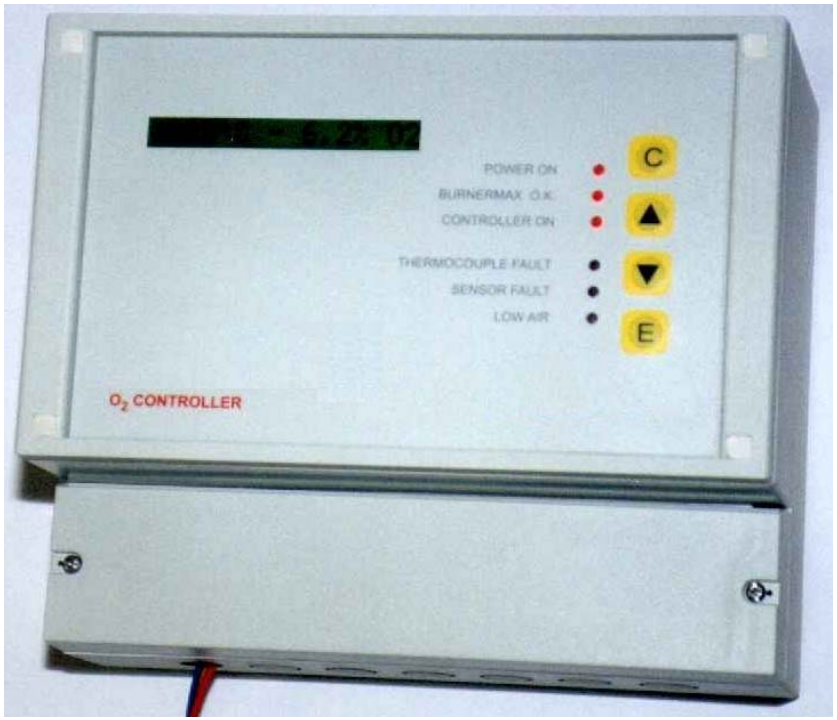
Environmental Equipment, Inc.
3634 Central Ave. · St. Petersburg, Florida 33711 · Phone 727-328-2818 · 800-RING-IMR
Fax: 727/328-2826 - Email: info@imrusa.com

IMR 60000

O2 – Excess Air Controller



Dear Customer

Thank you for selecting the **IMR6000** Its user-friendly operation and extensive features will assist you in your furnace or burner continuously operating efficiently and environmentally friendly.

Please take the time to read this manual carefully and make sure you become familiar with the unit's operation before using it. If there are any problems, please contact our Customer Service Department or your nearest distributor. We will help you quickly and competently in order to enable you to use the Controller to its full potential.

General information

Warnings and other important information relating to the controller are highlighted

Warnings

Warnings are highlighted by a pictogram. The accompanying **Text** indicates the degree of danger:

Danger	
	**Caution** means: Physical injury or damage to property may occur if the specified safety measures are not implemented. Please read all warnings carefully and carry out safety measures as specified to avoid risks.
Important information	
	**Measurement errors!** An exclamation sign highlights information, which has to be observed in order to achieve correct measured results.
Notes	
	Notes which should help you to work better with the controller are highlighted in this way.

Contents

1 Basic safety information

Please read the following safety information carefully!

1.1 Supply voltage

The controller can accept voltages from 90 to 230 Volt AC. It is however necessary to adjust the Voltage selector to either 110 or 220 Volt. If a voltage higher than 130 Volt AC is supplied when the unit's voltage selector is set to 110 Volt, **permanent damage can result!**

1.2 Electrical shock

The controller is certified to European norm EN 61010 to eliminate hazards of electrical shock. It is not allowed to open the main unit compartment by opening the four sealed screws. **All warranty will be void if the main compartment is opened by the client or if the screw seals are damaged!** The terminal compartment, locked by two screws, should only be opened by a qualified electrician for the installation and setting up of the unit. The termination compartment has small holes for the insertion of lead seals, which are recommended to prevent unauthorised access.

1.3 Sensor hazards

The **sensor is heated** while in operation to a temperature in excess of 600 °C. When the unit is switched on, the sensor should not be touched as **injuries and burns** can be sustained.

To prevent fires, the sensor should never be brought in contact with inflammable gases, liquids or solid material.

Product safety:

The controller should only be operated within the parameters specified in the technical data.

