GA-60

madur portable gas analyser

CHARACTERISTICS | FEATURES | TECHNICAL DATA | SENSORS | EQUIPMENT | APPEARANCE

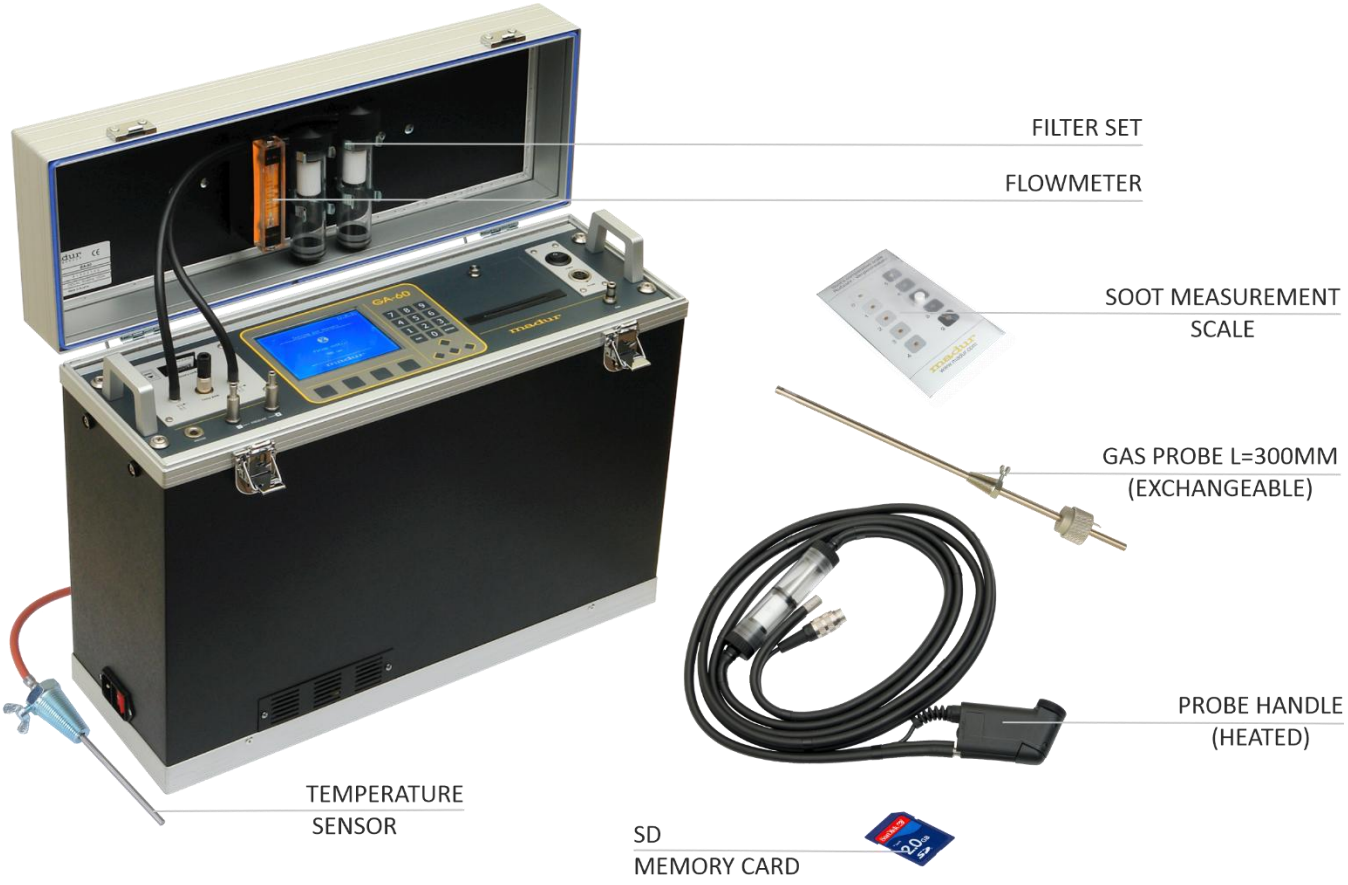
The largest of madur's analysers equipped with electrochemical cells. It can be equipped with up to 7 EC cells and up to 4 NDIR sensors, complemented by TCD and PID sensors. The GA-60 has a large (320*240) backlit graphic LCD. Data logger with SD card for storing results and built-in ribbon printer for standard (non-thermal) paper.

