MODEL 5000 ECG/RESPIRATION SIMULATOR

DESCRIPTION

The Model 5000 ECG/Respiration Simulator is a portable, battery-operated unit designed to test the performance of Respironics 16000, 16900, 9000, 900, 900S, 900SL, 950S, 970S, and 970SE Home Monitors, as well as the 900S-10 and 970SE-10 SmartMonitors for Hospitals.

APPLICATION

The Simulator simulates thoracic impedance, minute impedance changes produced by respiratory effort when measured between two electrodes, and outputs an average pediatric PQRST ECG waveform. The Simulator provides a five-lead ECG output and a three-lead combined output for ECG and/or respiration simulation. (These instructions discuss the two- or three-lead connection only.) Front-panel controls allow you to select a wide range of heart and breathing rates and amplitudes. A convenient apnea simulation push-button switch automatically reduces the respiration signal to zero while maintaining preset values.

THEORY OF OPERATION

The Simulator comprises four major subsystems:

- Time base and rate selection
- Memory address generation
- Read-only memories (ROM)
- Digital-to-analog conversion

The time base and rate selection circuits provide user-selectable ECG and respiration rates used to control memory addressing. A quartz crystal controlled oscillator provides a highly accurate and stable time base. ECG and respiration waveforms are stored digitally in ROM. This digital data is read out eight bits at a time via the memory address generating circuits. The ECG data is then converted into an analog voltage signal which is provided to both the three-lead and five-lead outputs. However, the respiration data is converted into a varying impedance by switching eight precision resistors into and out of the THREE-LEAD ECG/RESP circuit.
Front Panel Controls

![Front Panel Controls and Outputs](image)

## ECG Controls

Two controls affect the ECG waveform:

- The ECG BEATS/MIN. rate control is used to select one of eight ECG rates in beats per minute (BPM).
- The ECG AMPLITUDE MV control is used to select one of eight ECG amplitudes in millivolts.

## Respiration Controls

Four controls affect respiration:

- The RESPIRATION BREATHS/MIN. rate control is used to select one of eight respiration rates breaths per minute.
- The RESPIRATION VARIATION OHMS control is used to select one of eight peak-to-peak impedance variations in ohms.
- The RESPIRATION BASE IMPEDANCE OHMS control is used to select one of eight base impedances in ohms.
- The APNEA button is used to simulate an apnea condition.

## Low Battery Indicator

A flashing LOW BATTERY LED indicates that the battery needs to be changed (refer to the procedure in “Battery Replacement”).

## Power Switch

The POWER switch is used to turn the simulator ON and OFF.
Operating Instructions

This section describes how to connect two- or three-lead ECG and/or thoracic impedance respiration monitors.

Connection of the Model 5000 Simulator to the Home Series SmartMonitor

1. Connect the Simulator to the Home Series SmartMonitor (refer to the illustration above).

**NOTE:** The chassis ground lead is used to reference the Simulator ground to the Model 16000 (only) monitor chassis ground. This will bypass the isolation of the monitor input circuit and, as a result, minimize the effect of hand capacitance.

**NOTE:** When using clip-on lead wires, you will need to use the 9185A Self-Test adapters on the Simulator output connectors (post caps). Refer to the illustrations below.

2. Move the Simulator power switch to ON.

3. Perform testing and/or calibration according to the instructions in the monitor’s Checkout Procedure Manual.

**NOTE:** If properly connected and the operating monitor does not indicate presence of ECG and/or respiration, contact Respironics Customer Service at 1-800-345-6443.

4. When testing has been completed, move the Simulator POWER switch to OFF.
Apnea Simulation

To simulate apnea on two- or three-lead impedance monitors, follow these steps:

1. Make sure the monitor is connected according to the illustration on page 3.
2. Press and hold the APNEA button until an apnea is indicated on the monitor. Do not move your hand while depressing the button; a “breath” detection may occur, delaying the apnea alarm.

Maintenance

Respironics, Inc. recommends returning the unit once a year for calibration. For complete information and instructions, call Respironics Customer Service at 1-800-345-6443.

Battery Replacement

Follow the steps below to replace discharged batteries.

NOTE: The battery voltage can be too low for calibrated output signals prior to the activation of the LOW BATTERY light.

1. Locate the battery compartment door on the bottom of the Simulator, and open the door.
2. Remove the 9V battery from the compartment.
3. Disconnect the old battery from the connector.
4. Connect a new Mallory MN1604 9-volt alkaline (or equivalent) battery.
5. Insert the battery and cable into the battery compartment and snap the door closed.

Specifications

Dimensions

<table>
<thead>
<tr>
<th></th>
<th>Depth</th>
<th>6.375&quot; (16.193 cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Height</td>
<td>3.875&quot; (9.8425 cm)</td>
</tr>
<tr>
<td></td>
<td>Length</td>
<td>8.5625&quot; (21.75 cm)</td>
</tr>
<tr>
<td></td>
<td>Weight</td>
<td>1.5 lbs</td>
</tr>
</tbody>
</table>

Power Supply

<table>
<thead>
<tr>
<th></th>
<th>Battery Type</th>
<th>Mallory MN 1604 alkaline (or equivalent)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Amp Hour Rating</td>
<td>500 mAhrs</td>
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<tr>
<td></td>
<td>Battery Voltage</td>
<td>9 volts</td>
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</table>
Three-Lead Performance Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECG Rate</td>
<td>+2% of switch position</td>
</tr>
<tr>
<td>ECG Amplitude</td>
<td>+5% of switch position</td>
</tr>
<tr>
<td>Respiration Rate</td>
<td>+2% of switch position</td>
</tr>
<tr>
<td>Variation</td>
<td>+5% of switch position</td>
</tr>
<tr>
<td>Base Impedance</td>
<td>100 Ohms to 4K ohms</td>
</tr>
</tbody>
</table>

Operating Temperature Range

- 32° to 120°F

Storage Temperature Range

- -60° to +140°F

Humidity

Simulator will operate as specified at a relative humidity of up to 95%.