

CAS MEDICAL SYSTEMS, INC.

510 / 511
Cardiorespiratory Monitor
Bench Test Procedure

using the 8310 / 9310 Simulator



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I. Scope

The purpose of this procedure is to provide a means by which a qualified person can perform a Bench Test to a Model 510 or Model 511 Cardiorespiratory Monitor.

II. Maintenance Intervals

CAS Medical Systems, Inc. recommends the following Maintenance Intervals for the Model 510 or Model 511 monitor.

- Preventative Maintenance – In-Between Patients
- Bench Testing – Once every year
- Battery and Audio Indicator Replacement – Every (3) three years (performed at CAS Medical Systems)


III. Equipment Required

To perform this procedure, you will need the following:

- Model 510 or 511 monitor (hereafter referred to as 51X)
- Aequitron Model 8310 or CAS Model 9310 Simulator with updated software (see note) (p/n 01-05-0157)
- Power Supply Charger (p/n 01-04-0004)
- AC Power Cords (1 ea. for monitor and simulator) (p/n 01-05-0139)
- Patient Cable (p/n 01-04-0106)
- Lead Wires (p/n 01-04-0110)
- Remote Alarm (p/n 01-04-0091) (Optional)
- Remote Alarm Adapter Cbl (p/n 03-08-0269) (Optional)
- Event-Link[®] Software (p/n 01-04-0150) (Optional)
- Monitor to Computer Direct Download Cable (p/n 01-04-0026) (Optional)
- Stopwatch or equivalent
- Model 510 and 511 Operator's Manual (reference material) (p/n 21-02-0062)
- Model 9310 User's Manual (reference material) (p/n 21-02-0142)

Note: 8310 / 9310 Simulator

This procedure requires the use of a Model 8310 / 9310 Simulator with updated software. The software has been updated with parameters specifically for testing the Lead Alarm and Respiration Response of the monitor. The parameter selections added are: 1800 OHMS to the Electrode Impedance menu and 150 B/M (BrPM) to the Respiration Rate menu. Should your simulator not contain these selections, contact CAS Customer Service and obtain a Return Goods Authorization (RGA) number to have your simulator updated.

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Simulator

This procedure is based on the Aequitron Model 8310 or CAS Medical System's Model 9310 Heart Rate / Respiration Simulator. Should either of these not be available, a compatible, fully calibrated, simulator with similar settings will be acceptable. The simulator's Make, Model and Calibration Date should be noted on the Data Sheet. The Data Sheet should also be marked with the values that were used during the procedure for each step.

Data Sheet Requirement

This procedure uses a Data Sheet as the record for verifying monitor performance. Once the procedure is completed, CAS recommends the Data Sheet be kept with the respective monitor's Device History Record should verification of monitor performance be questioned.

IV. Initial Setup


- A. Connect the (6) six-pin Power Supply Charger connector to its mating receptacle located on the rear panel of the monitor.
- B. Connect the power cord to the power input receptacle on the Power Supply Charger. Plug the other end of the power cord into a properly grounded A.C. outlet of the appropriate voltage. Verify the green CHARGING visual indicator located on the front panel of the monitor is lit.
- C. Connect the power cord to the power input receptacle on the rear panel of the simulator. Plug the other end of the power cord into a properly grounded A.C. outlet of the appropriate voltage.
- D. Connect the Patient lead wires to the Patient Cable (white to RA; black to LA). Plug the male end of the lead wires into the Simulator (white to RA jack; black to LA jack).
- E. Connect the Patient Cable to the ECG/RESP input receptacle located on the front panel of the monitor.

V. Equipment Setup

1. Simulator Setup

- A. Turn the Simulator "ON" by depressing the POWER ON/OFF switch located on the rear panel.
- B. Once the Simulator has completed its power on sequence, verify the following power-on factory default settings.
 - a. ECG RATE = **165 BPM**
 - b. ECG AMPLITUDE = **1.0 MV**
 - c. RESPIRATION RATE = **30 B/M (BrPM)**
 - d. RESPIRATION IMPEDANCE CHANGE = **1.0 OHMS**
 - e. ELECTRODE IMPEDANCE = **500 OHMS**

NOTE: These power-on factory default settings are common to both the Model 8310 and 9310 Simulators. Contact CAS Technical Support should you have any questions or concerns.

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2. Monitor Setup

- A. Power up the monitor.

To power up the monitor, depress the front panel DISPLAY ON/OFF pushbutton switch.

- B. Access the Configuration Menus.

To access the Configuration Menus – The LCD Control Panel access door, located on the bottom of the monitor, must be opened to gain access and view the Configuration Menus. Once the monitor is turned “ON” and completes its Initialization, the LCD control panel defaults to a status screen where messages can be viewed. The +, -, and ↵ pushbutton switches are used to enter, exit and make selections within the Configuration Menus provided (Alarm Limits, Setup Menu, and Other). Refer to **Section 3, Configuration Menus** in the **Operator’s Manual** for assistance.

- C. At PRESS ANY KEY, press any key to enter the Configuration Menus.

- D. At ALARM LIMITS, press the + pushbutton switch to select.

NOTE: If the monitor is a Model 510 or if Sibling Protection is enabled, enter the password (+ + - +).

- E. Set the APNEA Alarm Limit to **5 SEC**.

- F. Set the LOW HEART RATE (LOW HR) Alarm Limit to **100 BPM**.

- G. Set the HIGH HEART RATE (HIGH HR) Alarm Limit to **250 BPM**.

- H. Set the LOW SPO2 to **88 (%)**.

- I. Set the HIGH SPO2 to **96 (%)**. (Model 511 only)

- J. Set PB (Periodic Breathing) to **OFF**.

- K. Press the – pushbutton switch to EXIT the ALARM LIMITS.

- L. Press the ↵ pushbutton switch and select the SETUP MENU.

