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## 10 Maintenance and checkout

This chapter specifies the checkout procedure and the maintenance activities to be performed to the patient monitor after corrective maintenance and during annual planned maintenance.

This chapter also covers the battery maintenance information for the patient monitor's lithium-ion battery.

**WARNING** Only perform maintenance procedures specifically described in the manual.

**WARNING** Planned maintenance should be carried out annually. Failure to implement the recommended maintenance schedule may cause equipment failure and possible health hazards.

NOTE: The manufacturer does not, in any manner, assume the responsibility for performing the recommended maintenance schedule, unless an Equipment Maintenance Agreement exists. The sole responsibility rests with the individuals, hospitals, or institutions utilizing the device.

NOTE: Refer to Module Frames and Modules Technical Manual for corrective and planned maintenance checkout procedures of the parameter modules.

NOTE: Refer to the PDM section in the Module Frames and Modules Technical Manual for the battery maintenance procedure of the PDM battery.

### Corrective maintenance

Service personnel shall perform the following checkout procedure steps after any corrective maintenance, before taking the monitor back into clinical use:

Performed service activity	Required checkout procedure		
	Visual inspections (section 10.1)	Electrical safety test (section 10.2)	Functional check (section 10.3)
After detaching, replacing or upgrading: - Recorder unit (FRU / Upgrade)	Yes	No	- 10.3.1 Start-up - 10.3.14 Recorder
After detaching or replacing: - Module rail unit (FRU)	Yes	No	- 10.3.1 Start-up - 10.3.3 PSM / PDM identification
After detaching, replacing: - CPU battery (FRU) - Mains fuses (FRU) - Battery door (FRU) - Monitor battery (FRU)	Yes	No	- 10.3.1 Start-up
After detaching or replacing any other part inside the patient monitor.	Yes	Yes	Perform all functional check steps from 10.3.1 to 10.3.15

### Planned maintenance schedule

Service personnel shall perform the following checkout procedure every 12 months after installation:

1. Visual inspection (section 10.1)
2. Electrical safety tests (section 10.2)
3. Functional check (section 10.3, all steps)
4. Battery maintenance (section 10.4)

Replace the CPU timekeeper battery every 5 years, or whenever the **Service Monitor Error Code 0xHOST1100** message is shown.

## 10.1 Visual inspection

Follow the procedure in section 8.1. [Visual inspection](#).

## 10.2 Electrical safety checks

Electrical safety tests provide a method of determining if potential electrical health hazards to the patient or operator of the device exist.

Perform the following electrical safety tests described in detail in chapter 8. [Installation checkout](#):

- 8.2.1. [Test setup](#)
- 8.2.2. [Power outlet](#)
- 8.2.3. [Power cord and plug](#)
- 8.2.4. [Ground \(earth\) integrity](#)
- 8.2.5. [Earth leakage current test](#)
- 8.2.6. [Enclosure leakage current \(touch current\) test](#)

Record the values of the tests on the [Appendix B. Maintenance checkform](#).

## 10.3 Functional check

### 10.3.1 Start-up

Follow the procedure in section [8.3.1. Start-up](#).

### 10.3.2 Display

Follow the procedure in section [8.3.2. Display](#).

### 10.3.3 PSM / PDM identification

1. Configure the ECG1 waveform field and the NIBP parameter window to the patient monitor screen with adequate priority. Connect a PSM or PDM module to the patient monitor.
2. Verify that the ECG waveform field, the NIBP parameter window and the related information appear on the patient monitor screen.

### 10.3.4 E-module identification

1. Log in to Webmin.
2. Select **Information > Device Information**.
3. Verify that the information about the connected module appears in the table named as **"Acquisition Information – E-Modules"**.

NOTE: For some parameter modules, the table does not show the actual module information, but the information of the individual subassemblies inside the module.

NOTE: You may need to refresh the Webmin screen if you have connected the module to the patient monitor after entering the **Device Information** Webmin screen.

### 10.3.5 Keypad and remote

Follow the procedure in section [8.3.5. Keypad and remote](#).

### 10.3.6 Mouse

Follow the procedure in section [8.3.6. Mouse](#).

### 10.3.7 Alphanumeric keyboard

Follow the procedure in section [8.3.7. Alphanumeric keyboard](#).

### 10.3.8 Barcode reader

Follow the procedure in section [8.3.8. Barcode reader](#).

### 10.3.9 MC Network and S/5 Network

Follow the procedure in section [8.3.9. MC Network and S/5 Network](#).

