

# Photon S

madur gas monitoring system

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

Photon S is madur's most recent and most sophisticated apparatus. It was created based on portable gas analyser - Photon. As its sucessor it also uses NDIR gas sensors as the main measurement method - it can have 9 of them supplemented with 4 EC cells. Along with power supply with control center and the most efficient gas dryer this modular CEMS system is available to mount in 19'' open frame rack. It is tailored to a very specific demands of customer, what is possible thanks to lot of available extensions and add-ons. Manufactured according to the principle of ISO 10396.

### CONTROL MODULE WITH POWER SUPPLY

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- Contains PC 104 computer with Windows CE operating system, that supervises the work of entire CEMS
- 6,4" large, VGA (640 \* 480) colorful display with touch-pad for results presentation and data input
- RS232C and Ethernet ports for communication with PC computer
- 3 bays for optional modules (available in the front or back of the analyser):
  - Analogue outputs / inputs
  - Digital outputs / inputs
  - Relays output
  - Wi-Fi communication adapter
- 2x USB port for peripherals (mice, keyboards)
- Calculation of combustion and related parameters
- Large SSD (Solid State Drive) for storage of measurement data

### GAS CONDITIONER MODULE

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- Equipped with heated hose with heated gas filter
- Large surface, fibre glass filters for removing dust, salt particles and soot
- Several versions of driers available - combination of NAFION® and Peltier exchangers
- For NO-NDIR measurement - water reservoir and peristaltic pump for automatic control of NO channel's damp
- Room for O<sub>2</sub> paramagnetic sensor

### MEASUREMENT MODULE

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- Thermal insulation and stabilization of the NDIR sensors' compartment
- Room for 9 NDIR sensors and 4 EC cells
- NDIR sensors, each with its own thermal stabilization (to 0,01°C)
- Double gas channel: the first "humid one" for NO-NDIR and the second, dry one for all other sensors
- Measurement of ambient and gas temperatures
- Measurement of atmospheric and differential pressures
- Measurement of chimney draft and flow velocity (with help of Pitot tube)

### ADD-ONS, TAILORED SOLUTIONS (EXAMPLES)

- Possibility to prepare overpressure version
  - With secure, NPT 1/4" gas connectors
  - With option to perform leakage test of the entire device prior measurements
- Possibility to deliver with / without frame rack
- Possibility to exclude the display and PC-104 module from the power supply
- Possibility to adjust / implement special options to the device program

CEMS Photon S is tailored each time according to a specific requirements. Separate implementations may differ considerably in terms of construction. Especially gas connections may be present or not depending on individual configuration. Hereby pictures and drawings present device in an example configuration.