Please use the controller appropriately and according to instructions.

Never use force!

The controller should not be opened except if expressly described in this instruction manual for maintenance or installation purposes.

Only maintenance and repair work, which is described in the instruction manual, should be carried out. We suggest, that for these purposes, you keep this manual. For safety reasons, only original spare parts should be used.

Authorised, trained personnel should only carry out any additional work, which may be required. Otherwise, the responsibility for the correct functioning of the instrument following repair work and the validity of approvals will be refused.

2 Product description

2.1 The Controller

The flue gas oxygen analyser and controller offers many features to ensure that your combustion process can be maintained to optimum conditions at all times.

2.2 Function description

The combustion controller has the following main properties:

- **Microprocessor** based “embedded” controller
- Measurement of **oxygen (vol %)** and flue gas **temperature** in combustion processed (boilers, furnaces etc.)
- Calculation of flue gas **CO_2** (vol %) and flue **heat loss**
- Reliable and robust zircon sensor for in situ gas analysis (no sampling)
- **Data storage** for approximately 4 weeks at 60 sec. storage intervals
- **LED** indication of unit status
- **Fail save** error replay to indicate unit function
- **Keypad** interface for programming, set-up and calibration
- **PC** communication for data download, online trending and unit programming
- **RS 232 or RS 485** two wire twisted pair for 1000 m communication
- **Interlock** alarms for oxygen, CO_2 and temperature
- **0 – 20 / 4 – 20 mA / 0 – 10 V** output for Oxygen / CO_2 or combustion control
- **3 point controller** and **PI controller**
- **0 – 20 / 4 – 20 mA / 0 – 10 V** input to generate trim signal
- **90-110V / 220- 250V** at **50/60 Hz** selectable

2.3 Efficiency in fuel burning

With raising fuel prices, the efficiency of fuel burning equipment becomes an important issue in industry and commerce. The operation of fuel burning appliances at the correct excess air level is important to maintain the optimum efficiency. It has been shown, that the setting of burners during commissioning is not sufficient to maintain a satisfactory air to fuel ratio. If too much air is supplied to the system, energy will be wasted, due to increased amount of flue gas. If not enough air is provided for the combustion, smoke and other harmful compounds are generated, and energy is again wasted through incomplete combustion of the fuel. The following background information on combustion technology should be considered:

Combustion control & energy efficiency

Every combustion process requires air for the burning of fuel. If the exact amount of air necessary for the combustion reaction is provided, stochiometric conditions are present. When the combustion air is reduced, at sub-stochiometric conditions, combustion is incomplete, excessive smoke is generated and fuel is wasted.
If too much air is mixed with the fuel, the flue gas volume increases and proportionally the amount of energy wasted through the chimney also increases.
The following table shows the typical energy loss (as % of total fuel cost) for an oil fired boiler operated at 210 ˚ C flue

Oxygen in flue	Excess air	Energy loss
4 %	**120 %**	**8.3 %**
8 %	**160 %**	**10.6 %**
12 %	**230 %**	**14.9 %**
16 %	**400 %**	**26.8 %**

Savings of 5 – 10 % fuel cost are easily achievable if the combustion is controlled to maintain the optimum excess air level. This can, however, only be done if oxygen in the flue is measured and adjusted continuously, as the following typical factors change the excess air level.

Liquid and gas fuels:

Factor	Possible change of excess air
Ambient air pressure	**± 15 %**
Ambient air temperature	**± 10 %**
Fuel supply pressure	**± 10 %**
Fuel supply heating	**± 5 %**
Fuel filter blockage	**± 10 %**

Additional factors with solid fuels:

Factor	Possible change of excess air
Fuel moisture content	**± 10 %**
Fuel bulk density	**± 10 %**

With a combination of the above factors, excess air level can easily vary by some ± 30 % resulting in up to 10 % fuel wastage.
Most modern industrial boilers and furnaces, lack continuous flue gas oxygen control and often produce heavy smoke. Large amounts of energy are also wasted due to high excess air operation.
Only the use of suitable equipment for the measurement and control of flue gas oxygen can rectify this problem.

