# GA-60

madur portable gas analyser

www.madur.com

**Ingeniería Brainco S.R.L.**
Tel.: + 54 (11) 4206-0151
Fax: + 54 (11) 4032-0622
Oyuela 315 (B1874DEG)
Avellaneda - Buenos Aires
Argentina

brainco@brainco.com.ar
www.brainco.com.ar

CHARACTERISTIC | FEATURES | TECHNICAL DATA | SENSORS | EQUIPMENT | APPEARANCE

The largest of madur's analysers equipped with electrochemical cells. It can fit even up to 7 EC cells and up to 3 NDIR sensors. GA-60 has a large (320*240), graphical LCD with backlighting. Datalogger with SD card for storing results and built-in ribbon printer for standard (non-thermal) paper.

The GA-60 analyser is offered in two versions:

- In basic configuration the analyser is not equipped with the gas dryer and works with the probe holder + gas probe pipe. It can be paired with PGD-100 gas dryer with heated hose.
- Analyser equipped with a built-in NAFION® type gas dryer and heated hose - configuration especially recommended for measurement of gases highly reactive with water or disturbed by its presence ($SO_2$, HCl, $NO_2$, $Cl_2$).

# GA-60



- Equipped with up to 7 electrochemical cells
- Equipped with up to 3 NDIR sensors
- Built-in 58mm ribbon, graphic printer
- Built-in rechargeable battery for up to 16 hours of operation (for basic configuration with probe holder + probe pipe)
- Measurements of gas and ambient temperatures, optionally 8 additional inputs for temperature sensors
- Additional gas filter with condensate trap (installed in the lid)
- Differential pressure sensor - for measurements of chimney draft and flow velocity (with help of Pitot tube)
- Soot measurement programme
- Analogue outputs (4-20mA / 0-10V) - optional
- SD card data-logger for saving results
- Calculations of many additional parameters
- Firmware for gas calibrations

- FOR ANALYSER IN A VERSION:
  - Works with madur standard probe holder and probe pipe
  - Possibility to work with full-size gas dryers (like PGD-100)

- FOR ANALYSER IN B VERSION:
  - Built-in NAFION® dryer with peristaltic pump for condensation removal
  - Driver for heated hose
  - Works with heated hose with built-in heated gas filter and with standard M30x1 fitting, that fits all madur gas probes with K-type thermocouples

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# GA-60



| ANALYSER | VERSION A<br>WITHOUT BUILT-IN DRYER | VERSION B<br>WITH BUILT-IN NAFLON® DRYER |
|---|---|---|
| Dimensions (W * H * D) | 500 mm * 395 mm * 173 mm | |
| Weight (without accessories) | 12,2 ÷ 13,2kg | 13,7 ÷ 14,7kg |
| Casing material | Plywood covered with aluminium | |
| Operating conditions | T: 10°C ÷ 50°C, RH: 5% ÷ 90% (non-condensing) | |
| Storing temperature | -20°C ÷ 55°C | |
| Power supply: Input \| maximal power consumption | 115 VAC or 230 VAC \| 90 W (without heated hose) | |
| Battery: type \|work time \| charging time | Lead-acid, rechargeable 3x6V / 4,5Ah \| 16h \| 12h | |
| Data memory: type \| size \| number of results | SD flash card \|max 4GB \| practically unlimited | |
| Display | Graphical LCD 320 * 240, with variable contrast and backlighting | |
| Printer | High-speed dot matrix, graphic printer for 2,25” (57,5 ± 0,5mm) normal paper | |
| Gas pump \| gas flow | Diaphragm, max 2l/min (with automatic flow control) \| 90l/h (1,5l/min) | |
| Purging pomp for CO sensor | Diaphragm, max 1,5l/min | |
| Communication interface with PC computer | RS-232C | |
| Gas filtering | Built-in final filter(behind the gas dryer)with replaceable insert | 1. Heated filter included in the heated hose<br>2. Built-in final filter(behind the gas dryer)with replaceable insert |

## BUILT-IN GAS DRYER, HEATED HOSE DRIVER, HEATED HOSE

CONCERNS ONLY THE B VERSION (WITH BUILT-IN NAFION® DRYER)

| | |
|---|---|
| Dryer type | Based on Nafion® exchanger |
| Drying method | Water transfer through Nafion membrane driven by partial vapour pressure differential<br>- first order kinetic reaction |
| Maximum gas flow for efficient drying | 100 l/h |
| Heated hose temperature | 120°C electronically stabilised |
| Heated hose temperature hysteresis | ~ 5°C |
| Heated hose length | 3m (optionally 5m or 10m) |
| Heated hose power consumption | 360W (max) |
| Heated hose thermocouple wires | K-type (S-type optionally) |

