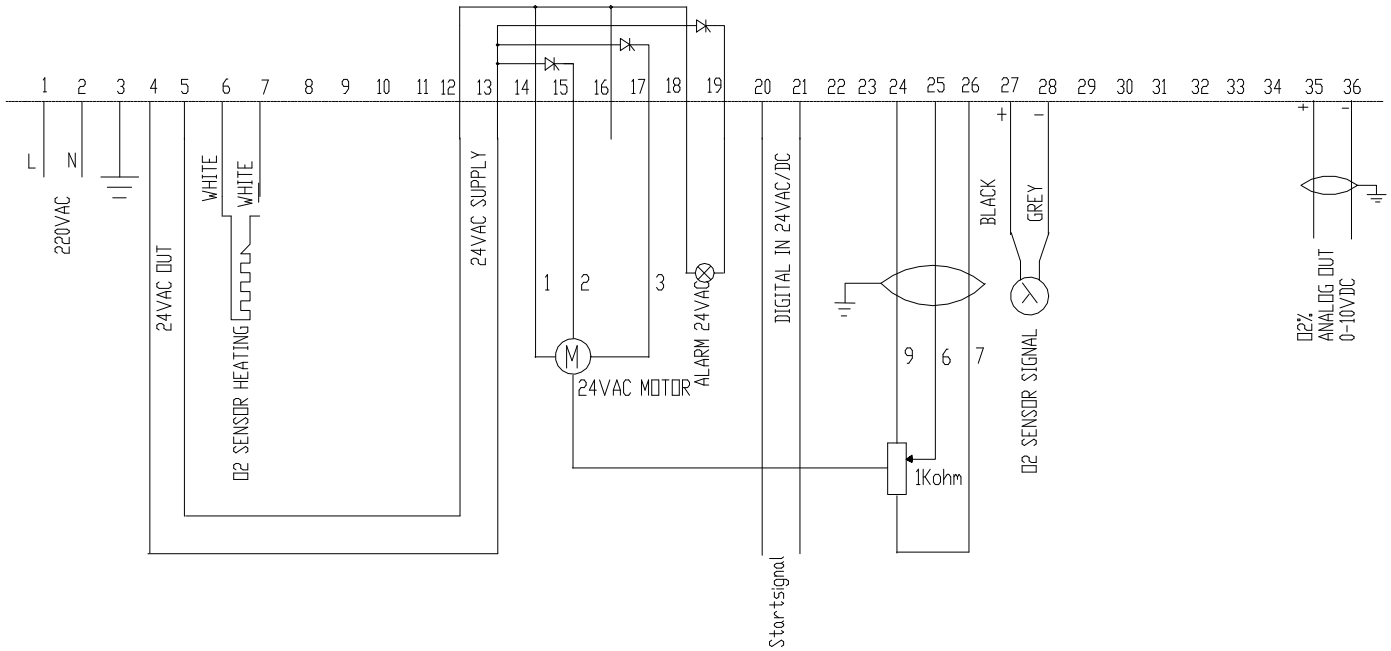


Object
Connection diagram MDC-100 V3.0
Connector 1-36
AIR / FUEL REGULATION

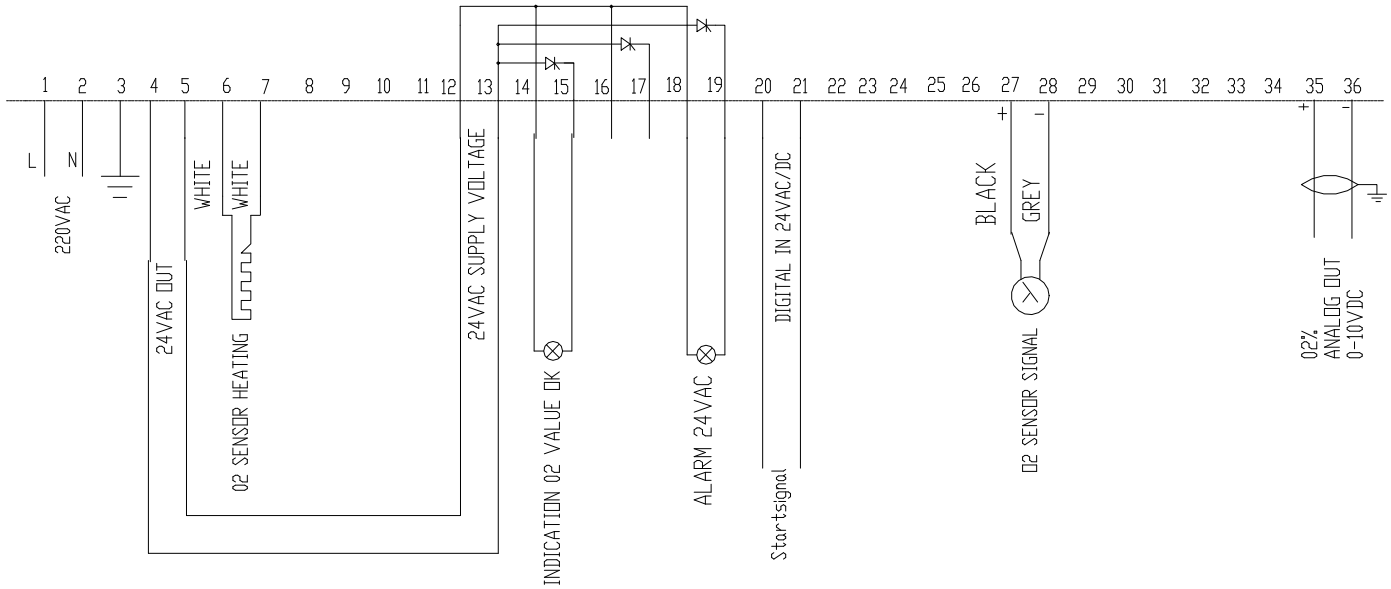
Project

Date 950602	Version	Sign
	MDC1301E	

MiLAB Sweden



Object: Connection diagram MOC-100 V3.0 connector 1-36 VALVE REGULATION			
Project			
Date 950127	Version	Sign	MiLAB Sweden
	MOC1302E		



Object: Connection diagram MOC-100 V3.0 Connector 1-36 02-MEASURING DEVICE			
Project			
Date 950602	Version	Sign	MiLAB Sweden
	MOC1303E		