2.4 Efficiency and environmental performance

Efficiency and environmentally friendly operation go “hand in hand”. Combustion equipment which operates on low efficiency often generates excessive smoke - in case of solid fuel firing, the emission of small particulate is increased. Secondary gas clean up equipment such as wet scrubbers, electrostatic precipitators, bag house filters or high efficiency cyclones all have reduced performance when large amounts of sub-micron particles are emitted. If insufficient air is provided for the combustion of fuel, unburned hydrocarbons, excess carbon mono oxide and other harmful compounds leave the combustion process.

2.5 Electronics

The unit is based on an embedded microprocessor solution utilising the Atmel 89C512 flash-programming chip. The digital circuits are completely separated from the analogue in- and outputs as well as from the communication connections by optocouplers. These ensure that the digital service is not subjected to noise or spikes, which might be generated in the field cabling.

The analogue circuits are further protected by “Tranzorp” high voltage earth connections to protect the in- and output circuits.

The design of the unit satisfies the requirements of the European **CE** certification and the enclosure is rated to IP 65.

2.6 In- and outputs

A wiring diagram is supplied at the end of this document, showing all the terminations . A termination drawing can also be found in the cover of the termination compartment. For additional copies of these drawings, please contact us.

The unit has the following terminations and connections:

- Power 90-110V/ 220-250V at 50 – 60 Hz (change from 200 to 110 V to be done by authorised service station only)
- Fail save relay (240 V AC – 10 Amp) to indicate functioning and vital alarms
- Analogue input for trim control. (Also see Chapters 4.2 as well as 4.6, heading 5)
- Analogue output set as Forced Value, PI- or PI trim controller.

Please note that the power supply for the analogue output is internal in the unit and power only has to be provided for the analogue input circuit <u>NOT</u> the output circuit.

- Two wire RS 485 communication for PC connection of up to 1000 m.
- Standard 9 pin RS 232 connector for PC communication.
- 3 x 3 point control relays. (each 240 V AC – 10 Amp)

2.7 Special features

Over and above the measurement of flue gas oxygen, temperature and the indication of the efficiency of combustion, the combustion controller has special features, which are normally not found in comparable equipment. These features are described below.

2.7.1 Data logging

The unit is equipped with a memory chip which allows the storage for measurement data at a 60 second interval e.g. the stored data will cover approximately 4 weeks of operation. If longer intervals are selected, the storage period increases accordingly. The stored data can be retrieved from a PC through the RS 232 or RS 485 communication connection. It is possible to download the complete stored information or select specific days and limit the download of data to these periods. The data storage can be erased either with the keyboard menu or with the appropriate commands from the PC software.

2.7.2 Controller action

The controller has integral controlling functions, which are described as follows:

The three-point controller activating the two switchover relays (marked control), which compare the oxygen set points selected in the keyboard menu with the actual measured value. According to the band selected, these relays will switch over if the actual flue gas oxygen is outside the allowable band. The three-point controller can be used for a simple oxygen trim or it can also be used for indication and alarm purposes. One example how to operate a three light indicator is shown in the attached wiring diagram.

The three-point controller works continuously, but the relay operation can be switched off by selecting a maximum band width.

The PI controller consists of an analogue control unit integral to the unit which, if selected, will either generate a controller output on the 4-20 (0-20) mA output or it can, in conjunction with the analogue input also be used as a trim control. The trim control will add a controlling current to the input current and in this way an existing control signal can be trimmed to adjust the air to fuel ratio in a burning appliance. The controlling parameters can be set-up with the control menu and a "trim max" variable allows to limit the add on trim control to a certain percentage of total output to ensure that overswings in the control are not disturbing normal operation.

2.7.3 PC communication

A comprehensive WINDOWS based software package is delivered with the analyzer, which allows online communication with the combustion controller. The communication can be either effected through a RS 232 computer connection or can also be installed with a RS 485 two wired twisted bear communication. Special non-powered adapters for the PC sides are available as options. The RS 485 communication can run up to 1000 m and can address up to 32 separate units on one twisted bear communication line in series.

The WINDOWS based software includes a comprehensive help file and also learning programs, which allow the operator to become fully familiar with the many features which are included in the software such as:

- Online trending of process variables
- Download and display of historical data
- Calibration of sensors
- Troubleshooting and fault finding

The program CD also includes copies of the wiring diagrams and general information about the unit.