- M. At SETUP MENU, press the + pushbutton switch to select.

NOTE: If the monitor is a Model 510 or if Sibling Protection is enabled, enter the password (- + - -).

- N. Set the ALARM VOLUME to **1**.

- O. Set the QRS VOLUME to **1**. (Model 511 only)

- P. Set the PATIENT MODE to **INFANT**.

- Q. At CLEAR MEMORY, press the + TO SELECT pushbutton switch.

- R. Set the DATE/TIME to the current **Day, Month, Year, Hour and Minute**.

- S. If the unit has a Memory Card installed, set the ECG Trace Storage to **OFF**.

- T. If the unit has a Memory Card installed, set the SPO2 Trace Storage to **OFF**.

- U. If the unit has a Memory Card installed, set the Auxiliary Trace Storage to **OFF**.


- V. Set the ID Number to **000001234**.

- W. Press the – pushbutton switch to EXIT the SETUP MENU.

- X. Turn the Model 51X monitor “OFF”.

NOTE: If Sibling Protection is not enabled - Press the front panel DISPLAY ON/OFF pushbutton.

If the monitor is a Model 510 or if Sibling Protection is enabled - Press and hold the RESET (RESET/MUTE) pushbutton for at least (3) three seconds, continue to hold the pushbutton, and then push the DISPLAY ON/OFF pushbutton.


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VI. Bench Test

1. Functional Test

1.1 Alarm Test #1


- A. Turn “ON” the monitor by pressing the front panel **DISPLAY ON/OFF** pushbutton. Verify the green visual indicator next to the DISPLAY ON/OFF pushbutton switch is lit.
- B. Once the monitor has completed its power up sequence, verify the HEART RATE and RESPIRATION visual indicators are flashing at the rates set on the simulator with no Human Alarm visual indicators or audible alarms active. If the monitor is a Model 511, verify 1) the numeric values for HEART RATE and RESPIRATION are correct and 2) an audible “beep” is heard with each heartbeat.
- C. Set the simulator ECG RATE to **265 BPM** by pressing the ECG RATE button then the Arrow UP button followed by pressing the ENTER button. Verify, the monitor’s HEART RATE **HIGH** visual indicator and audible alarm activate. If the monitor is a Model 511, also verify the HEART RATE numeric value is flashing.
- D. Set the simulator ECG RATE to **240 BPM** by pressing the ECG RATE button then the Arrow DOWN button followed by pressing the ENTER button. Verify, the monitor audible alarm silences and the HEART RATE **HIGH** visual indicator remains on. If the monitor is a Model 511, also verify the HEART RATE numeric value is no longer flashing.
- E. Press the RESET (RESET/MUTE) pushbutton switch on the monitor. Verify, the **HIGH** visual indicator clears and the HEART RATE and RESPIRATION indicators are flashing at the rates set on the simulator.
- F. Set the simulator ECG RATE to **95 BPM** by pressing the ECG RATE button then the Arrow DOWN button followed by pressing the ENTER button. Verify, the monitor’s HEART RATE **LOW** visual indicator and audible alarm activate. If the monitor is a Model 511, also verify the HEART RATE numeric value is flashing.
- G. Set the simulator ECG RATE to **105 BPM** by pressing the ECG RATE button then the Arrow UP button followed by pressing the ENTER button. Verify, the monitor audible alarm silences and the HEART RATE **LOW** visual indicator remains on. If the monitor is a Model 511, also verify the HEART RATE numeric value is no longer flashing.
- H. Press the RESET (RESET/MUTE) pushbutton switch on the monitor. Verify, the **LOW** visual indicator clears and the HEART RATE and RESPIRATION indicators are flashing at the rates set on the simulator.
- I. Set the simulator RESPIRATION RATE to **APNEA=INF SEC**. (Press RESPIRATION RATE button, hold the Arrow DOWN button until the LCD displays 00 and press ENTER. Hold the Arrow UP button until the LCD displays APNEA = INF SEC. Press ENTER to begin the apnea event).
 1. Begin timing for apnea with the last Respiration pulse. Stop timing when the monitor’s **APNEA** visual and audio alarm activates. Verify, the time is 5 +/- 1.0 seconds. If the monitor is a Model 511, also verify the RESPIRATION numeric value is flashing.
- J. Press the RESPIRATION RATE button on the simulator. Verify, the monitor audible alarm silences and the **APNEA** visual indicator remains on. If the monitor is a Model 511, also verify the RESPIRATION numeric value is no longer flashing.

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- K. Press the RESET (RESET/MUTE) pushbutton switch on the monitor. Verify, the **APNEA** visual indicator clears and the HEART RATE and RESPIRATION indicators are flashing at the rates set on the simulator.
 - L. Turn the monitor “OFF”.
 - M. Turn the simulator “OFF”.
- Proceed to the Alarm Test #2.