The GA-60 analyser is available in three versions:

- In the basic configuration the analyser is NOT equipped with the gas dryer and works with the probe holder + gas probe tube. It can be combined with the **PGD-100** gas dryer with heated hose.
- Version with an optional integrated Peltier gas dryer (installed in the bottom part of the analyser's case). This configuration can work with or without the heated line.
- The last option is the analyser equipped with the built-in NAFION® type gas dryer and the heated line – a configuration particularly recommended for the measurement of gases that are highly reactive with water or disturbed by its presence (e.g. SO_2, HCl, NO_2, Cl_2).

GA-60

- Can be fitted with up to 7 electrochemical cells
- Can be fitted with up to 4 NDIR sensors
- Can be equipped with one thermal conductivity detector (TCD) to measure H_2 or He
- Can be equipped with one photo-ionic detector (PID) to measure VOC (volatile organic compounds)
- Built-in 58mm ribbon graphic printer
- Built-in Li-ion battery – the standard 8 cells (12800mAh)
- Probe holder with a standard M30x1 fitting, fits all madur gas probes with the K-type thermocouples
  Or a heated line with M30x1 fitting for all madur gas probes (for versions equipped with NAFION® or Peltier gas dryer)
- 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 program
- Analogue outputs (8x 0/4-20mA + 8x 0-10V) – optional module installed in the lid
- SD datalogger – results stored to csv file on microSD >4GB card
- Calculations of many additional parameters
- Firmware for gas calibrations



GA-60

GA-60 GAS ANALYSER

Dimensions (W * H * D)	500mm x 395mm x 173mm
Weight (without accessories)	12,2 kg ÷ 13,2 kg – version without the gas dryer
Casing material	plywood & aluminium
Operating conditions	T: 10°C ÷ 50°C, RH: 5% ÷ 90% (non-condensing)
Storing temperature	-20°C ÷ +55°C (version without the gas dryer) 0°C ÷ +55°C (version with the gas dryer)
Power supply	90 ÷ 240 VAC
Maximal power consumption	90 W (without the heated hose)
Standard battery: type | work time | charging time	8-cells Li-Ion 7,2V / 12,8 Ah | 4,5h /11 h* | 6 h *(without the dryer and the heated line)
Datalogger	≥4GB micro-SD card, records stored to CSV with 2 sec. interval
Display	320 * 240 graphical LCD with variable contrast and backlighting
Printer	High-speed dot matrix, graphic printer for 58 mm normal paper
Analogue outputs (optional)	16: (8x 0/4÷20 mA and 8x 0÷10V)
Gas pump	Diaphragm, max 2 l/min (with automatic flow control)
gas flow	90l/h (1,5l/min)
Purging pump for CO sensor (optional)	Diaphragm, max 1,5 l/min
Wired communication interface	USB with PC Windows
Coarse gas filter grade | inside diameter | length	PE inline filter installed on a probe holder with condensate trap 20µm | 12mm | 32mm or glass microfibre filter installed in the heated head of the heated line 70µm | 16mm | 32
Fine gas filter grade | inside diameter | length	PE inline filter installed on the analyser's lid 5µm | 15mm | 32mm

OPTIONAL BUILT-IN GAS DRYER, HEATED LINE

Dryer type	Based on the NAFIONR exchanger	Peltier chiller
Drying method	Water transfer through Nafion membrane driven by partial vapour pressure differential - first order kinetic reaction	Forced condensation due to rapid cooling of the gas flowing through
Maximum gas flow for efficient drying	100 l/h	
Heated line temperature	120°C electronically stabilised	
Heated line temperature hysteresis	~5°C	
Heated line length	3m (other optional lengths: 5m, 10m)	
Heated line power consumption	max 100W/m	
Heated line thermocouple wires	K-type	

