

# MM-100 Metabolic Monitor System

Accurate oxygen consumption measurement for small animals



The MM-100 Metabolic Monitor System measures oxygen consumption ( $\text{VO}_2$ ) and  $\text{CO}_2$  production ( $\text{VCO}_2$ ) of small animals using the open circuit technique. The animal is placed in a closed chamber with a known flow of fresh air passing through it. Oxygen and carbon dioxide concentrations are measured at the inlet and outlet of the chamber. The three measurements (flow,  $\text{O}_2$ , and  $\text{CO}_2$ ) enable the computation of oxygen consumption,  $\text{CO}_2$  production, and Respiratory Exchange Ratio (RER), or  $\text{VCO}_2/\text{VO}_2$ .

The keys to accurate  $\text{O}_2$  consumption measurement are the sensors. The MM-100 uses the latest generation of highly accurate and stable gas and flow sensors. Flow is monitored by a linear thermal mass flowmeter. Oxygen is measured by a high-resolution paramagnetic  $\text{O}_2$  sensor.  $\text{CO}_2$  measurement uses a special low-range infrared analyzer cell. The system automatically calibrates itself against ambient room air, so the key differential gas measurements are always accurate.

The system can monitor one or many animals. In its basic configuration, the MM-100 will make measurements on a single animal without requiring any additional components. Multiple cages can be added using economical expansion modules. The expansion modules are available in two, eight, or sixteen-cage units.

## Measures:

- $\text{O}_2$  consumption ( $\text{VO}_2$ )
- $\text{CO}_2$  production ( $\text{VCO}_2$ )
- Optional food and drink measurement

## Standard Features:

- Paramagnetic  $\text{O}_2$  analyzer
- Infrared  $\text{CO}_2$  analyzer
- Solid-state mass flow meter
- Monitoring software included
- No additional equipment required for one animal

The MM-100 communicates with and controls the expansion modules; cage flow measurements and gas samples are routed automatically as required.

## External control and measurement

Gas and flow measurements are reported directly on the front-panel LCD display. These variables are output as analog voltages for external monitoring with standard PC-based data acquisition. Windows-based MM-Comm software is provided for computing, graphically monitoring, and logging the metabolic measurements. Communication to the PC is via a standard serial port using the supplied cable. The logged data is recorded in an ASCII format that can be easily imported into a spreadsheet for further analysis.

When using a multi-cage system, the MM-100 main unit detects and communicates automatically with any connected expansion units. A built-in remote-control interface can also be used for custom applications using the digital I/O capabilities of most data acquisition boards.

## Operation and enhancements

Operation of the system is fully automatic. The animal is placed in the chamber and allowed to become accustomed to the environment. Once the gasses are equilibrated, continuous readings of  $\text{O}_2$  consumption and  $\text{CO}_2$  production are calculated and displayed on the computer. When any of the multi-cage expansion units are attached, the gas sampling is automatically sequenced through the cages, and the results are displayed. The only consumable material is the drying agent used to condition the gas samples.

Complete systems with food and drink monitoring are also available. These special metabolic chambers, made by Ugo Basile, provide measurements that are merged with the gas metabolism measurements made by the MM-100 for a complete metabolic profile of the animal under test.

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## Specifications:

Oxygen analyzer type	paramagnetic
Linearity (0 - 100%)	$\pm 0.1\%$ O <sub>2</sub>
Repeatability	< 0.01% O <sub>2</sub> /hour
Zero stability	$\pm 0.002\%$ O <sub>2</sub> /hour
Response time	2.0 seconds
Operating temperature	0 - 65°C
Maximum pressure	15 psi
Maximum sample flow	250 ml/min
Instrument measurement range	0 - 24.5%O <sub>2</sub>
Carbon Dioxide analyzer type	single-beam infrared
Operating range	0 - 5000ppm (0.5%) CO <sub>2</sub>
Linearity (full scale)	1% FS
Zero drift	2% FS/week
Sensor cell temperature	controlled at 60°C
Warm-up time	<15 min
Maximum sample flow	200 ml/min
Instrument measurement range	0 - 0.41%CO <sub>2</sub>
Flow transducer	thermal mass flowmeter
Flow range	0 - 10,000 ml/min
Linear flow range	50 - 10,000 ml/min
Response time	< 2S
Operating temperature	-20 - 70°C
Main unit analog outputs	flow, O <sub>2</sub> , CO <sub>2</sub>
Analog signal outputs (rear panel)	.BNC jacks
Flow output	1mV/ml/min
Flow output zero offset	1.250V
O <sub>2</sub> output	0.1667V/%O <sub>2</sub>
CO <sub>2</sub> output	.10V/%CO <sub>2</sub>
Serial data output format	9600 baud, 8 data bits, no parity, 1 stop bit
Serial data interval	complete set of readings sent 1 per minute
Serial output connector (rear panel)	DB9 female
Dimensions, main unit	19W x 5.25H x 15D in.
Power requirements	.120/240V (switchable), 200VA

## Ordering Information:

<b>Part No.</b>	<b>Model</b>	<b>Description</b>	<b>Applications</b>
11-20000	MM-100	Metabolic Monitor system with mouse chamber	Measure O <sub>2</sub> consumption, CO <sub>2</sub> production
11-22000	MMX-2	Two-chamber expansion unit w/ 2 chambers	Monitor two animals simultaneously
11-23000	MMX-8	Eight-chamber expansion unit w/ 8 chambers	Monitor eight animals simultaneously
11-24000	MMX-16	Sixteen-chamber expansion unit w/ 16 chambers	Monitor sixteen animals simultaneously
11-20100	Mouse cage	Measurement chamber, approx. 1 liter	For mice and similar size animals
11-20110	Rat cage	Measurement chamber, approx. 2.5 liter	For rats and similar size animals
11-20200	Drying tube	Spare Drierite tube, pk of 4	Can be regenerated by oven heating
11-20210	Drying column	Large dessicant column, 6.7cmD x 29cmH	For long-term monitoring
11-20211	Dessicant	Bulk Drierite dessicant, 12 1 lb packs	Refill for drying tubes or columns
11-40100	UB-Chamber	Mouse metabolic chamber with food/drink	For complete metabolic profile

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