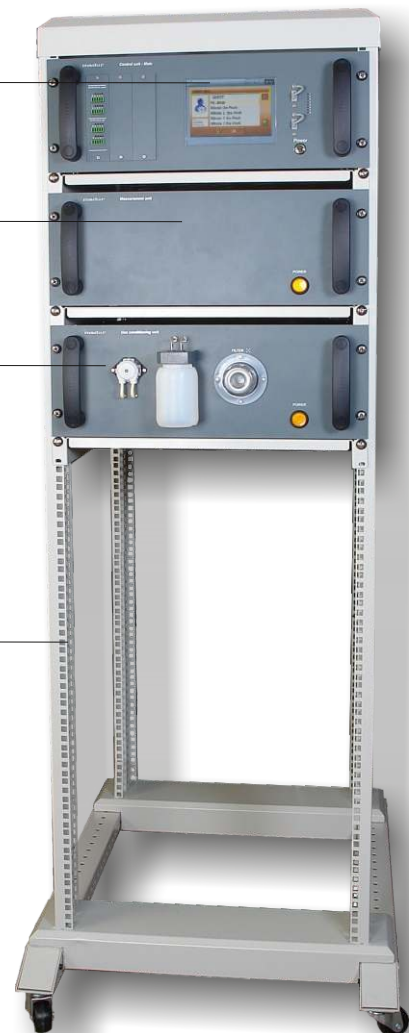
### PHOTON S ANALYSER BUILT INTO 19" OPEN FRAME RACK

CONTROL MODULE WITH 6,4" VGA COLORFUL DISPLAY WITH TOUCHSCREEN

MEASUREMENT MODULE CAN BE FITTED WITH UP TO 9 NDIR SENSORS AND UP TO 4 EC CELLS

DRYER MODULE HOLDS O<sub>2</sub> SENSOR (PARAMAGNETIC OR PARTIAL PRESSURE). PREPARES THE GAS SAMPLE – DEHUMIDIFIES, REMOVES DUST, SALT PARTICLES

19" MODULES CAN BE FITTED IN STANDARD 19" RACKS (OPTIONALLY ANALYSER CAN BE EQUIPPED WITH ONE)



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

## CONTROL UNIT

Dimensions (W * H * D)	486 mm * 176 mm * 287 mm
Weight	4 kg ÷ 5 kg
Casing material	Aluminum, powder coated
Operating conditions	T: 10°C ÷ 50°C, RH: 5% ÷ 90% (non-condensing)
Storing temperature	-20°C ÷ 55°C
Power supply: input   maximal power consumption	90V ÷ 230V AC   150 W
Operating system	Windows CE 5.0
Display	6,4" VGA (640 * 480)
Data storage: type   capacity	Compact Flash card   max 4GB
Interface for external devices (USB disk, mouse, keyboard)	2 * USB
Communication interface with PC computer	RS - 232C, RJ45 (Ethernet)
Analogue outputs: 8x voltage   8x current	0V ÷ 10V DC, max 10mA per output   0/4mA ÷ 20mA
Digital I/O: 8x inputs   8x outputs	0V ÷ 24V; Hi_3,5V   OC; max. 50mA
Relays outputs: quantity   type   limitations	4   SPDT   24V AC; max: 5A 4   SPDT   230V AC; max: 5A

## GAS CONDITIONING UNIT WITH CONDENSATION & NAFION® DRYER

Dimensions (W * H * D)	486 mm * 176 mm * 538 mm
Weight	9 kg ÷ 10 kg
Casing material	Aluminum, powder coated
Operating conditions	T: 10°C ÷ 50°C, RH: 5% ÷ 90% (non-condensing)
Storing temperature	-20°C ÷ 55°C
Power supply: input   maximal power consumption	90V ÷ 230V AC   150 W (without heated hose)
Cooler type	Outlet 1: Based on Nafion® exchanger Outlet 2: Based on Peltier cooling element with fan (12V DC supply)
Drying method	Outlet 1: Water transfer through Nafion® membrane driven by partial vapour pressure differential - first order kinetic reaction Outlet 2: Water condensation by rapid cooling down
Cooling temperature	Outlet 1: n/a Outlet 2: 0°C ÷ 20°C
Ready to operate after	5 minutes

CHARACTERISTIC	FEATURES	TECHNICAL DATA	SENSORS	EQUIPMENT	APPEARANCE
Maximum gas flow for efficient drying (at inlet gas temp. 100°C and RH 100%)					100 l/h
Gas filters: quantity   material					2   PA - body, PC - cover, viton - sealing
Filter insert: length   ID   OD   material   pore size					32mm   12mm or 15mm   18mm or 20mm   PE   5_μm
Condensate removal					With built-in peristaltic pump
Peristaltic pump capacity					38 ml/min
Heated hose temperature					+ 180°C electronically stabilised
Heated hose temperature hysteresis					~ 5°C
Heated hose length					3m (optionally 5m or 10m)
Heated hose power supply: input   maximal power consumption					230V AC   1000W
Heated hose thermocouple wires					K-type (S-type optionally)
<b>GAS CONDITIONING UNIT WITH NAFION® DRYER</b>					
Dimensions (W * H * D)					486mm * 176mm * 538mm
Weight					7kg ÷ 8kg
Casing material					Aluminium, powder coated
Operating conditions					T: 10°C ÷ 50°C, RH: 5% ÷ 90% (non-condensing)
Storing temperature					-20°C ÷ 55°C
Power supply: input   maximal power consumption					90V ÷ 230V AC   150 W (without heated hose)
Cooler type					Based on Nafion® exchanger
Drying method					Water transfer through Nafion® membrane driven by partial vapour pressure differential - first order kinetic reaction
Cooling temperature					n/a
Ready to operate after					1 minute
Maximum gas flow for efficient drying (at inlet gas temp. 100°C and RH 100%)					100l/h
Gas filters: quantity   material					2   PA - body, PC - cover, viton - sealing
Filter insert: length   ID   OD   material   pore size					32mm   12mm or 15mm   18mm or 20mm   PE   5_μm
Condensate removal					n/a
Peristaltic pump capacity					n/a
Heated hose temperature					+ 180 °C electronically stabilised