GA-60

MEASUREMENTS: ENVIRONMENT SENSORS AND CALCULATIONS

Variable	Method	Range | Resolution		Accuracy	T_{90} time
T_{gas} – gas temperature	K-type thermocouple	-10°C ÷ 1150°C	0,1°C	±2°C	10 sec
T_{amb} – boiler intake air temperature	PT500 resistive sensor	-10°C ÷ 100°C	0,1°C	±2°C	10 sec
Differential pressure (draft)	Silicon piezoresistive pressure sensor	-25 hPa ÷ +25 hPa	10 Pa	±2Pa abs. or 5% rel.	10 sec
Gas flow velocity	Indirect: with L-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	0 ÷ 100%	0,1%	± 5% rel.	10 sec
Eta η - combustion efficiency	Calculated	0 ÷ 100%	0,1%	± 5% rel.	10 sec
$U_1 \div U_2$ - external analogue input (voltage)	Delta - sigma ADC	-20V ÷ +20V	0,01V	± 2% rel.	10 sec
$I_1 \div I_2$ - external analogue input (current)	Delta - sigma ADC	-20mA ÷ +20mA	0,01mA	± 2% rel.	10 sec

METHOD	RANGE | RESOLUTION		ACCURACY	T_{90} TIME	CONFORMITY
O_2 - OXYGEN					
Electrochemical	20,95%	0,01%	± 0,2% abs. or 5% rel.	45 sec	ISO 12039; CTM-030
Electrochemical, partial pressure	20,95%	0,01%	± 0,2% abs. or 5% rel.	45 sec	ISO 12039; CTM-030
Electrochemical, partial pressure	25%	0,01%	± 0,2% abs. or 5% rel.	45 sec	ISO 12039; CTM-030
Electrochemical, partial pressure	100%	0,1%	± 0,2% abs. or 5% rel.	45 sec	ISO 12039; CTM-030
Paramagnetic	25%	0,01%	± 0,2% abs. or 5% rel.	45 sec	ISO 12039; CTM-030
Paramagnetic	100%	0,1%	± 0,2% 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 with H_2 compensation	10 000 ppm	1 ppm	± 0,005% abs. or 5% rel.	45 sec	ISO 12039; CTM-030
NDIR	20 000 ppm	10 ppm	± 50 ppm abs. or 5% rel.	45 sec	ISO 12039; CTM-030
NDIR	10%	0,01%	± 0,05% abs. or 5% rel.	45 sec	ISO 12039; CTM-030
NDIR	100%	0,1%	± 0,5% abs. or 5% rel.	45 sec	ISO 12039; CTM-030
CO_2 – CARBON DIOXIDE					
NDIR	25%	0,01%	± 0,05% abs. or 5% rel.	45 sec	ISO 12039
NDIR	50%	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
C_XH_Y – HYDROCARBONS (CALIBRATED WITH METHANE)					
NDIR	25%	0,01%	± 0,05% abs. or 5% rel.	45 sec	
NDIR	50%	0,01%	± 0,05% abs. or 5% rel.	45 sec	
NDIR	100%	0,1%	± 0,5% abs. or 5% rel.	45 sec	