3 Installation and commissioning

3.1 Scope of supply

The standard package comprises of the following items:

Part description	Part Number
Main electronic unit	361.001
Lambda sensor	361.002
20 m of special sensor cable	361.20.003
Sensor welding adaptor	361.004
RS 232 communication cable (9 / 9 pin)	361.022
PC software & data CD	361.D.005
Instruction manual	361.D.006
Calibration certificate	361.D.007

The package has been carefully checked. In the unlikely event that the supply is not complete or damaged during transport please notify us immediately.

3.2 Mechanical installation

To ensure correct operation of the unit**,** some care needs to be given to the installation.

Analyzer:

Mount the unit in at least 2 meter distance from variable speed drives and other high frequency emitting devices.

The unit is fixed to a wall or plate with 3 bolts, two of which are introduced through holes in the termination compartment. The third bolt is located at the back of the casing, and can be hooked in after the bolt is located in the wall. The main enclosure must not be opened.

Do not drill additional holes in the casing, as this will invalidate the IP 65 rating of the enclosure, and in turn void the guarantee.

Sensor:

The adapter supplied for the gas sensor must be welded airtight into the side or the top of the flue duct. The adapter shall be welded to the flue gas duct on the collar so that the extended part is standing out into the duct by about 80 mm. This ensures, that the sensor is not picking up streams of air, which can travel along the duct inside wall in the case of the duct flange leakages.

The sensor is screwed into the adapter after zero calibration with approximately 11 Nm moment. Use only correct size spanner (29 mm) for tightening the gas sensor. To fit the sensor with any other tool, can damage the sensor casing and the sensor.

3.3 Electrical installation

A single line wiring drawing for the electrical installation can be seen in the drawing supplied with the hardware or in the Appendix of this document. A termination drawing can also be found inside the cover of the termination compartment. For additional copies of these drawings, please contact us.

Power supply

The unit can be set up for AC power (mains) supply of 220 V or 110 V. The supply voltage is preset to 220V at the factory. Please ensure that the required voltage is requested in the order, should the equipment be supplied to a country with a supply voltage other than 220 – 250 V AC! Frequencies of 50 or 60 Hz are acceptable.

Sensor

The cabling of the Sensor (not the extension cable) is colour coded as follows

White	Heater 12V	Pin 1 of connector
White	Heater 0V	Pin 2 of connector
Grey	Sensor – (Ox-)	Pin 3 of connector
Black	Sensor + (Ox+)	Pin 4 of connector

Make sure to remove the protective plastic cover from the sensor before switching the analyzer on!

Do not run any cables directly on **hot surfaces.**

A sensor cable with maximum length of 20 meter is supplied with the unit. The cable length cannot be increased but the cable can be shortened as necessary.

Thermocouple

The type K thermocouple has to be connected with the correct **compensating cable**. Do not extend the compensating cable with any other type of cable.

Thermocouple connections:

Red	T/C -
Yellow	T/C +

Analogue in- and outputs

Please note that the power supply for the analogue output is internal in the unit and power only has to be provided for the analogue input circuit, **NOT** the output circuit**.**

Communication

The unit can communicate with a PC using either a dedicated RS 232 connection or a RS 485 two wire twisted pair cable, where up to 32 units can be connected to one PC. If RS 485 communication is used, please ensure that the communication cable is routed in separate instrumentation cable trays with sufficient distance from high voltage, power or frequency cables and equipment.

3.4 Pre-commissioning

After the completion of the installation of the combustion controller, it is recommended to conduct a number of pre-commissioning tests to ensure the proper functioning of the unit. At this time the oxygen sensor is still located outside of the flue gas duct hanging in fresh air. Before the unit is connected to the power mains, please ensure that all terminations are wired correctly and that the power supply selector is switched to the correct voltage either 220 or 110 Volt. To operate the unit with a 220 V supply when 110 V is selected will result in overheating of a fuse and the unit will not be operational after that. Further damage to the power transformer units within the unit might occur and therefore it is of paramount importance to ensure that the selector switch is positioned correctly.

After all the connections are checked to be correct and a visual inspection shows that the mechanical and electrical installation is without fault (all cables are undamaged etc.) a unit can be connected to the mains. As soon as power is connected to the analyzer a beep can be heard and its followed by the software version number will be seen on the units display. On completion of this step the commissioning of the unit can commence.