1.2 Alarm Test #2


- A. Power-up the monitor and access the Configuration Menus. Select the following settings:
 - a. Set APNEA to **30 SEC**. (Alarm Limits Menu)
 - b. Set LOW HR to **40 BPM**. (Alarm Limits Menu)
 - c. Set HIGH HR to **80 BPM**. (Alarm Limits Menu)
 - d. Set the QRS VOLUME to **OFF**. (Setup Menu) (Model 511)
 - e. Default through to complete the Setup. Turn the monitor “OFF”.
- B. Power-up the simulator and select the following settings:
 - a. Set the ECG RATE to **65 BPM**.
 - b. Set the RESPIRATION RATE to **30 BrPM**.
- C. Turn “ON” the monitor by pressing the front panel **DISPLAY ON/OFF** pushbutton. Verify the green visual indicator next to the DISPLAY ON/OFF pushbutton switch is lit.
- D. Once the monitor has completed its power up sequence, verify the HEART RATE and RESPIRATION indicators are flashing at the rates set on the simulator with no Human Alarm visual indicators or audible alarms active. If the monitor is a Model 511, also verify the audible “beep” is not heard with each heartbeat.
- E. Set the simulator ECG RATE to **85 BPM**. Verify, the monitor’s HEART RATE **HIGH** visual indicator and audible alarm activate. If the monitor is a Model 511, also verify the HEART RATE numeric value is flashing.
- F. Set the simulator ECG RATE to **75 BPM**. Verify, the monitor audible alarm silences and the HEART RATE **HIGH** visual indicator remains on. If the monitor is a Model 511, also verify the HEART RATE numeric value is no longer flashing.
- G. Press the RESET (RESET/MUTE) pushbutton switch on the monitor. Verify, the **HIGH** visual indicator clears and the HEART RATE and RESPIRATION indicators are flashing at the rates set on the simulator.
- H. Set the simulator ECG RATE to **35 BPM**. Verify, the monitor’s HEART RATE **LOW** visual indicator and audible alarm activate. If the monitor is a Model 511, also verify the HEART RATE numeric value is flashing.
- I. Set the simulator ECG RATE to **45 BPM**. Verify, the monitor audible alarm silences and the HEART RATE **LOW** visual indicator remains on. If the monitor is a Model 511, also verify the HEART RATE numeric value is no longer flashing.

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- J. Press the RESET (RESET/MUTE) pushbutton switch on the monitor. Verify, the **LOW** visual indicator clears and the HEART RATE and RESPIRATION indicators are flashing at the rates set on the simulator.
 - K. Set the simulator RESPIRATION RATE to **APNEA=INF SEC**. Press ENTER to begin the apnea event.
 - 1. Begin timing for apnea with the last Respiration pulse. Stop timing when the monitor's **APNEA** visual and audio alarm activates. Verify, the time is 30 +/- 1.0 seconds. If the monitor is a Model 511, also verify the RESPIRATION numeric value is flashing.
 - L. Press the RESPIRATION RATE button on the simulator. Verify, the monitor audible alarm silences and the **APNEA** visual indicator remains on. If the monitor is a Model 511, also verify the RESPIRATION numeric value is no longer flashing.
 - M. Press the RESET (RESET/MUTE) pushbutton switch on the monitor. Verify, the **APNEA** visual indicator clears and the HEART RATE and RESPIRATION indicators are flashing at the rates set on the simulator.
 - N. Turn the monitor "OFF".
 - O. Turn the simulator "OFF".
- Proceed to ECG Response Test.

1.3 ECG Response Test

- A. Power up the monitor and access the Alarm Limits Menu. Select the following settings:
 - a. Set APNEA to **10 SEC**.
 - b. Set LOW HR to **40 BPM**.
 - c. Set the HIGH HR to **OFF**.
 - d. Default through to complete the Setup. Turn the monitor "OFF".
- B. Power up the simulator and select the following settings:
 - a. Set the ECG RATE to **165 BPM**.
 - b. Set RESPIRATION RATE to **20 BrPM**.
- C. Turn "ON" the monitor by pressing the front panel **DISPLAY ON/OFF** pushbutton. Verify the green visual indicator next to the DISPLAY ON/OFF switch is lit.
- D. Once the monitor has completed its power up sequence, verify the HEART RATE and RESPIRATION indicators are flashing at the rates set on the simulator with no Human Alarm visual indicators or audible alarms active.
- E. Set the simulator ECG RATE to **45 BPM** and the ECG AMPLITUDE (AMPL) to **0.2 mV**. Verify, the HEART RATE and RESPIRATION indicators continue to flash at the rates set on the simulator with no Human Alarm visual indicators or audible alarms active.
- F. Set the simulator ECG RATE to **315 BPM**. Verify, the HEART RATE and RESPIRATION indicators continue to flash at the rates set on the simulator with no Human Alarm visual indicator or audible alarms active.


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- G. Set the simulator ECG AMPLITUDE to **5.0 mV**. Verify, the HEART RATE and RESPIRATION indicators continue to flash at the rates set on the simulator with no Human Alarm visual indicator or audible alarms active.
- H. Set the simulator ECG RATE to **45 BPM**. Verify, the HEART RATE and RESPIRATION indicators continue to flash at the rates set on the simulator with no Human Alarm visual indicator or audible alarms active.
- I. Set the following settings on the simulator:
 - a. Set the ECG RATE to **165 BPM**.
 - b. Set the ECG AMPLITUDE to **1.0 mV**.

Proceed to the Inverted Polarity Test.

1.4 Inverted Polarity Test

- A. Disconnect the white and black lead wires from the simulator. Verify, the **LEAD OFF** visual indicator and audible alarm activate.
- B. Connect the white lead to the LA jack and the black lead to the RA jack on the simulator. Verify, the audible alarm silences and the **LEAD OFF** visual indicator remains on. (leave the connections reversed).
- C. Press the RESET (RESET/MUTE) pushbutton switch on the monitor. Verify, the **LEAD OFF** visual indicator clears.
- D. Set the simulator ECG RATE to **45 BPM** and the ECG AMPLITUDE to **0.2 mV**. Verify, the HEART RATE and RESPIRATION indicators continue to flash at the rates set on the simulator with no Human Alarm visual indicators or audible alarms active.
- E. Set the simulator ECG RATE to **315 BPM**. Verify, the HEART RATE and RESPIRATION indicators continue to flash at the rates set on the simulator with no Human Alarm visual indicator or audible alarms active.
- F. Set the simulator ECG AMPLITUDE to **5.0 mV**. Verify, the HEART RATE and RESPIRATION indicators continue to flash at the rates set on the simulator with no Human Alarm visual indicator or audible alarms active.
- G. Set the simulator ECG RATE to **45 BPM**. Verify, the HEART RATE and RESPIRATION indicators continue to flash at the rates set on the simulator with no Human Alarm visual indicator or audible alarms active.
- H. Set the following settings on the simulator:
 - a. Set the ECG RATE to **165 BPM**.
 - b. Set the ECG AMPLITUDE to **1.0 mV**.
- I. Disconnect the lead wires from the simulator. Re-connect the white and black lead wires onto their appropriate jacks on the simulator. Verify, the **LEAD OFF** visual indicator and audible alarm activate until the lead wires are reconnected.