GA-60

METHOD	RANGE | RESOLUTION		ACCURACY	T_{90} TIME	CONFORMITY
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.	60 sec	EN 50379; CTM-022
Electrochemical	5 000 ppm	5 ppm	± 25 ppm abs. or 5% rel.	60 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
NDIR	20 000 ppm	10 ppm	± 50 ppm abs. or 5% rel.	45 sec	EN 50379;Method 6C
H_2S – HYDROGEN SULPHIDE					
Electrochemical	1 000 ppm	1 ppm	± 5 ppm abs. or 5% rel.	70 sec	
Electrochemical	5 000 ppm	1 ppm	± 5 ppm abs. or 5% rel.	70 sec	
H_2 – HYDROGEN					
Electrochemical	1 000 ppm	1 ppm	± 5 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	
N_2O – NITROUS OXIDE					
NDIR	2 000 ppm	1 ppm	± 10 ppm abs. or 5% rel.	45 sec	ISO 21258
NH_3 – ANHYDROUS AMMONIA (MEASUREMENT OF DRY OR NON-CONDENSING GAS ONLY)					
Electrochemical	100 ppm	1 ppm	± 5 ppm abs. or 5% rel.	45 sec	
Electrochemical	1 000 ppm	1 ppm	± 5 ppm abs. or 5% rel.	45 sec	
HCL – HYDROGEN CHLORIDE (REQUIRES VERSION WITH THE NAFION DRYER AND THE HEATED LINE)					
Electrochemical	100 ppm	1 ppm	± 5 ppm abs. or 5% rel.	45 sec	
Electrochemical	1 000 ppm	1 ppm	± 5 ppm abs. or 5% rel.	45 sec	
CL_2 – CHLORINE (REQUIRES VERSION WITH THE NAFION DRYER AND THE HEATED LINE)					
Electrochemical	250 ppm	1 ppm	± 5 ppm abs. or 5% rel.	45 sec	
VOC – VOLATILE ORGANIC COMPOUNDS					
PID - Photoionization Detector	100 ppm	1 ppm	± 5 ppm abs. or 5% rel.	120 sec	METHOD 21
PID - Photoionization Detector	1 000 ppm	1 ppm	± 5 ppm abs. or 5% rel.	120 sec	METHOD 21

STANDARD EQUIPMENT

SUPPLIED WITH THE DEVICE

- 3m mains cable with selected plug type (EU, US, UK, AU, BR)
- Gas filter mounted on the analyser lid with condensate trap and replaceable filter element (pore size 5µm)
- Flow indicator
- Data logger with ≥4GB SD card
- 3m USB A-B cable
- Quick coupler for the pressure sensor (2 pcs)
- Quick coupler for the probe holder (1 pc)
- External ambient temperature sensor (1 pc)

ADDITIONAL EQUIPMENT

NECESSARY FOR THE ANALYSER TO WORK

- Probe holder

  SUITABLE FOR USE WITH ANALYSER WITHOUT THE GAS 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 is 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:
  - unheated (standard probe holder without a possibility to perform soot test),
  - heated (with a slit for a filter for soot measurement test).

- Heated line

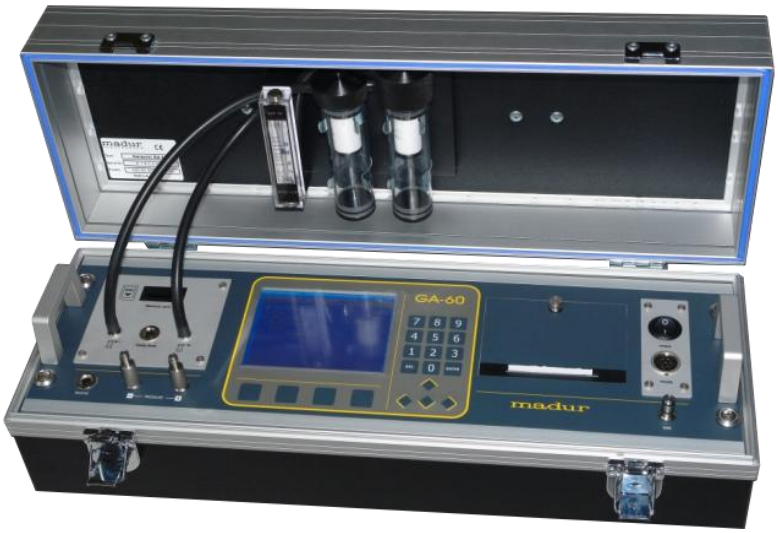
  SUITABLE FOR USE WITH ANALYSER WITH GAS DRYER (NAFION® OR PELTIER)

  Heated line with an integrated heated gas filter delivers the gas to the analyser without the risk of unwanted condensation. This is particularly important when measuring water soluble gases (e.g. SO_2, NO_2, HCl, Cl_2).
  The heated line has an M30x1 threaded connection for attaching madur gas probes. The other end of the heated line has a magnetic quick coupling and an electrical connector to connect the line to the analyser.
  The standard length of the heated line is 3m. Other lengths can be supplied request. The hose is supplied 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. With the probe holder is a complete gas probe.
  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.