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## MEASUREMENTS

| Variable | Method | Range \| Resolution | Accuracy | Time ($T_{90}$) |
|---|---|---|---|---|
| $T_{gas}$ - gas temperature | K-type thermocouple | -10 ÷ 1000°C \| 0,1°C | ± 2°C | 10 sec |
| $T_{gas}$ - gas temperature | S-type thermocouple | -10 ÷ 1500°C \| 0,1°C | ± 2°C | 10 sec |
| $T_{amb}$ - boiler intake air temperature | PT500 resistive sensor | -10 ÷ 100°C \| 0,1°C | ± 2°C | 10 sec |
| Differential pressure | Silicon piezoresistive pressure sensor | -25 hPa ÷ +25 hPa \| 1 Pa (0,01hPa) | ± 2Pa abs. or 5% rel. | 10 sec |
| Gas flow velocity | Indirect, with Pitot tube & pressure sensor | 1 ÷ 50 m/s \| 0,1 m/s | 0,3 m/s abs. or 5% rel. | 10 sec |
| Lambda λ - excess air number | Calculated | 1 ÷ 10 \| 0,01 | ± 5% rel. | 10 sec |
| qA - stack loss | Calculated | 1 ÷ 100% \| 0,1% | ± 5% rel. | 10 sec |
| Eta η - combustion efficiency | Calculated | 1 ÷ 120% \| 0,1% | ± 5% rel. | 10 sec |



| Method | Range \| Resolution | Accuracy | Time (T90) | Conformity |
|---|---|---|---|---|
| **$O_2$ - OXYGEN** | | | | |
| Electrochemical | 20,95% \| 0,01% | ± 0,01% abs. or 5% rel. | 45 sec | ISO 12039; CTM-030 |
| Electrochemical, partial pressure | 20,95% \| 0,01% | ± 0,01% abs. or 5% rel. | 45 sec | ISO 12039; CTM-030 |
| Electrochemical, partial pressure | 25,00% \| 0,01% | ± 0,01% abs. or 5% rel. | 45 sec | ISO 12039; CTM-030 |
| Electrochemical, partial pressure | 100,00% \| 0,1% | ± 0,1% abs. or 5% rel. | 45 sec | ISO 12039; CTM-030 |
| **CO - CARBON MONOXIDE** | | | | |
| Electrochemical | 4 000 ppm \| 1 ppm | ± 5 ppm abs. or 5% rel. | 45 sec | ISO 12039; CTM-030 |
| Electrochemical | 20 000 ppm \| 1 ppm | ± 5 ppm abs. or 5% rel. | 45 sec | ISO 12039; CTM-030 |
| Electrochemical | 10% \| 0,001% ppm | ± 0,005% abs. or 5% rel. | 45 sec | ISO 12039; CTM-030 |
| Electrochem. with H2 compensation | 4 000 ppm \| 1 ppm | ± 5 ppm abs. or 5% rel. | 45 sec | ISO 12039; CTM-030 |
| NDIR | 10% \| 0,01% | ± 0,05% abs. or 5% rel. | 45 sec | EN 15058 |
| NDIR | 100% \| 0,1% | ± 0,5% abs. Or 5% rel. | 45 sec | EN 15058 |
| **$CO_2$ - CARBON DIOXIDE** | | | | |
| NDIR | 5% \| 0,01% | ± 0,05% abs. or 5% rel. | 45 sec | ISO 12039 |
| NDIR | 25% \| 0,01% | ± 0,05% abs. or 5% rel. | 45 sec | ISO 12039 |
| NDIR | 100% \| 0,1% | ± 0,5% abs. or 5% rel. | 45 sec | ISO 12039 |