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

Heated hose temperature hysteresis	~ 5°C
Heated hose length	3m (optionally 5m or 10m)
Heated hose power supply: input   maximal power consumption	230V AC   1000W
Heated hose thermocouple wires	K-type (S-type optionally)
Under pressure in Nafion® collar	~ 500 mbar

### MEASUREMENTS UNIT

Dimensions (W * H * D)	486mm * 176mm * 538mm
Weight (depends on installed sensors)	10 kg ÷ 16 kg
Casing material	Aluminium, powder coated
Operating conditions	T: 10°C ÷ 50°C, RH: 5% ÷ 90% (non-condensing)
Storing temperature	-20°C ÷ 55°C
Power supply: input   maximal power consumption	90V ÷ 230V AC   150 W
Warming up time	max 90 minutes
Warming up temperature	About 18°C above unit's outside air temperature
Maximum outside temperature drift not affecting warming up temperature	±5°C

### MEASUREMENTS

Variable	Method	Range   Resolution	Accuracy	Time (T <sub>90</sub> )
T <sub>gas</sub> - gas temperature	K-type thermocouple	-10 ÷ 1000°C   0,1°C	± 2°C	10 sec
T <sub>gas</sub> - gas temperature	S-type thermocouple	-10 ÷ 1500°C   0,1°C	± 2°C	10 sec
T <sub>amb</sub> - 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	0 ÷ 100%   0,1%	± 5% rel.	10 sec
Eta - η combustion efficiency	Calculated	0 ÷ 120%   0,1%	± 5% rel.	10 sec
IL - incomplete combustion	Calculated	0 ÷ 100%   0,01%	± 5% rel.	10 sec

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

Method	Range   Resolution	Accuracy	Time (T <sub>90</sub> )	Conformity
<b>O<sub>2</sub> - OXYGEN</b>				
Electrochemical	20,95%   0,01%	± 0,1% abs. or 5% rel.	45 sec	ISO 12039; CTM-030
Electrochemical, partial pressure	20,95%   0,01%	± 0,1% abs. or 5% rel.	45 sec	ISO 12039; CTM-030
Electrochemical, partial pressure	25,00%   0,01%	± 0,1% 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
Paramagnetic	25,00%   0,01%	± 0,1% abs. or 5% rel.	45 sec	EN 14789; OTM-13
Paramagnetic	100,00%   0,1%	± 0,1% abs. or 5% rel.	45 sec	EN 14789; OTM-13
<b>CO - CARBON MONOXIDE</b>				
NDIR	20 000 ppm   1 ppm	± 3 ppm abs. or 3% rel.	45 sec	EN 15058; METHOD 10
NDIR	10%   0,01%	± 0,3% abs. or 3% rel.	45 sec	EN 15058; METHOD 10
NDIR	100%   0,1%	± 0,3% abs. or 3% rel.	45 sec	EN 15058; METHOD 10
<b>CO<sub>2</sub> - CARBON DIOXIDE</b>				
NDIR	5%   0,01%	± 0,3% abs. or 3% rel.	45 sec	ISO 12039; OTM-13
NDIR	25%   0,01%	± 0,3% abs. or 3% rel.	45 sec	ISO 12039; OTM-13
NDIR	100%   0,1%	± 0,3% abs. or 3% rel.	45 sec	ISO 12039; OTM-13
<b>CH<sub>4</sub> – METHANE</b>				
NDIR	5%   0,01%	± 0,3% abs. or 3% rel.	45 sec	
NDIR	25%   0,01%	± 0,3% abs. or 3% rel.	45 sec	
NDIR	100%   0,1%	± 0,3% abs. or 3% rel.	45 sec	
<b>NO - NITRIC OXIDE</b>				
NDIR	1 000 ppm   1 ppm	± 3 ppm abs. or 3% rel.	45 sec	ISO 10849; METHOD 7E
NDIR	5 000 ppm   1 ppm	± 3 ppm abs. or 3% rel.	45 sec	ISO 10849; METHOD 7E
<b>NO<sub>2</sub> - NITROGEN DIOXIDE</b>				
NDIR	1 000 ppm   1 ppm	± 3 ppm abs. or 3% rel.	45 sec	ISO 10849; METHOD 7E
Electrochemical	1 000 ppm   1 ppm	± 5ppm abs. or 5% rel.	60 sec	CTM-022