GA-60



OTHER OPTIONAL EQUIPMENT

- Boiler's inlet air temperature sensor

  The ambient air temperature (or rather the temperature of the air entering the boiler) is a parameter used to calculate many combustion parameters.
  This PT500 temperature sensor on a 3m cable is used to measure this temperature and must be connected to the Temp. Amb. socket.
  If the sensor is not connected, the analyser will assume that the boiler air inlet temperature is equal to the temperature measured by the NTC2k7 sensor (installed in the connector of the gas probe holder).

- Pitot tube

  A pitot tube is an accessory used to measure the flow velocity of a gas stream. The measurement is indirect – the pitot tube is connected to the analyser's differential pressure sensor. The analyser then recalculates the differential pressure at the pitot tube's outlets to determine the velocity of the gas stream.
  A variety of lengths of tubes are available for purchase. The pitot tube is supplied with 2m of gas tubing to connect to the analyser.

- GF4 scrubber

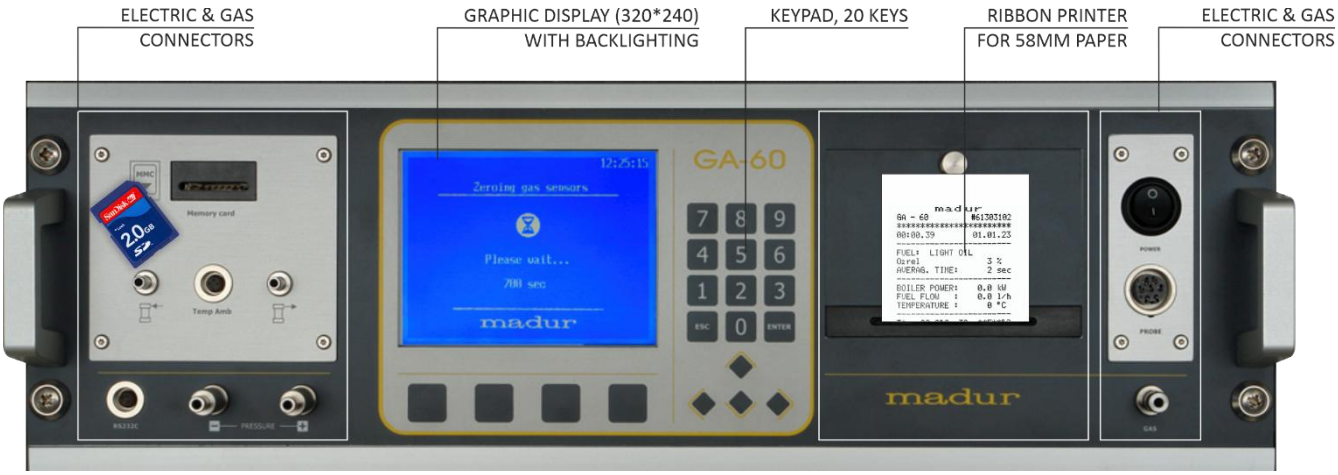
  2x water bubblers, 1x coalescing filter, 1x container with the activated carbon.
  This filter has been designed for harsh measurement conditions such as syngas, where tar, oily mists and high levels of dust need to be removed before the sample can be further conditioned.