3.5 Commissioning & calibration

If a PC connection is utilised it is recommended to first establish communication between the PC and the unit. Further instructions with regard to the PC software can be found in the software help files and the tutor program in the PC. WINDOWS based software will guide the user through the commissioning of communication between the unit and the PC. Problems with the communication can be solved as described under debugging in the software's help file.

The commissioning can be continued with the calibration of the sensor and it is recommended that this is done with the keyboard, as action on the place of measurement is required.

Although the sensor is calibrated before it leaves the manufacturing facility, it is recommended to recalibrate the sensor to ensure high accuracy measurement.

First of all a zero calibration shall be conducted during which the sensor should still be hanging outside in fresh air. Sensor calibration should only be conducted after the sensor was in operation for at least 15 minutes to ensure that the sensor has reached its operational temperature.

Span calibration is necessary if measurement values better than 0.4 % oxygen are required and it is necessary to have a auxiliary hand held oxygen test equipment available against which the span calibration can be effected. The span calibration done on the final checks of the unit before it leaves the manufacturing facility are based on long term average values of all sensors supplied and therefore the span calibration represents a historical value and the

accuracy of oxygen will be within ± 0.4 % oxygen. The span calibration can also be done after the sensor is screwed into the sensor socket in the flue gas duct and left there for approximately 15 minutes after which the sensor can be calibrated to a manual measured oxygen value using the span calibration in the keyboard menu.

3.6 The keyboard menu

The keypad of the analyzer makes the controller independent of a PC, as all __ functions and selections can now be entered into the unit via the keypad.

It is recommended to carry out the calibration and set up of the analyzer with the keypad, as it is easier to evaluate the effects at the plant location than in a remote control room. With the keypad now available we recommend, that the PC software is primarily used for online trending or historical data download.

The keypad menu structure is documented in a spreadsheet, which is supplied with the hardware and at the end of this document. For additional copies please contact us.

The main items of the keypad menu are shown in the following graphical display:

1 Password - Enter password to access the units keyboard menu
↓↑
2 Error Log – Displays or clears the last 5-recorded errors
↓↑
3 Display Mode – Selects and sets the units display mode
↓↑
4 Log setting – Sets the units data logging parameters
↓↑
5 Control settings – Setting of controller mode and input and output variables
↓↑
6 Alarm settings – Settings for the main alarm relay
↓↑
7 Comms settings – Setting of PC communication parameter
↓↑
- 8 Set fuel – Setting of fuel to calculate flue gas CO_2
↓↑
9 Calibration – Zero and span calibration of O_2 sensor
↓↑
10 Set password – Change of access password
↓↑
11 Diagnostics – Function checks and troubleshooting
↑↓

At the menu items of the keypad menu are described in detail as follows:

1 Password

The default password of the factory-supplied unit is 1234. Should the password be changed manually and the new password be forgotten, the unit has to be returned to the manufacturer for resetting of the password; therefore please ensure that the password is stored in a safe place.

2 Error log

The Error key allows the following functions:

To view the last 5 errors with description and time
To clear the error log

3 Display mode

The Display menu allows the selection of the following display types:

Flue gas temperature – Flue gas oxygen
Flue gas loss – Flue gas oxygen
Flue gas temperature – Flue gas CO_2 (calculated)
Flue gas loss – Flue gas CO_2 (calculated)
Analogue input mA – Analogue output mA

4 Log settings

The unit log stores date, time, flue gas temperature, oxygen or CO [2]
At 60 sec storage interval (preset), approximately 4 weeks of data are stored.

In the log settings menu the following parameters and actions can be chosen:

Log mode (to store oxygen or CO_2)
Log interval (recommended 60 sec)

Show log statistics (Log size, first entry, last entry)

Erase the log

5 Control settings

The controller menu allows the following settings:

To force the analogue output to 4 mA
To force the analogue output to 20 mA
To force the analogue output to represent the measured oxygen
To force the analogue output to represent the calculated CO_2
To force the analogue output to supply the controller output
To force the analogue output to represent the analogue input

The controller can be set up to provide:

To force the analogue output to 4 or 20 mA or to a process value
3 point control using the two control relays
PI control
PI Add control – the control signal is added to the analogue input signal

	**Only one of the above functions can be selected at any time!**

In the same menu the following constants can also be set

Select either oxygen or CO_2 for control
Set the oxygen and CO_2 set points
P value for 3 point controller
Band for 3 point controller
P value for PI or PI Add controller
Integral P value for PI or PI Add controller
Integral T value for PI or PI Add controller (larger values increase response)
TrimMax

6 Alarm – set-up

If any of the alarms are triggered, the following actions will be executed:

The vital alarm relay will switch
The alarm is logged in the error log
The “ok” LED on the facia will switch off

The LED will also switch off and an error is logged, if other malfunctions occur, such as a sensor short, disconnected sensor or thermocouple or a system reset.