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

Method	Range   Resolution	Accuracy	Time (T <sub>90</sub> )	Conformity
<b>SO<sub>2</sub> - SULPHUR DIOXIDE</b>				
NDIR	1 000 ppm   1 ppm	± 3 ppm abs. or 3% rel.	45 sec	ISO 7935; METHOD 6C
NDIR	5 000 ppm   1 ppm	± 3 ppm abs. or 3% rel.	45 sec	ISO 7935; METHOD 6C
<b>H<sub>2</sub>S- HYDROGEN SULPHIDE</b>				
Electrochemical	1 000 ppm   1 ppm	± 5 ppm abs. or 5% rel.	70 sec	
<b>H<sub>2</sub>- HYDROGEN</b>				
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	
<b>N<sub>2</sub>O - NITROUS OXIDE</b>				
NDIR	2 000 ppm   1 ppm	± 3 ppm abs. or 3% rel.	45 sec	ISO 21258
<b>CHF<sub>3</sub> - FLUOROFORM (REFRIGERANT R23)</b>				
NDIR	2,5%   0,01%	± 0,3% abs. or 3% rel.	45 sec	
<b>VOC - VOLATILE ORGANIC COMPOUNDS</b>				
PIT - Photoionization Detector	100 ppm   1 ppm	± 5ppm abs. or 5% rel.	120 sec	METHOD 21
PIT - Photoionization Detector	1 000 ppm   1 ppm	± 5ppm abs. or 5% rel.	120 sec	METHOD 21

CHARACTERISTIC | FEATURES | TECHNICAL DATA | **EQUIPMENT** | APPEARANCE

## STANDARD EQUIPMENT

### SUPPLIED ALONG WITH THE DEVICE

- Each installation of the Photon S analyser is unique and requires individual approach to customer's requirements
- Generally, the installation consists of three main modules each in 19" rack:
  - Control module with colorful display and touch panel
  - Gas conditioning module
  - Measurement module
- Besides, the necessary part of the CEMS system are:
  - 19" frame or cabinet for installation of aforesaid modules
  - Gas probe pipe
  - Heated hose



## ADDITIONAL EQUIPMENT

### NECESSARY FOR THE ANALYSER TO WORK

- Heated hose

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 with the analyser. Standard length of hose is 3m, it is possible to order other lengths of hoses. It is especially advised when dealing with high humidity and SO<sub>2</sub>, NO<sub>2</sub>, and other gases highly reactive with water.



- 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. The pipe with the heated hose is a complete gas probe.



- Stationary gas probe

Gas probe designed specially for stationary purposes. Probe is available in different lengths and is equipped with suitable holder (different types are available).