- Analogue outputs

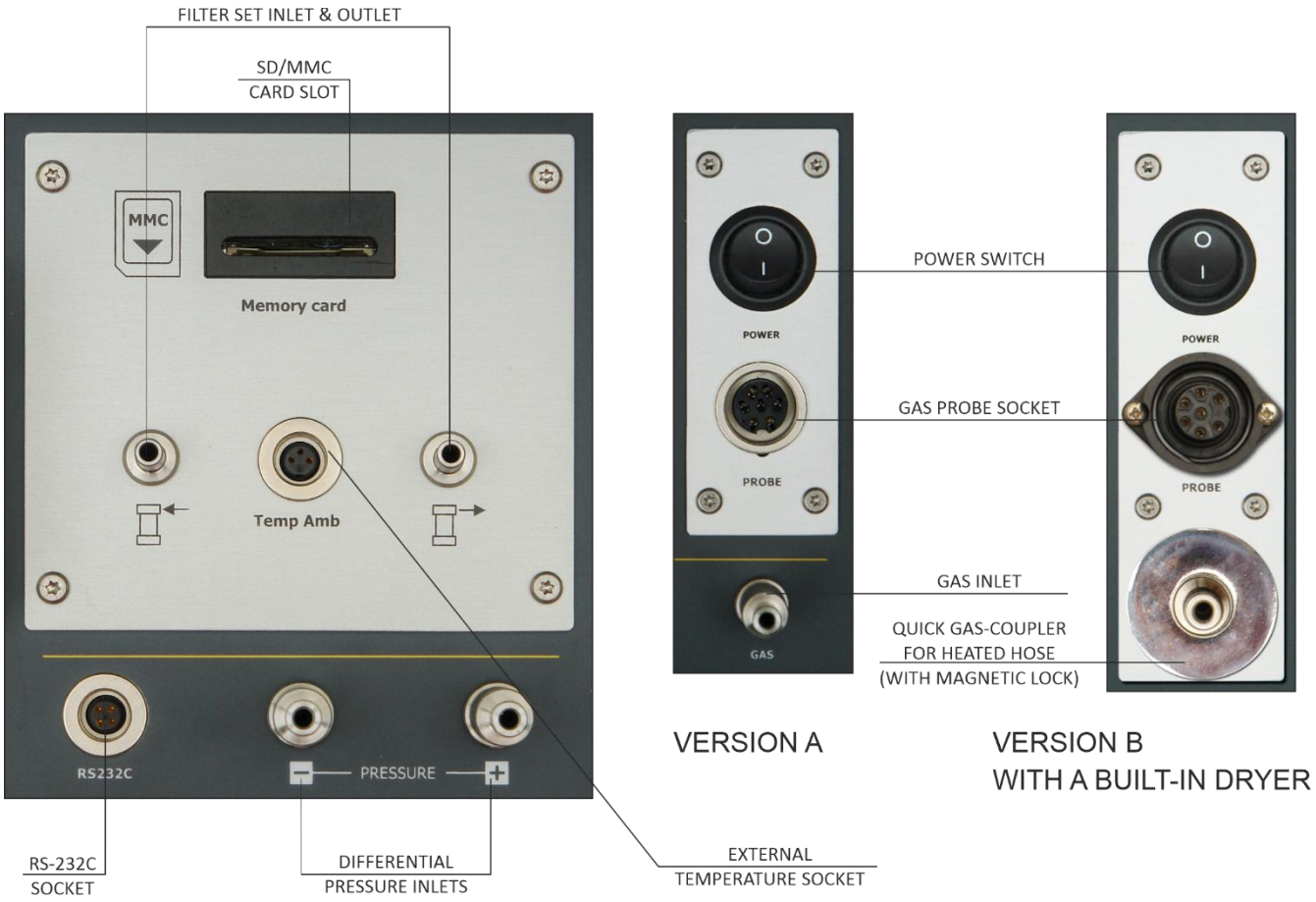
  A separate module (installed in the analsyer's lid) allows selected measured or calculated values to be assigned to one of the 16 analogue outputs.
  The user has at his disposal 8x 4-20mA outputs and 8x 0-10V outputs.