The following alarms can be set up in the menu:

Minimum flue gas oxygen value
Maximum flue gas CO_2 value
Maximum sensor heating current
Minimum flue gas temperature
Maximum flue gas temperature

7 Comms settings

The communication between the analyzer and the PC must be configured, so that the parameters match the PC settings. The following can be set:

PC Port (protocol as RS 232 or RS 485)
Baud rate (The PC program only supports 9600 or 19200 bps)
Address (For RS 485 communication, the PC can communicate with the unit on addresses 1-32 over one serial cable)

For setting up the PC, please refer to the software menu communications.

8 Set fuel

In this menu, the fuel used in the combustion process is selected. The fuel selection is used to determine the maximum CO_2 necessary for the calculation of the CO_2 content in the flue gas. A number of fuels are given in the menu, but the CO_2 max can also be selected for a custom fuel.

9 Calibration

The sensor calibration allows:

Zero calibration by pressing one key (when sensor is in air and heating has stabilised)

Span calibration (with the use of an independent flue gas analyser)

The span calibration constant is set in the factory to a long term average value, which already will result in measurements with + / - 5 % accuracy (of full span) if a zero calibration was performed on the individual sensor. Span calibration is either in oxygen or in CO_2 depending on the unit selected in the menu.

This menu further allows the reading of all set up constants K1 – K7, which can be used for evaluation and troubleshooting. If any of the following constants have changed, the unit must be reset:

K1 = 1090
K2 = 0.26
K4 = 0.0 (for future use)
K6 = 0.041 (TC calibration value)

The constants can also be read with the PC software configuration command.

	Although it is preferred to calibrate the sensor at the unit to have better supervision, it is also possible to calibrate remotely through the PC software.

10 Set password

The keypad menu is protected by a password, consisting of four digits, which can be configured by the authorised user. If the password is forgotten, the unit has to be returned to the service station for resetting of a valid password.

The default password as delivered ex works is “1234”

	. After a 30 second time out, as a safety measure, the menu will disable and can be re-activated by re-entering the password.

11 Diagnostics

The keypad allows for extensive setting up and the following functions can be used in this menu:

Show Date and Time

Set Date and Time

ComCheck: When this function is selected it will show any incoming communication received by the unit. The settings have to be equal in the PC and the analyzer. The communication is displayed as an ANSI character and normal character, allowing the operator to determine the complete details of the communication string received by the analyzer. At the end of the communication, the data is evaluated and will be displayed as valid or not.

To check the communication from the unit to the PC, it is possible to send a string of current measurement data manually from the unit to the PC. To do this, exit the keypad program and press the upward arrow key. The display will acknowledge the sending with “Data Sent” and a string in the format:

“MM,DD,hh,mm,ss,tttt,c.c,Koo.o” will be send

MM = month
DD = day
hh = hour
mm = minute
ss = second
tttt = temperature
c.c = heater current
K = C for CO_2 or O for Oxygen
oo.o = Oxygen or CO_2 value

This string can be received by a standard terminal program for analysis.

Reset Settings: This feature clears all settings in the unit and resets all variables to the factory values. Therefore any specific set ups including sensor calibration will be lost and the unit has to be completely re-configured. The reset function should only be used when all other actions fail.

DEBUG: This function allows the check on analogue input and outputs. Each display shows the analogue value received by the AD converter and the digital value sent to the micro controller from the AD converter (toggled with the arrow keys). With this function, it is possible to determine if an error is related to the sensing device, the cabling or internal in the analyzer. The following checks are available.

Test Temp: The analogue values and the AD digital values are displayed to check **thermocouple** functioning and wiring

Test Current: The analogue values and the AD digital values are displayed to check

sensor heating functioning and wiring

Test Oxygen: The analogue values and the AD digital values are displayed to check **sensor signal** functioning and wiring

Test Analogue in: The analogue values and the AD digital values are displayed to check **analogue input functioning** and wiring

The debug mode further allows the creation of an analogue output over the full selected range where 0 (bits) will be minimum and 255 (bits) will be the maximum.