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- J. Once the lead wires have been re-connected, verify, the audible alarm silences and the **LEAD OFF** visual indicator remains on.
- K. Press the RESET (RESET/MUTE) pushbutton switch on the monitor. Verify, the **LEAD OFF** visual indicator clears.

Proceed to the Heart Rate = Respiration Test.


1.5 Heart Rate = Respiration Test

- A. Set the simulator to the following settings:
 - a. Set the ECG RATE to **95 BPM**.
 - b. Set the ECG AMPLITUDE to **1.0 mV**.
 - c. Set the RESPIRATION RATE to **75 BrPM**.
 - d. Set the RESPIRATION IMPEDANCE CHANGE to **1.0 OHMS**.
- B. Verify the HEART RATE and RESPIRATION indicators are flashing at the rates set on the simulator with no Human Alarm visual indicators or audible alarms active.
- C. Set the simulator to the following settings:
 - a. Set the ECG RATE to **75 BPM**.
 - b. Set the RESPIRATION RATE to **75 BrPM**.
- D. Verify, 1) the HEART RATE indicator continues to flash at the rate set on the simulator 2) the RESPIRATION indicator is no longer flashing and 3) the monitor audible alarm and **APNEA** visual indicator are activated after 10 seconds. If the monitor is a Model 511, also verify the RESPIRATION numeric value is flashing.
- E. Set the simulator RESPIRATION RATE to **50 BrPM**. Verify, 1) the monitor audible alarm silences 2) the HEART RATE and RESPIRATION indicators are flashing at the rates set on the simulator and 3) the **APNEA** visual indicator remains on. If the monitor is a Model 511, also verify the RESPIRATION numeric value is no longer flashing.
- F. Press the RESET (RESET/MUTE) pushbutton switch on the monitor. Verify, the **APNEA** visual indicator clears and the HEART RATE and RESPIRATION indicators are flashing at the rates set on the simulator.

Proceed to the Lead Off Alarm Test.

1.6 Lead Off Alarm Test


- A. Set the simulator ELECTRODE IMPEDANCE to **1800 OHMS**. Verify, 1) the HEART RATE and RESPIRATION indicators are no longer flashing and 2) the monitor **LEAD OFF** visual indicator and audible alarm activate. If the monitor is a Model 511, verify both the HEART RATE and RESPIRATION numeric values indicate dashes (---).
- B. Set the simulator ELECTRODE IMPEDANCE to **1500 OHMS**. Verify, 1) the monitor audible alarm silences 2) the HEART RATE and RESPIRATION indicators are flashing at the rates set on the simulator and 3) the **LEAD OFF** visual indicator remains on. If the monitor is a Model 511, verify the HEART RATE and RESPIRATION numeric values are correctly displayed.

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- C. Press the RESET (RESET/MUTE) pushbutton switch on the monitor. Verify, the **LEAD OFF** visual indicator clears and the HEART RATE and RESPIRATION indicators are flashing at the rates set on the simulator.
 - D. Set the simulator ELECTRODE IMPEDANCE to **500 OHMS**.
- Proceed to the Respiration Response Test.

1.7 Respiration Response Test

- A. Access the Configuration Menus. Select the following settings:
 - a. Set the PATIENT MODE to **ADULT**. (Setup Menu)
 - b. Set the LOW RESPIRATION RATE (LOW RR) to **12 BrPM**. (Alarm Limits Menu)
 - c. Default through to complete the Setup.
- B. Set the simulator to the following settings:
 - a. Set the ECG RATE to **165 BPM**.
 - b. Set the RESPIRATION RATE to **30 BrPM**.
- C. Verify the HEART RATE and RESPIRATION indicators are flashing at the rates set on the simulator with no other Human Alarm visual indicators or audible alarms active.
- D. Set the simulator RESPIRATION IMPEDANCE to **0.2 OHMS**. Verify, the HEART RATE and RESPIRATION indicators continue to flash at the rates set on the simulator with no Human Alarm visual indicators or audible alarms active.
- E. Set the simulator RESPIRATION RATE to **10 BrPM**. Verify, 1) the HEART RATE indicator continue to flash at the rate set on the simulator 2) the monitor audible alarm and RESPIRATION **LOW** visual indicator are activated. If the monitor is a Model 511, also verify the RESPIRATION numeric value is flashing.
- F. Set the simulator RESPIRATION RATE to **50 BrPM**. Verify, 1) the HEART RATE and RESPIRATION indicators are flashing at the rates set on the simulator 2) the audible alarm silences and 3) the RESPIRATION **LOW** visual indicator remains on. If the monitor is a Model 511, also verify the RESPIRATION numeric value is no longer flashing.
- G. Press the RESET (RESET/MUTE) pushbutton switch on the monitor. Verify, the **LOW** visual indicator clears and the HEART RATE and RESPIRATION indicators continue to flash at the rates set on the simulator.
- H. Set the simulator RESPIRATION RATE to **75 BrPM**. Verify, the HEART RATE and RESPIRATION indicators continue to flash at the rates set on the simulator with no Human Alarm visual indicators or audible alarms active.
- I. Set the simulator RESPIRATION IMPEDANCE to **5.0 OHMS**. Verify, the HEART RATE and RESPIRATION indicators continue to flash at the rates set on the simulator with no Human Alarm visual indicators or audible alarms active.
- J. Set the simulator RESPIRATION RATE to **15 BrPM**. Verify, the HEART RATE and RESPIRATION indicators continue to flash at the rates set on the simulator with no Human Alarm visual indicators or audible alarms active.