FRONT PANEL

WITH LCD AND SOCKET BOARD

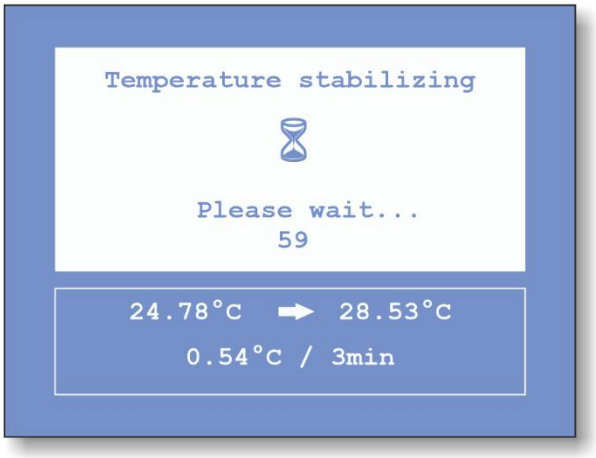


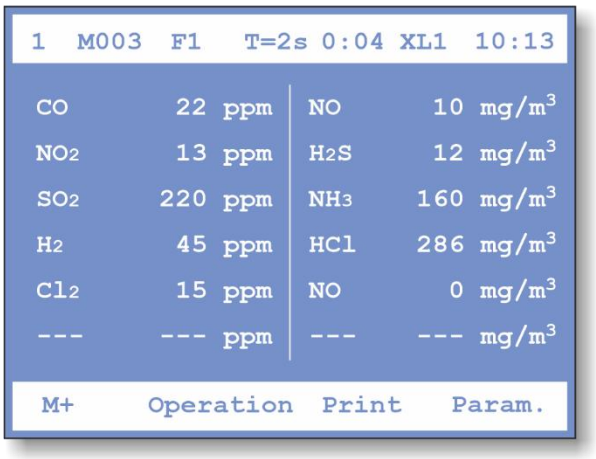
GAS AND ELECTRICAL CONNECTIONS



EXAMPLE PRINTSCREENS

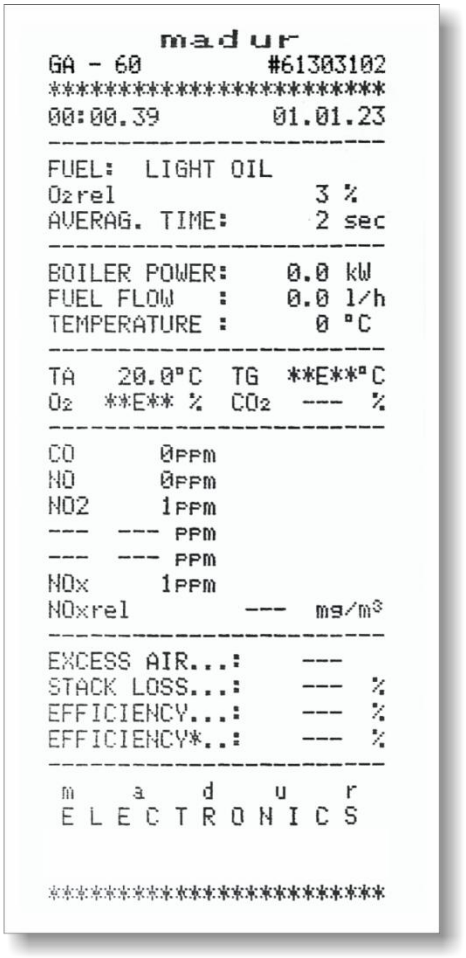
CURRENT RESULTS

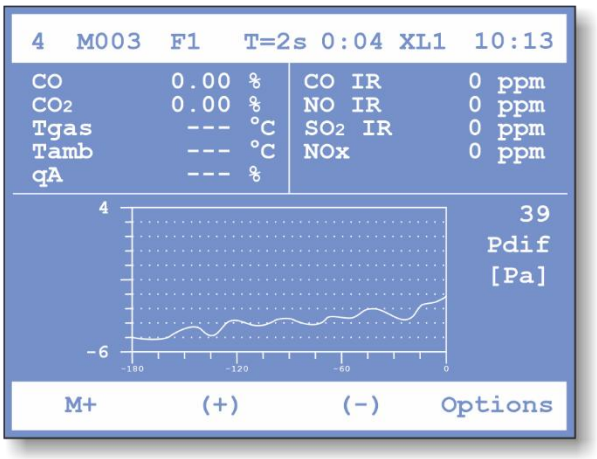




EXAMPLE PRINTOUTS

CURRENT RESULTS





NOTES