3.7 Communication with a PC & software

With the supplied WINDOWS based software, it is possible to connect up to 32 units to one PC and use the following features:

- Online trending of measured values
- Downloading of historical data
- Set-up and calibration

A comprehensive help and tutorial is included in the software supplied with the unit.

Please install the software on the computer, which will be connected to the unit by inserting the CD, and double click set-up in the set-up directory of the CD.

4 Maintenance

The combustion controller has been designed as a robust unit, which requires very little, if any maintenance. However, extensive features are included in the unit to allow the operator to check the function of the controller and to optimise its operation, as well as to conduct fault finding and troubleshooting.

4.1 Routine maintenance

The routine maintenance of the unit is limited to cleaning exercises.

4.1.1 External cleaning

If the unit has to be cleaned externally, please use a soft cloth with a mild cleaning agent.

4.1.2 Sensor cleaning

The sensor should only be removed and cleaned while the unit is non operational and the sensor has cooled down completely. Attempts to clean the sensor during operation or when the sensor is still hot can result in thermostresses and destruction of the sensor. If the sensor is dirtied by soot or carbon deposits, it is advised to leave the sensor in air and switch on for some 24 to 48 hours. This will give the sensor the opportunity to burn off the excessive carbon and return to normal operation. Otherwise the sensor can be cleaned with a dry cloth when it is cold and dust can be wiped off the sensor.

	**<u>Never</u> use high-pressure water or compressed air on the sensor for cleaning.**

4.2 Function checks

The function of the unit can be checked by using the analytical program included in the unit, as described under item 11- Diagnostics in the menu above. Further to the diagnostic possibilities, the following should be noted:

4.3 Troubleshooting

4.3.1 LED indication

The LED indication on the front plate of the analyzer shows, if the operation of the unit is within its prescribed limits. The ok indication will switch off if vital errors occur such as a sensor shortage etc. or if one of the alarm values is exceeded. When the ok LED goes off, at the same time the main alarm on relay no. 1 is also de-energised during the possibility of an external indication of a malfunction of the unit.

4.3.2 Error messages

The analyzer stores the last 5 errors giving the error as well as the time it last occurred. Error messages can be accessed through the keyboard menu as described above under item *2- Diagnostics* in the menu.

4.3.3 The fuses

Fuses safeguard the power supplies as well as the relay outputs. If the unit does not start up please check first, if any of these fuses have blown. Before replacing these fuses, investigate the cause for the high current and rectify the problem before re-starting the unit.

4.3.4 The LCD display

The LCD display can be used to show process variables such as O_2, calculated CO_2, flue gas temperature, combustion efficiency or analogue input and/or output values. If the LCD display is not indicating any messages after the unit is switched on and the LED lights are shown then a wrong contrast setting of the LCD display might be the case. The variable resistor to adjust the LCD display contrast is located on the right hand corner next to the RS 232 connector in the termination box.

4.3.5 Sensor heating

The power supply of the unit is fail safe and even on a short circuit sensor heating the unit will not fail, however,

4.3.6 Alarm and control relays

The analyzer is equipped with 3 relays. All 3 relays are switchover relays so that vital problems such as power supply failures can also be detected. The first relay, located on the left hand site in the cable termination cubicle will switch to the energized position if all vital functions are in the desired band. The relay will de-energize on the following conditions:

Power failure
Sensor heater current = 0 (cable break) or above maximum value (short)
Oxygen signal is below or above allowable alarm levels.
Thermocouple signal is below or above allowable alarm levels

The LED indication “o.k” on the front will also switch off, indicating that the unit is not operating correctly.

The other two switchover relays are switched by the 3 point controller and can also be used, for example, to indicate the level of oxygen in the flue gas to be within the permissible band. A typical wiring diagram to use these relays is included on the software CD.