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- K. Set the simulator to the following settings:
- a. Set the RESPIRATION RATE to **30 BrPM**.
 - b. Set the RESPIRATION IMPEDANCE CHANGE to **1.0 OHMS**.

Proceed to Improper Shutoff Test.

1.8 Improper Shutoff Test (Sibling Protection Alarm) Model 510 or Model 511 if enabled


- A. Depress the front panel DISPLAY ON/OFF pushbutton switch. Verify, 1) all the front panel visual indicators are turned “ON” 2) an audible alarm is active. If the monitor is a Model 511, also verify the HEART RATE numerics indicate “888”, the RESPIRATION and %SpO₂ (if installed) numerics indicate “188”.
- B. Depress the DISPLAY ON/OFF pushbutton switch. Verify, 1) the audible alarm silences and 2) the monitor performs a reset and continues to count at the rates set on the simulator.

Proceed to Remote Alarm Test.

1.9 Remote Alarm Test (Optional)

- A. Obtain the Remote Alarm and cables used with the monitor and connect them to the AUX. INPUT/OUTPUT connector, located on the rear panel of the monitor.
- B. Turn the Remote Alarm “ON”. To turn the Remote Alarm “ON”, pull out the ON/OFF switch and flip it up.
- C. Set the simulator ECG AMPLITUDE to **0.0 mV**. Verify, 1) a HEART RATE **LOW** visual and audible alarm on the monitor and 2) a red **ALARM** visual indicator and audible alarm on the Remote Alarm.
- D. Set the simulator ECG AMPLITUDE to **1.0 mV**. Verify on the Remote Alarm, 1) the audible alarm silences and 2) the **ALARM** visual indicator is no longer lit.
- E. Turn the Remote Alarm “OFF”. To turn the Remote Alarm “OFF”, pull out the ON/OFF switch and flip it down.
- F. Press the RESET (RESET/MUTE) pushbutton switch on the monitor. Verify, the **LOW** visual indicator clears.
- G. Turn the monitor “OFF”.
- H. Disconnect the Remote Alarm and Simulator from the monitor.

Proceed to Download Verification.

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1.10 Download Verification (Optional)

NOTE: Refer to the Operator’s Manual and Event-Link Help Menu, for assistance.


- A. Connect the monitor to the computer using the Direct Download Cable.
- B. Turn the monitor “ON”.
- C. Launch the Event Link Software program and perform a Direct Download of the data stored in the monitor.
- D. Review the Compliance Log and verify, 1) correct Date and Time information 2) correct APNEA, Low Heart Rate (LHR) and High Heart Rate (HHR) Alarm Limit changes and 3) Monitor Off / On and Total Time Log Entry Events.
- E. Review the Event Log and verify, 1) correct Date and Time information 2) correct APNEA, LHR and HHR Event Types and Alarm Settings.
- F. Print a copy of both the Compliance and Event Log reports. Attach them to the back of the completed Data Sheet.
- G. Turn the monitor “OFF”.

Turn the simulator “OFF”.

Disconnect the monitor from the computer and any other remaining cables.

This concludes the Model 510 / 511 Bench Test Procedure.

Should you have any questions, do not hesitate to contact CAS Technical Support at 203-488-6056 / 800-227-4414 (US only) (phone), 203-488-9438 (fax) or www.techsrv@casmed.com (email).

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VII. Test Data Sheet

Date: _____
 Tested By: _____

510 / 511 Monitor using the 8310 / 9310 Simulator

Home Care Dealer / Hospital:

Monitor Type: (select one) 510 () ; 511 ()

Address: _____

Monitor Serial Number: _____

City: _____

Simulator Type / Serial Number: _____

State: _____ Zip: _____

Simulator Calibration Date: _____

IV. Initial Setup

- | | |
|---|-------------------|
| A. Connect the (6) six-pin charger cord to the monitor. | Completed () |
| B. Connect the power cord to the Power Supply Charger. Verify, green CHARGING indicator is lit. | Pass () Fail () |
| C. Connect the power cord to the simulator. | Completed () |
| D. Connect the Patient lead wires to the Patient Cable and Simulator. | Completed () |
| E. Connect the Patient Cable to the ECG/RESP input on the monitor. | Completed () |


V. Equipment Setup

1. Simulator Setup

- | | |
|--|-------------------|
| A. Turn the simulator "ON". | Completed () |
| B. Verify the following power on default settings: | |
| a. ECG RATE = 165 BPM. | Pass () Fail () |
| b. ECG AMPLITUDE = 1.0 mV. | Pass () Fail () |
| c. RESPIRATION RATE = 30 B/M. | Pass () Fail () |
| d. RESPIRATION IMPEDANCE CHANGE = 1.0 OHMS. | Pass () Fail () |
| e. ELECTRODE IMPEDANCE = 500 OHMS. | Pass () Fail () |

2. Monitor Setup

- | | |
|--|---------------|
| A. Power up the monitor. | Completed () |
| B. Access the Configuration Menus. | Completed () |
| C. At PRESS ANY KEY, press any key to enter the Configuration Menus. | Completed () |
| D. At ALARM LIMITS, press the + pushbutton switch to select. | Completed () |
| E. Set the APNEA Alarm Limit to 5 SEC. | Completed () |
| F. Set the LOW HR Alarm Limit to 100 BPM. | Completed () |
| G. Set the HIGH HR Alarm Limit to 250 BPM. | Completed () |
| H. Set the LOW SPO2 to 88. | Completed () |
| I. Set the HIGH SPO2 to 96. (511 only) | Completed () |
| J. Set the PB to OFF. | Completed () |