Optionally it may also be equipped with:

- Thermocouple for measurements of gas temperature
- Sintered stainless-steel filter (cleanable) - especially recommended when dealing with high concentration of dust and soot
- "Blow-back" cleaning option - valve that allows to switch between measured gas and the compressed air inlet that is used for cleaning the sintered filter

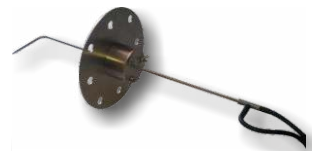


## OPTIONAL EQUIPMENT & SPARE PARTS

- 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. It may be provided with a suitable holder for stationary purposes.



ordering codes:

pitot tube 800mm - Z00-PITOT-8002

pitot tube 500mm - Z00-PITOT-5002

Holder - Z00-PITOT-HA4

- Heated filter

Heated filter is installed right after the gas probe. It is best when it is paired with heated hose to prevent vapour from condensing.



- WIFI communication interfaces

Optional interface allows to communicate wirelessly with Photon S analyser

ordering code:

ZMA3-ADAP-WIFI



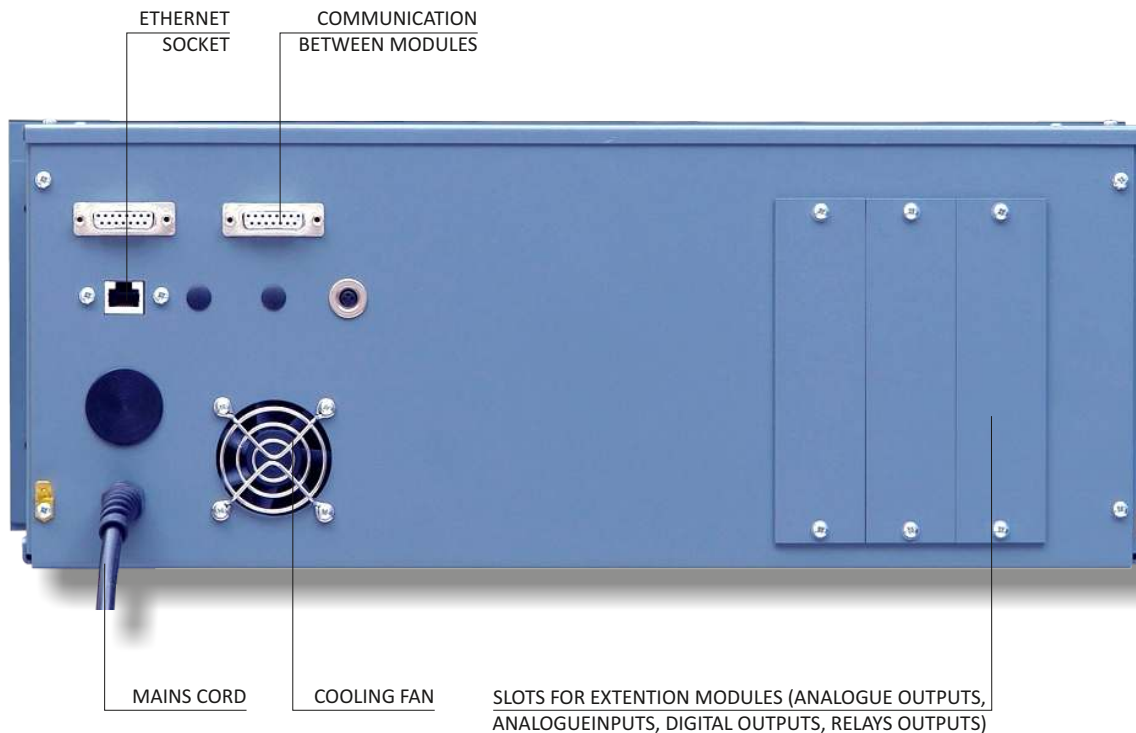
## CONTROL UNIT

FRONT VIEW



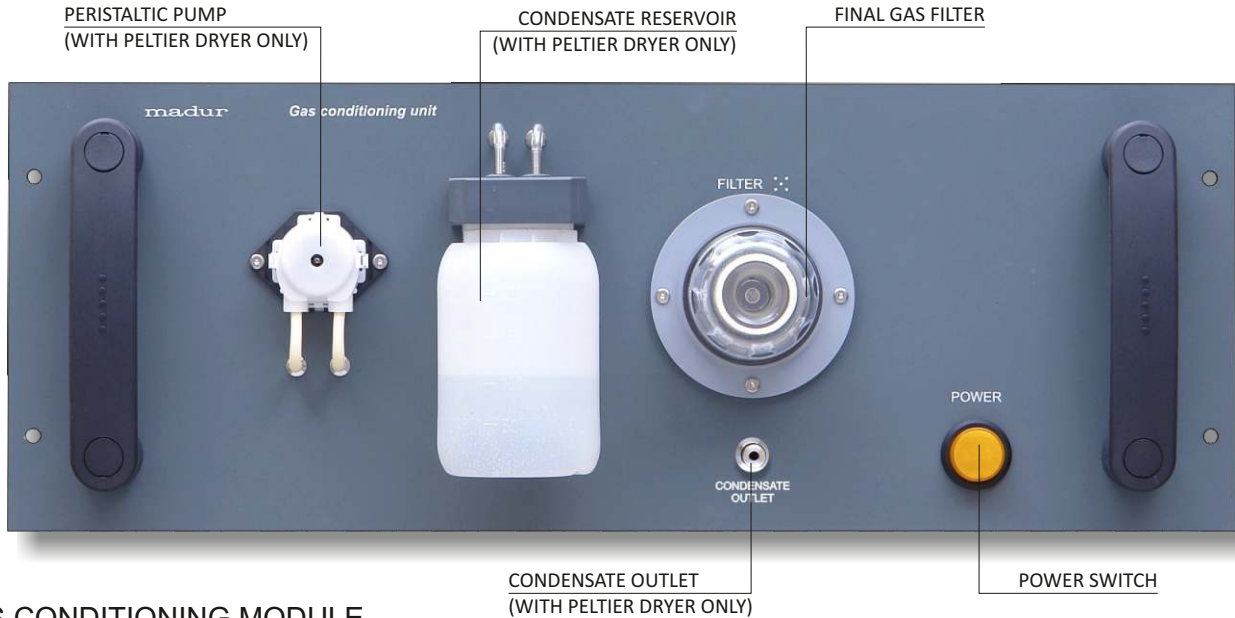
## CONTROL UNIT

REAR VIEW



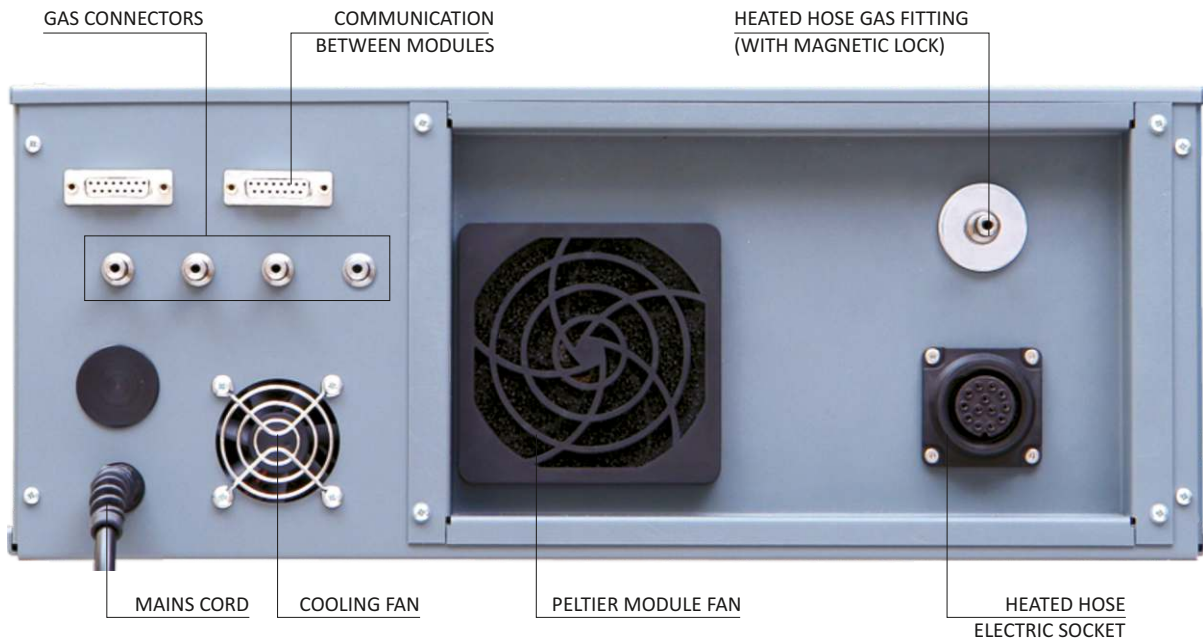
## GAS CONDITIONING MODULE

FRONT VIEW



## GAS CONDITIONING MODULE

REAR VIEW



## GAS CONNECTORS



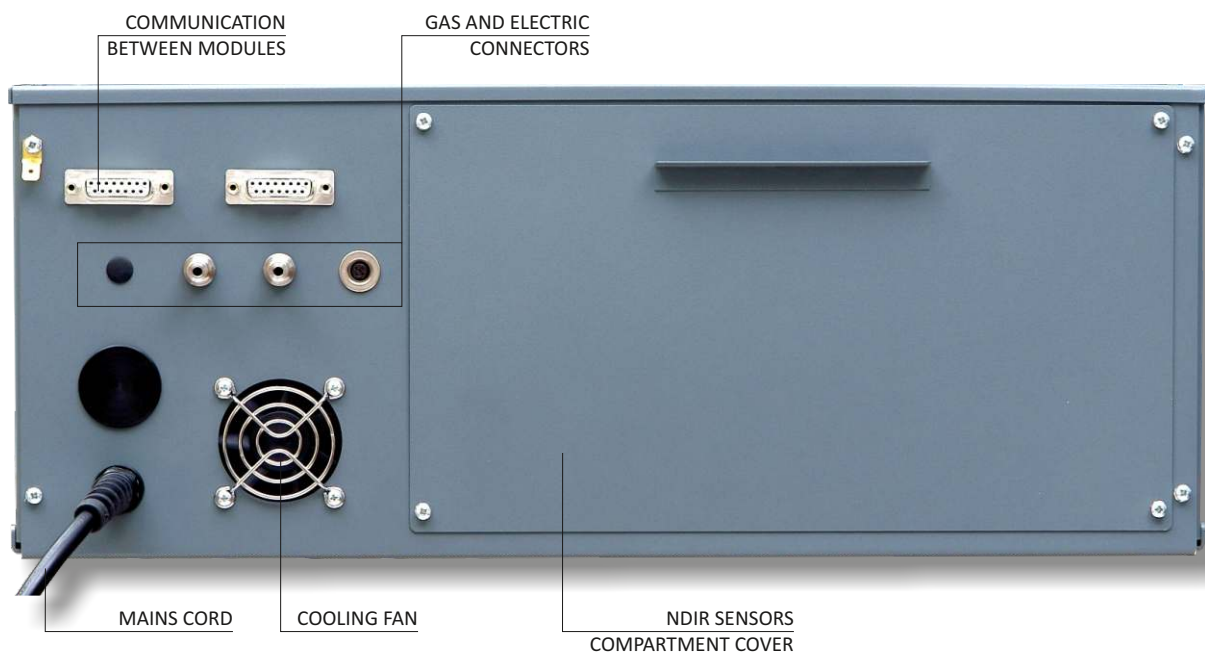
## MEASUREMENT UNIT

FRONT VIEW



## MEASUREMENT UNIT

REAR VIEW



## GAS AND ELECTRIC CONNECTORS