4.3.7 Inputs & outputs

Apart from the inputs for the oxygen sensor and the thermocouple signal, the unit has the following inputs and output channels:

- 4 – 20 (0 – 20) mA input selectable. This input can be used to introduce a control signal into the unit which is trimmed by the unit to control the combustion process to the correct excess air level.
- 4 – 29 (0 – 20) mA output signal. To indicate:
    - 0 – 20.9 vol % Oxygen value
    - 0 – CO_2 max vol % CO_2 value
    - PI controller output value
    - PI add on controller output value (adds to analogue input)

5 Technical data

5.1 Measuring ranges and accuracies

Type of measurement	Meas. range	Reading accuracy	Display resolution
Temperature [1]	-10 to +400 °C	-10 to +99,9°C: ±2°C [3]100°C: ±2% of reading	0.1°C
Efficiency[2]	0…99.9%	-	0.1%
Oxygen (O_2)	0 to 21 Vol.%	±0.3vol.% absolute	0.1%
Carbon dioxide (CO_2)[3]	0 to $CO_{2max.}$	-	0.1Vol.%

[1]Sensor: Type K thermocouple (NiCr-Ni)
[2]Calculated flue gas loss
[3]calculated

5.2 Additional instrument data

Power supply	90-110V or 220-250V at 50-60 Hz
Operating temperature	0º - 50º
Storage/transport temperature	-10º – 80º
Weight	app. 7kg

5.3 Calculation fundamentals

These equations are used to calculate the following values.

Carbon dioxide: $$CO_2 = \frac{CO_{2max} \bullet (21\% - O_2)}{21\%}$$

CO_{2max}: Maximum Carbon dioxide value specific to fuel
21 %: Oxygen level in air
O_2: Measured oxygen level in %

Efficiency referred to H_o:

$$EFF\ GROSS = 100 - \left(\left(\frac{A}{21\% - O_2} + B\right) \bullet (FT - AT) + C\right)$$

A/B/C Fuel-specific factors
21%: Oxygen level of air
O_2: Measured oxygen level in %
FT: Flue gas temperature
AT: Ambient temperature

Efficiency referred to H_u:

EFF NET is calculated using the same formula as for **EFF GROS**. However, the fuel-specific factors are different.

6 Accessories / spare parts

Description	Part No
Oxygen Sensor with 1.2 m connection cable and plugs	361.002
Oxygen sensor weld-in socket	361.004
20 meter oxygen sensor cable	361.20.003
Unit housing	361.011
Unit display / keyboard facia	361.012
Unit printed circuit board (without transformer)	361.013
Transformer	361.014
K – type Thermocouple 300 mm insertion	361.007
Thermocouple weld-in socket	361.008
20 m Thermocouple compensating cable	361.009
RS 232 / 485 converter	361.021
RS 232 converter (9 / 25 pin) connection cable	361.022
RS 232 (9 / 9 pin) communication cable	361.023
Software CD	361.D.005
Instruction manual	361.D.006

7 Warranty

A 6 month warranty on this product from the date of purchase. The oxygen sensor carries a 6 month warranty. All material and manufacturing errors are covered by the warranty.

Any faults occurring during the warranty time will be repaired by us, authorised sales companies or authorised dealers in accordance with the following conditions and without charge for working and material costs. It is left to our discretion as to whether defect parts are to be replaced by new spare parts or if the complete product is to be replaced by a new product.

The following are excluded from the manufacturer's warranty:

Damage caused by:

- inexpert handling or non-observance of the Instruction manual and/or safety information,
- lack of care, accidents or normal use,
- outside influences (e.g. damage during transport, damage caused by vibration, excess heat, water, moisture or acids),
- use of unsuitable accessories.

This warranty is void if:

- the type or serial number of the product is changed, deleted, removed or made illegible
- any of the screw wax covers protecting the main compartment screws or the internal calibration variable resistors are damaged, indicating unauthorised opening of the equipment.
- repairs or modifications where undertaken by third parties or unauthorised persons.

This warranty does not cover the following:

- Regular maintenance and repair or the replacement of parts as a result of normal wear and tear,
- Costs of packaging and transport,
- Transport risks connected directly or indirectly to this warranty,
- Costs for necessary repairs, adjustments or similar carried out outside the warranty.

If you have a warranty claim, please contact your local distributor or the sales company responsible for your company.
Please send a brief description of the fault and your receipt showing date of delivery and purchase with the product.
Also include your details should we need to contact you.
Warranty services rendered do not extend the warranty time.
Other claims such as cancellation, mitigation or compensation,
regardless of type, are not admitted.
If your flue gas analyser is not functioning to your satisfaction, please contact the company who sold the equipment or contact us directly on the address shown below.