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- K. Press the – pushbutton switch to EXIT the ALARM LIMITS. Completed ()
- L. Press the ← pushbutton switch and select the SETUP MENU. Completed ()
- M. At SETUP MENU, press the + pushbutton switch to select. Completed ()
- N. Set the ALARM VOLUME to 1. Completed ()
- O. Set the QRS VOLUME to 1. Completed ()
- P. Set the PATIENT MODE to INFANT. Completed ()
- Q. At CLEAR MEMORY, press the + TO SELECT pushbutton switch. Completed ()
- R. Set the DATE/TIME to the current Day, Month, Year, Hour, and Minute. Completed ()
- S. If the unit has a Memory Card installed, set the ECG Trace Storage to OFF. Completed ()
- T. If the unit has a Memory Card installed, set the SPO2 Trace Storage to OFF. Completed ()
- U. If the unit has a Memory Card installed, set the Auxiliary Trace Storage to OFF. Completed ()
- V. Set the ID Number to 000001234. Completed ()
- W. Press the – pushbutton switch to EXIT the SETUP MENU. Completed ()
- X. Turn the Model 51X monitor “OFF”. Completed ()

VI. Bench Test

1. Functional Test

1.1 Alarm Test #1

- A. Turn the monitor “ON”. Verify the visual indicator is lit. Pass () Fail ()
- B. Verify, monitor counts rates set on simulator with no alarms. Pass () Fail ()
 For Model 511, verify
 - 1) the numeric values for HEART RATE and RESPIRATION are correct. Pass () Fail ()
 - 2) an audible “beep” is heard with each heartbeat. Pass () Fail ()
- C. Set the simulator ECG RATE to 265. Verify, HIGH visual and audible alarms. Pass () Fail ()
 For Model 511 – Verify, HEART RATE numeric value is flashing. Pass () Fail ()
- D. Set the simulator ECG RATE to 240. Verify, audible stops and HIGH visual remains on. Pass () Fail ()
 For Model 511 – Verify, HEART RATE numeric value is no longer flashing. Pass () Fail ()
- E. Press RESET. Verify, HIGH visual clears and monitor counts rates set on simulator. Pass () Fail ()
- F. Set the simulator ECG RATE to 95. Verify, LOW visual and audible alarms. Pass () Fail ()
 For Model 511 – Verify, HEART RATE numeric value is flashing. Pass () Fail ()
- G. Set the simulator ECG RATE to 105. Verify, audible stops and LOW visual remains on. Pass () Fail ()
 For Model 511 – Verify, HEART RATE numeric value is no longer flashing. Pass () Fail ()
- H. Press RESET. Verify, LOW visual clears and monitor counts rates set on simulator. Pass () Fail ()
- I. Set the simulator RESPIRATION RATE to APNEA = INF SEC. Press ENTER. Pass () Fail ()
 - 1) Verify, the time to be 5 +/- 1.0 seconds. Pass () Fail ()
 For Model 511 – Verify, RESPIRATION numeric value is flashing. Pass () Fail ()
- J. Press the RESPIRATION RATE button on the simulator. Verify, audible stops and APNEA visual remains on. Pass () Fail ()
 For Model 511 – Verify, RESPIRATION numeric value is no longer flashing. Pass () Fail ()
- K. Press RESET. Verify, APNEA visual clears and monitor counts rates set on simulator. Pass () Fail ()
- L. Turn the monitor “OFF”. Completed ()
- M. Turn the simulator “OFF”. Completed ()


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1.2 Alarm Test #2

- A. Power up the monitor and access the Configuration Menus. Select the following settings:
 - a. Set APNEA to 30. Completed ()
 - b. Set LOW HR to 40. Completed ()
 - c. Set HIGH HR to 80. Completed ()
 - d. Set QRS VOLUME to OFF. Completed ()
 - e. Default through to complete the setup. Turn the monitor "OFF". Completed ()
- B. Power up the simulator and select the following settings:
 - a. Set the ECG RATE to 65. Completed ()
 - b. Set the RESPIRATION RATE to 30. Completed ()
- C. Turn the monitor "ON". Verify the visual indicator is lit. Pass () Fail ()
- D. Verify, monitor counts rates set on simulator with no alarms. Pass () Fail ()
 For Model 511 – Verify, an audible "beep" is not heard with each heartbeat. Pass () Fail ()
- E. Set the simulator ECG RATE to 85. Verify, HIGH visual and audible alarms. Pass () Fail ()
 For Model 511 – Verify, HEART RATE numeric value is flashing. Pass () Fail ()
- F. Set the simulator ECG RATE to 75. Verify, audible stops and HIGH visual remains on. Pass () Fail ()
 For Model 511 – Verify, HEART RATE numeric value is no longer flashing. Pass () Fail ()
- G. Press RESET. Verify, HIGH visual clears and monitor counts rates set on simulator. Pass () Fail ()
- H. Set the simulator ECG RATE to 35. Verify, LOW visual and audible alarms. Pass () Fail ()
 For Model 511 – Verify, HEART RATE numeric value is flashing. Pass () Fail ()
- I. Set the simulator ECG RATE to 45. Verify, audible stops and LOW visual remains on. Pass () Fail ()
 For Model 511 – Verify, HEART RATE numeric value is no longer flashing. Pass () Fail ()
- J. Press RESET. Verify, LOW visual clears and monitor counts rates set on simulator. Pass () Fail ()
- K. Set the simulator RESPIRATION RATE to APNEA = INF SEC. Press ENTER.
 - 1) Verify, the time to be 30 +/- 1.0 seconds. Pass () Fail ()
 For Model 511 – Verify, RESPIRATION numeric value is flashing. Pass () Fail ()
- L. Press the RESPIRATION RATE button on the simulator. Verify, audible stops and APNEA visual remains on. Pass () Fail ()
 For Model 511 – Verify, RESPIRATION numeric value is no longer flashing. Pass () Fail ()
- M. Press RESET. Verify, APNEA visual clears and monitor counts rates set on simulator. Pass () Fail ()
- N. Turn the monitor "OFF". Completed ()
- O. Turn the simulator "OFF". Completed ()