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| Method | Range \| Resolution | Accuracy | Time (T90) | Conformity |
|---|---|---|---|---|
| **$CH_4$ – METHANE** | | | | |
| NDIR | 5% \| 0,01% | ± 0,05% abs. or 5% rel. | 45 sec | |
| NDIR | 25% \| 0,01% | ± 0,05% abs. or 5% rel. | 45 sec | |
| NDIR | 100% \| 0,1% | ± 0,5% abs. or 5% rel. | 45 sec | |
| **NO - NITRIC OXIDE** | | | | |
| Electrochemical | 1 000 ppm \| 1 ppm | ± 5 ppm abs. or 5% rel. | 45 sec | EN 50379, CTM-022 |
| Electrochemical | 5 000 ppm \| 1 ppm | ± 5 ppm abs. or 5% rel. | 45 sec | EN 50379, CTM-022 |
| **$NO_2$ - NITROGEN DIOXIDE** | | | | |
| Electrochemical | 1 000 ppm \| 1 ppm | ± 5 ppm abs. or 5% rel. | 45 sec | EN 50379, CTM-022 |
| **$SO_2$ - SULPHUR DIOXIDE** | | | | |
| Electrochemical | 2 000 ppm \| 1 ppm | ± 5 ppm abs. or 5% rel. | 45 sec | EN 50379 |
| Electrochemical | 5 000 ppm \| 1 ppm | ± 5 ppm abs. or 5% rel. | 45 sec | EN 50379 |
| **$H_2S$- HYDROGEN SULPHIDE** | | | | |
| Electrochemical | 1 000 ppm \| 1 ppm | ± 5 ppm abs. or 5% rel. | 70 sec | |
| **$H_2$ - HYDROGEN** | | | | |
| Electrochemical | 2 000 ppm \| 1 ppm | ± 10 ppm abs. or 5% rel. | 50 sec | |
| Electrochemical | 20 000 ppm \| 1 ppm | ± 10 ppm abs. or 5% rel. | 70 sec | |
| Thermal Conductivity Detector | 10% \| 0,1% | ± 0,5% abs. or 5% rel. | 45 sec | |
| Thermal Conductivity Detector | 25% \| 0,1% | ± 0,5% abs. or 5% rel. | 45 sec | |
| Thermal Conductivity Detector | 50% \| 0,1% | ± 0,5% abs. or 5% rel. | 45 sec | |
| Thermal Conductivity Detector | 100% \| 0,1% | ± 0,5% abs. or 5% rel. | 45 sec | |
| **$CL_2$ - CHLORINE** | | | | |
| Electrochemical | 250 ppm \| 1 ppm | ± 5 ppm abs. or 5% rel. | 60 sec | |
| **HCl - HYDROGEN CHLORIDE** | | | | |
| Electrochemical | 100 ppm \| 1 ppm | ± 5 ppm abs. or 5% rel. | 70 sec | |
| **$N_2O$ - NITRUS OXIDE** | | | | |
| NDIR | 2 000 ppm \| 1 ppm | ± 10 ppm abs. or 5% rel. | 45 sec | ISO 21258 |
| **$CHF_3$ - FLUOROFORM (REFRIGERANT R23)** | | | | |
| NDIR | 2,5% \| 0,01% | ± 0,05% abs. or 5% rel. | 45 sec | |
| **$SO_2$ - SULPHUR DIOXIDE** | | | | |
| NDIR | 1% \| 0,01% | ± 0,05% abs. or 5% rel. | 45 sec | |
| **$NO_2$ - NITROGEN DIOXIDE** | | | | |
| NDIR | 1% \| 0,01% | ± 0,05% abs. or 5% rel. | 45 sec | |
| **VOC - VOLATILE ORGANIC COMPOUNDS** | | | | |
| PIT - Photoionization Detector | 100 ppm \| 1 ppm | ± 5 ppm abs. or 5% rel. | 120 sec | METHOD 21 |
| PIT - Photoionization Detector | 1 000 ppm \| 1 ppm | ± 5 ppm abs. or 5% rel. | 120 sec | METHOD 21 |

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## STANDARD EQUIPMENT

SUPPLIED ALONG WITH THE DEVICE

- 3m mains cable (type of plug to be selected)
- Comparison scale with paper filters for the soot test
- Gas filter with condensation trap and replaceable filter insert (pore size 5µm)
- Flow indicator
- Data-logger with 2GB SD card
- 2,5m RS-232C communication cable with DB9 female connector
- Software CD with programmes and manuals
- Quick-couplers for the pressure sensor (2pc.)
- External ambient temperature sensor (1pc.)

## ADDITIONAL EQUIPMENT

NECESSARY FOR THE ANALYSER TO WORK

- Probe holder

  SUITABLE ONLY FOR THE A VERSION OF GA-60 (WITHOUT BUILT-IN DRYER).

