

MRI-1 Volume-cycled Ventilator

MRI-compatible rodent ventilator

Standard Features:

- Non-magnetic pneumatic valves
- Dependable all-electronic ventilator
- Wide tidal volume and rate range
- Mice to Guinea pig size
- Safe with oxygen and anesthesia
- Direct readout of volume and rate



The MRI-1 Ventilator is a small animal ventilator designed for use in MRI and other high magnetic field environments. The system comprises a microprocessor-based control unit and a set of remote, pneumatically operated, non-metallic valves. The MRI-1 can operate by itself or can be controlled and/or monitored by a computer.

The MRI-1 operates on the *flow-time* principle: an inspiratory airflow is established and gated into the animal for a known time, thus producing a known volume. This approach provides extraordinary flexibility — a wide range of volumes, breaths-per-minute, and I/E ratios are possible with no hardware changes, and using just three front-panel controls.

Respiratory airflow is provided by an internal airpump. Alternatively, an external pressurized gas source can be attached (oxygen or anesthetic gasses).

The remote high-speed, miniature pneumatic valves do the actual airflow switching. By locating these valves close to the animal (including inside the magnet bore if necessary), dead-space and tubing compliance are minimized.

Operation

Setting up and operating the MRI-1 is easy. Two lengths of flexible tubing connect the control unit and the valves; one supplies the inspiratory airflow and the other is the pressure source for operating the valves. Only three controls are required: RESPIRATORY RATE is set in breaths/minute; the FLOW RATE is set using the front-panel flowmeter (and measured

internally by a mass flowmeter); and the PERCENT INSPIRATION is set to establish the ratio of inspiration to expiration time (I/E ratio). All respiratory parameters are shown on the front-panel LCD display. The tidal volume and minute ventilation reflecting the current settings is also continuously displayed, and can easily be changed by adjusting the FLOW RATE.

Expandable

Of course, the MRI-1 can also be used in other than magnetic environments. Because of the non-electrical nature of the ventilation valves, this unit is particularly well suited to sensitive electrophysiology recording situations. Besides the standard miniature pneumatic valves, the MRI-1 accepts any of the valve assemblies available for the popular SAR-830 series ventilators. Using the MVA-4 multi-valve expander, it is also possible to ventilate several rodent-sized animals simultaneously using just one MRI-1 as the control unit. The external valves operate synchronously, but tidal volumes are independently set by varying the flow rate to each valve assembly.

A source of compressed air or helium is required for operating the pneumatic valves. This is attached to the rear panel of the unit, and the pressure is internally switched on or off as required for remote valve operation. Helium is often used as the actuating gas because its lower density and viscosity permits somewhat faster valve switching. All models feature switchable 120/240VAC operation.

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010-62329030 010-62329880 FAX 010-62329881
www.quatronix-cn.com

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SPECIFICATIONS

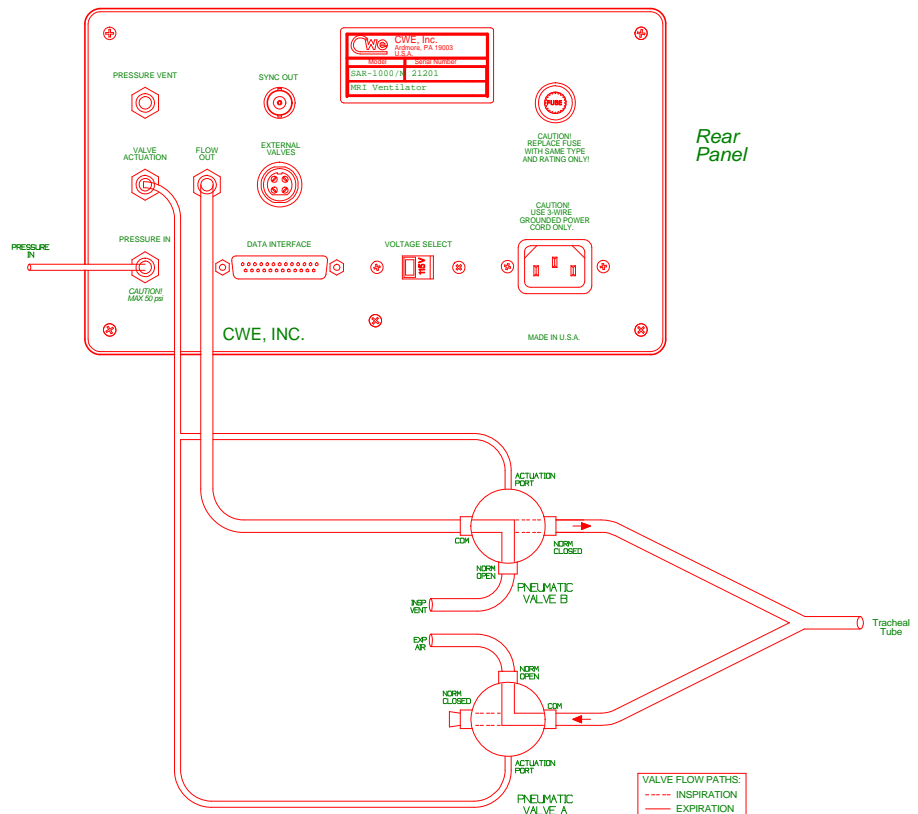
Respiratory rate range	5 - 150 breaths/min
Inspiratory flow range	.50 - 1000ml/min
Inspiration/Expiration (I/E ratio) range	20 - 80%
Tidal volume range	0.1 - 30ml
Manual control functions	.HOLD (suspends inspiration), MAN (manual inflation)
LCD panel	.4 lines x 20 chars, backlit
Indicator lights	.INSPIRATION, LOW PRES WARNING, ERROR
Internal airpump capacity	4 lpm
Pneumatic valve switching speed (air actuation)	< 75mS
Pneumatic valve switching speed (Helium actuation)	< 55mS
Pneumatic valve actuation pressure	.3 - 5 bar
Pneumatic valve flow orifices	0.080 in. (2.0mm)
Pneumatic valve materials	.PTFE body, non-metallic fasteners, one non-ferrous coil spring
Dimensions, main unit	9W x 5.5H x 9D in. (23 x 14 x 23cm)
Dimensions, pneumatic valve (each, of two)	1.0 dia x 1.8 long, in. (47 x 25mm)
Port connections, respiratory and pressure functions	.0.125" (3mm) ID Tygon tubing
SYNC OUT connector	.BNC
Data Port connector	.DB-25S
Power requirements	.120/240V (switchable), 100VA

How the MRI-1 Ventilator works

A pressurized air (or helium) source is connected to the PRESSURE IN port. The pneumatic valve control inlets are connected to the VALVE ACTUATION port. The inspiratory airflow to the animal comes from the FLOW OUT port.

To begin inspiration, valve "B" connects the animal to the inspiratory air flow, while simultaneously valve "A" closes off the expiratory pathway. At the end of inspiration, valve "B" is closed to the animal, and valve "A" opens the lungs to atmosphere for passive expiration to occur. Note that the inspiratory airflow continues to flow, even during the expiration phase, but is gated to the INSP VENT port on valve "B". This is done to prevent pressure transients that would result from suddenly starting and stopping the air-flow.

The distal "Y" connector attaches directly to the animal's endotracheal tube, and presents the only dead space in the system. Otherwise, flow is unidirectional; it proceeds from valve "B" to the animal, and expired air flows from the animal to valve "A".



MRI-1 Ventilator Connection Block Diagram