1.3 ECG Response Test

- A. Power up the monitor and access the Alarm Limits menu. Select the following settings:
 - a. Set APNEA to 10. Completed ()
 - b. Set LOW HR to 40. Completed ()
 - c. Set HIGH HR to OFF. Completed ()
 - d. Default through to complete the setup. Turn the monitor "OFF". Completed ()
- B. Power up the simulator and select the following settings:
 - a. Set the ECG RATE to 165. Completed ()
 - b. Set the RESPIRATION RATE to 20. Completed ()
- C. Turn the monitor "ON". Verify the visual indicator is lit. Pass () Fail ()
- D. Verify, monitor counts rates set on simulator with no alarms. Pass () Fail ()
- E. Set the ECG RATE to 45 and the ECG AMPL to 0.2. Verify, monitor continues to count rates set on simulator with no alarms. Pass () Fail ()
- F. Set the ECG RATE to 315. Verify, monitor continues to count rates set on simulator with no alarms. Pass () Fail ()

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- G. Set the ECG AMPL to 5.0. Verify, monitor continues to count rates set on simulator with no alarms. Pass () Fail ()
- H. Set the ECG RATE to 45. Verify, monitor continues to count rates set on simulator with no alarms. Pass () Fail ()
- I. Set the following settings on the simulator:
 - a. Set the ECG RATE to 165. Completed ()
 - b. Set the ECG AMPLITUDE to 1.0. Completed ()

1.4 Inverted Polarity Test

- A. Disconnect the lead wires from the simulator. Verify LEAD OFF visual and audible alarms. Pass () Fail ()
- B. Connect the white lead to the LA jack and the black lead to the RA jack. Verify, the audible stops and the LEAD OFF visual remains on. Pass () Fail ()
- C. Press RESET. Verify, LEAD OFF visual clears. Pass () Fail ()
- D. Set the ECG RATE to 45 and the ECG AMPLITUDE to 0.2. Verify, monitor continues to count rates set on simulator with no alarms. Pass () Fail ()
- E. Set the ECG RATE to 315. Verify, monitor continues to count rates set on simulator with no alarms. Pass () Fail ()
- F. Set the ECG AMPL to 5.0. Verify, monitor continues to count rates set on simulator with no alarms. Pass () Fail ()
- G. Set the ECG RATE to 45. Verify, monitor continues to count rates set on simulator with no alarms. Pass () Fail ()
- H. Set the following settings on the simulator:
 - a. Set the ECG RATE to 165. Completed ()
 - b. Set the ECG AMPLITUDE to 1.0. Completed ()
- I. Disconnect the lead wires from the simulator. Re-connect the white and black lead wires onto their appropriate jacks on the simulator. Verify, LEAD OFF visual and audible alarms activate. Pass () Fail ()
- J. Once the lead wires have been reconnected. Verify, the audible alarm silences and the LEAD OFF visual remains on. Pass () Fail ()
- K. Press RESET. Verify, LEAD OFF visual clears. Pass () Fail ()

1.5 Heart Beat = Respiration Test

- A. Set the simulator to the following settings:
 - a. Set the ECG RATE = 95. Completed ()
 - b. Set the ECG AMPLITUDE = 1.0. Completed ()
 - c. Set the RESPIRATION RATE = 75. Completed ()
 - d. Set the RESPIRATION IMPEDANCE CHANGE = 1.0. Completed ()
- B. Verify, monitor counts rates set on simulator with no alarms. Pass () Fail ()
- C. Set the simulator to the following settings:
 - a. Set the ECG RATE to 75. Completed ()
 - b. Set the RESPIRATION RATE to 75. Completed ()
- D. Verify,
 - 1) the HEART RATE indicator continues to flash at the rate set on the simulator. Pass () Fail ()
 - 2) the RESPIRATION indicator is no longer flashing. Pass () Fail ()
 - 3) the monitor audible alarm and APNEA visual indicator are activated after 10 seconds. Pass () Fail ()
 For Model 511 – Verify, RESPIRATION numeric value is flashing. Pass () Fail ()
- E. Set the simulator RESPIRATION RATE to 50. Verify,
 - 1) the monitor audible alarm silences. Pass () Fail ()
 - 2) the HEART RATE and RESPIRATION indicators flash at the rates set on the simulator. Pass () Fail ()
 - 3) the APNEA visual indicator remains on. Pass () Fail ()
 For Model 511 – Verify, RESPIRATION numeric value is no longer flashing. Pass () Fail ()
- F. Press RESET. Verify, APNEA visual clears and the monitor counts rates set on simulator. Pass () Fail ()


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1.6 Lead Off Alarm Test

- A. Set the simulator ELECTRODE IMPEDANCE to 1800. Verify,
 - 1) the HEART RATE and RESPIRATION indicators are no longer flashing. Pass () Fail ()
 - 2) LEAD OFF visual and audible alarms. Pass () Fail ()
 For Model 511 – Verify, HEART RATE and RESPIRATION numeric values are dashes (---). Pass () Fail ()
- B. Set the simulator ELECTRODE IMPEDANCE to 1500. Verify,
 - 1) audible alarm silences. Pass () Fail ()
 - 2) the HEART RATE and RESPIRATION indicators flash at the rates set on the simulator. Pass () Fail ()
 - 3) LEAD OFF visual remains on. Pass () Fail ()
 For Model 511 – Verify, both numeric values are correctly displayed. Pass () Fail ()
- C. Press RESET. Verify, LEAD OFF visual clears and monitor counts rates set on simulator. Pass () Fail ()
- D. Set the simulator ELECTRODE IMPEDANCE to 500. Completed ()