  Together with an exchangeable gas probe pipe the holder is a complete gas probe for extraction of gas samples. It has a single gas tube ended with quick coupler and electric cable ended with a 7-pin connector. Gas probe pipe is mounted with a M30x1 fastening.
  In the electric connector there is a PT500 sensor for measurement of ambient temperature.
  Probe holder can be equipped with an in-line filter with a condensation trap (pore size of the filter inlet is 20µm). Probe holder is available in two versions:
  - heated (with a slit for a filter for soot measurement test),
  - unheated (without a possibility to perform soot test).

- Heated hose

  SUITABLE ONLY FOR THE B VERSION OF GA-60 (WITH BUILT-IN NAFION DRYER). REPLACES THE PROBE HOLDER.

  Heated hose with heated gas filter supplies gas sample to the analyser's conditioning module.
  Hose has M30x1 threaded connection to fix gas probe pipe. The other end has magnetic quick coupler and electric connector to connect it to the analyser.
  Standard length of hose is 3m, it is possible to order other lengths of hoses.
  Hose is provided with a carrying bag.

- Gas probe pipe

  Gas probe is immersed in the gas duct and is supposed to extract the gas sample and to measure its temperature.
  Exchangeable probes are easily connected to probe holders (with M30x1 fastening). They have thermocouple type K (in some configurations type S) for measurement of gas temperature and a threaded fixing cone.
  There are many probe pipes available. They differ in length and working temperature.
  For work efficiency it is advised to own different probe pipes to be able to adjust to the measurement place.

## OPTIONAL EQUIPMENT & SPARE PARTS

### Ambient temperature sensor

- This ambient temperature sensor on a 3m cable is used for measurement of the boiler's inlet air. In basic configuration the ambient temperature is measured by sensor installed in the connector of the gas probe handle.

ordering code:
Z40P-SENS-TEMP

- Pitot tube

Pitot tube is an accessory that allows to perform measurement of the flow velocity of the gas stream. The measurement is performed indirectly – Pitot tube is connected to analyser's differential pressure sensor. Analyser recalculates the differential pressure on the Pitot tube's outlets to velocity.
A few lengths of tubes are available. Pitot tube has 2m gas tubings to connect it with the analyser.

ordering codes:
pitot tube 800mm - Z00-PITOT-8002
pitot tube 500mm - Z00-PITOT-5002

- RS232C to USB converter

2.5m cable that allows to connect the analyser (its RS232C port) with USB port in PC computer (especially valuable when PC is not equipped with COM port).

ordering code:
Z40P-USB-ADAP

- Bluetooth communication module

Module connected to the analyser's RS232C port, allows to communicate with PC computer over Bluetooth protocol.

ordering code:
Z40P-BLUE-TOOTH

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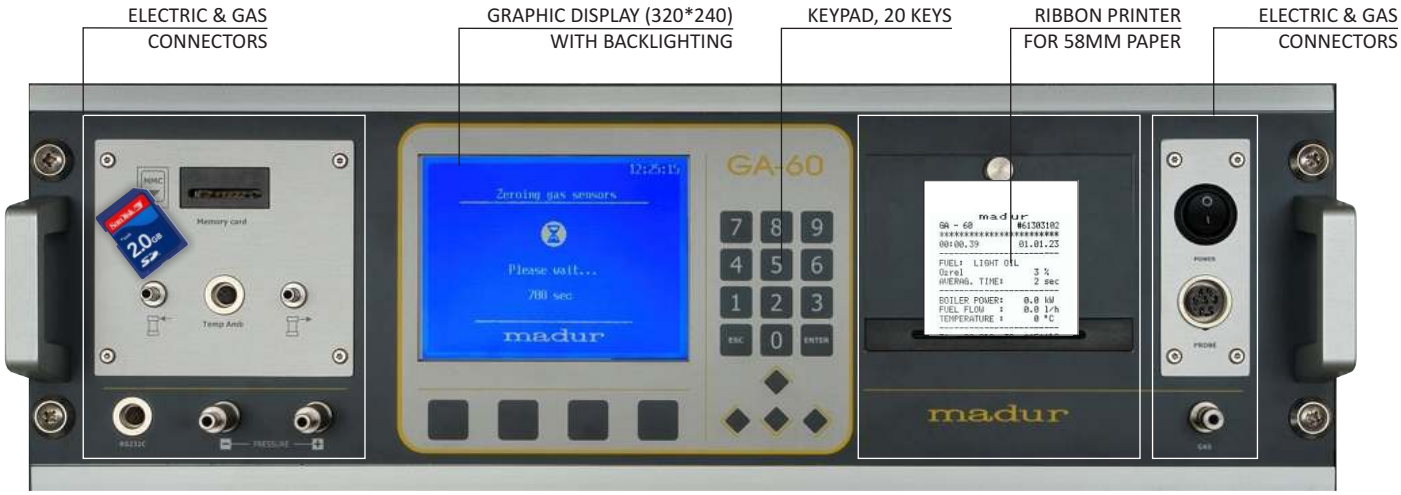
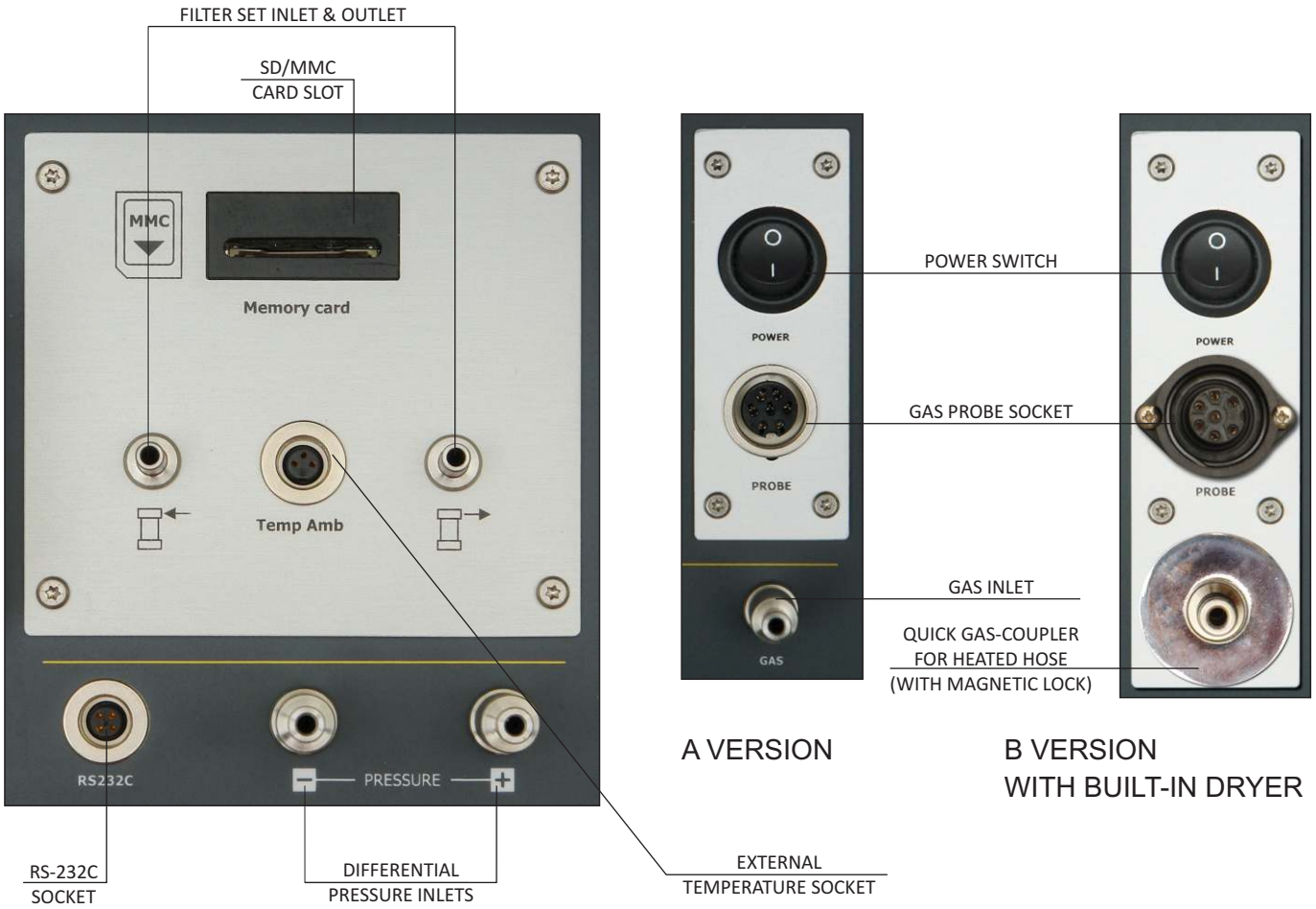
## FRONT PANEL