1.7 Respiration Response Test

- A. Access the Configuration Menus. Select the following settings:
 - a. Set the PATIENT MODE to ADULT. Completed ()
 - b. Set LOW RR to 12. Completed ()
 - c. Default through to complete the setup. Completed ()
- B. Set the simulator to the following settings:
 - a. Set the ECG RATE = 165. Completed ()
 - b. Set the RESPIRATION RATE = 30. Completed ()
- C. Verify, monitor counts rates set on simulator with no alarms. Pass () Fail ()
- D. Set the RESPIRATION IMPEDANCE to 0.2. Verify, monitor continues to count rates set on simulator with no alarms. Pass () Fail ()
- E. Set the RESPIRATION RATE to 10. Verify,
 - 1) the HEART RATE indicator continues to flash at the rate set on simulator. Pass () Fail ()
 - 2) the audible alarm and LOW visual are activated. Pass () Fail ()
 For Model 511 – Verify, RESPIRATION numeric value is flashing. Pass () Fail ()
- F. Set the RESPIRATION RATE to 50. Verify,
 - 1) the HEART RATE and RESPIRATION indicators flash at the rates set on the simulator. Pass () Fail ()
 - 2) the audible alarm silences. Pass () Fail ()
 - 3) the LOW visual indicator remains on. Pass () Fail ()
 For Model 511 – Verify, RESPIRATION numeric value is no longer flashing. Pass () Fail ()
- G. Press RESET. Verify, LOW visual clears and monitor counts rates set on simulator. Pass () Fail ()
- H. Set the RESPIRATION RATE to 75. Verify, monitor continues to count rates set on simulator with no alarms. Pass () Fail ()
- I. Set the RESPIRATION IMPEDANCE to 5.0. Verify, monitor continues to count rates set on simulator with no alarms. Pass () Fail ()
- J. Set the RESPIRATION RATE to 15. Verify, monitor continues to count rates set on simulator with no alarms. Pass () Fail ()
- K. Set the simulator to the following settings:
 - a. Set the RESPIRATION RATE = 30. Completed ()
 - b. Set the RESPIRATION IMPEDANCE CHANGE = 1.0. Completed ()

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1.8 Improper Shutoff Test (Sibling Protection Alarm)


- A. Depress the front panel DISPLAY ON/OFF pushbutton switch. Verify,
 - 1) all front panel visual indicators are turned "ON". Pass () Fail ()
 - 2) an audible alarm is active. Pass () Fail ()
 For Model 511 – HEART RATE numerics = 888, RESPIRATION and % SpO2 (if installed) numerics = 188. Pass () Fail ()
- B. Depress the DISPLAY ON/OFF pushbutton switch. Verify,
 - 1) the audible alarm silences. Pass () Fail ()
 - 2) the monitor performs a reset and continues to count at the rates set on the simulator. Pass () Fail ()

1.9 Remote Alarm Test

- A. Connect the Remote Alarm to the monitor. Completed ()
- B. Turn the Remote Alarm "ON". Pass () Fail ()
- C. Set the ECG AMPLITUDE to 0.0. Verify,
 - 1) a LOW visual and audible alarm on the monitor. Pass () Fail ()
 - 2) a red ALARM visual indicator and an audible alarm on the Remote Alarm. Pass () Fail ()
- D. Set the ECG AMPLITUDE to 1.0. Verify on the Remote Alarm,
 - 1) the audible alarm silences. Pass () Fail ()
 - 2) the ALARM visual indicator is no longer on. Pass () Fail ()
- E. Turn the Remote Alarm "OFF". Pass () Fail ()
- F. Press the RESET button on the monitor. Verify, the LOW visual clears. Pass () Fail ()
- G. Turn the monitor "OFF". Pass () Fail ()
- H. Disconnect the Remote Alarm, Simulator from the monitor. Completed ()

1.10 Download Verification


- A. Connect the monitor to the computer using the Direct Download Cable. Completed ()
- B. Turn the monitor "ON". Completed ()
- C. Launch the Event Link program and perform a Direct Download of data stored in the monitor. Completed ()
- D. Review the Compliance Log and verify,
 - 1) correct date and time information. Pass () Fail ()
 - 2) correct Apnea, Low Heart Rate (LHR) and High Heart Rate (HHR) Alarm Limit changes. Pass () Fail ()
 - 3) Monitor Off/On and Total Time Log Entry Events. Pass () Fail ()
- E. Review the Event Log and verify,
 - 1) correct date and time information. Pass () Fail ()
 - 2) correct Apnea, LHR and HHR Event Types and Alarm Settings. Pass () Fail ()
- F. Print a copy of both reports. Attach them to the completed Data Sheet. Completed ()
- G. Turn the monitor "OFF". Completed ()

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If the monitor fails to pass any part of this procedure, please return a copy of this Data Sheet with the monitor when it is returned for service.

Comments: _____

This concludes the Model 510 / 511 Test Data Sheet.

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VIII. Certification Acknowledgement Sign-Off Sheet

Home Care Dealer / Hospital: _____

Address: _____

City: _____ State: _____ Zip: _____

Phone: _____ Fax Phone: _____

By signing below, I have read and understood the Model 510 / 511 Bench Test Procedure and agree to adhere to it using the equipment required to the best of my ability.

Print Name, as it would appear on the certificate of the individual being certified:

Signature: _____ Date: _____

Email Address: _____

Would you like to be contacted concerning any product updates / improvements? Yes () No ()

Once completed, keep a copy for your records and mail the original sign-off sheet to:

CAS Medical Systems, Inc.
44 E. Industrial Rd
Branford, CT 06405
U.S.A.

203-488-6056 / 800-227-4414 (US only)(phone)
203-488-9438 (fax)
www.casmed.com

ATTN: Product Support Manager

This Sign-Off Sheet may be copied if additional individuals will be certified.