## GAS AND ELECTRIC CONNECTORS



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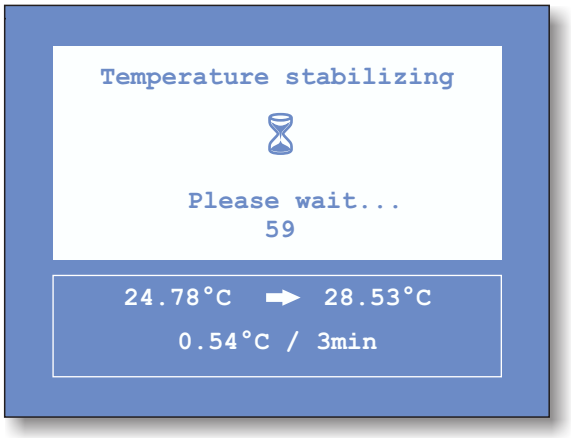
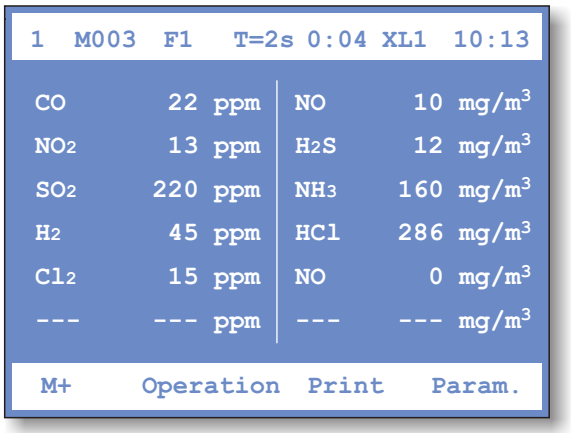
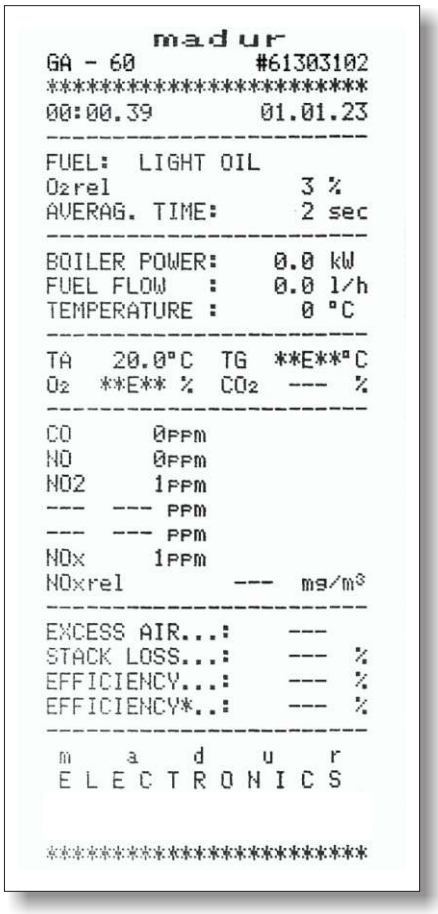
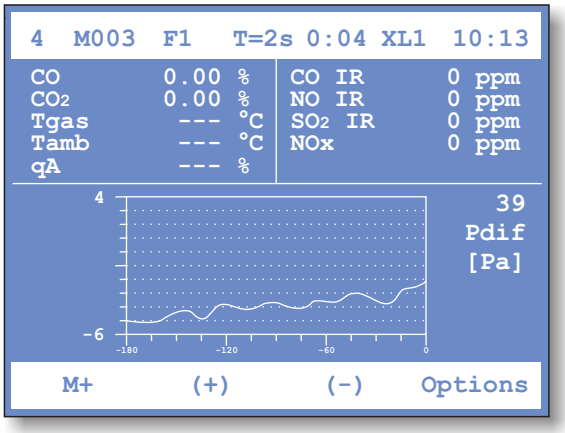
## EXAMPLE PRINTSCREEN






## EXAMPLE PRINTOUT