### 10.3.10 Wireless LAN

Follow the procedure in section [8.3.10. Wireless LAN](#).

### 10.3.11 IX printers

Follow the procedure in section [8.3.11. IX printers](#).

### 10.3.12 iPanel connection

Follow the procedure in section [8.3.12. iPanel connection](#).

### 10.3.13 Insite with Exc

Follow the procedure in section [8.3.13. Insite with EXC](#)

### 10.3.14 Recorder

1. Select **Monitor Setup > Printing > Devices > Setup** and configure:  
**Printout:** Waveforms  
**Location:** Local
2. Select **Monitor Setup > Printing > Waveforms** and configure:  
**Waveform 1:** II  
**Waveform 2:** V1
3. Select **Monitor Setup > Printing > Waveforms > Print Waveforms** or the related soft key in the main menu, or the **Print Waveforms** hard key in the keypad to start printing.
4. Verify that the recorder starts printing. Let the recorder print for approximately 10 seconds and verify the following things from the printout:
  - The header line contains the date, time and some other applicable status and configuration information.
  - The grid is clear.
  - The waveforms labels appear in the printout as configured.

Stop printing by selecting **Monitor Setup > Printing > Waveforms > Stop Printing**, or the related soft key in the main menu.

### 10.3.15 Synchronization connector test

#### Required Tools

- E-PSMP module
- A multiparameter patient simulator with invasive pressure adapter cable to GE invasive pressure connector.
- 5 lead ECG trunk cable, IEC or AHA
- 5 leadwire set, IEC or AHA
- Oscilloscope
- Analog output cable (2000633-001)

NOTE: You can alternatively use the GE defib sync tester, 2040582-001, together with the Analog output cable, 2000633-001 and a multiparameter simulator to perform this test. Follow

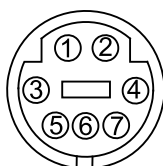
the instructions included with the tester. See analog output cable wire colors and related signals from the table below.

## Connections

1. Ensure that the module is connected to the patient monitor.
2. Connect the 5-lead ECG trunk cable to the green ECG connector in the module.
3. Connect the 5-leadwire sets to the trunk cable and to the simulator.

## Procedure

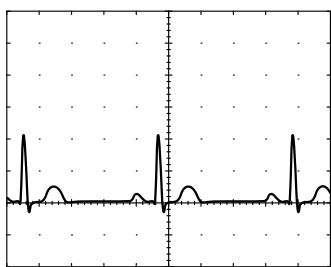
1. Use the figure and table below as a reference for connecting the oscilloscope to the defibrillator synchronization connector port, located on the left side of the patient monitor, for performing these tests.



Defibrillator Synchronization connector		Analog output Cable (2000633-001). Related wire color in the open end of the cable *)
Pin number	Signal	
1	Digital defibrillator synchronization marker out signal	Black
2	Digital defibrillator synchronization marker in signal	Green
3	Common GND	Red
4	Analog GND	Blue
5	Analog GND	White
6	IP analog output	Yellow
7	ECG analog output	Grey

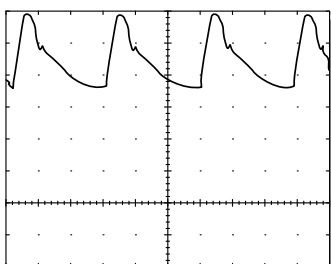
\*) Brown wire is not connected.

2. Test the ECG, Arterial BP, and Marker Out signals from the defibrillator synchronization connector port. They should closely resemble the waveforms in the figures below.



**DEFIB Sync connector: ECG**

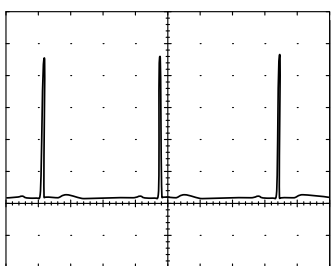
ECG analog output signal: Grey  
 Analog GND: Blue or White  
 Probe Type: x10  
 Time/Division: 200 mS  
 Volts/Division: 0.5V



**DEFIB Sync connector: arterial BP**

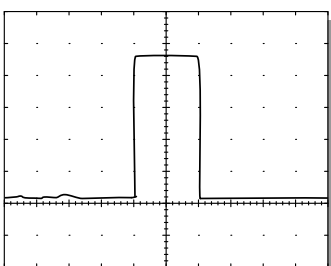
IP analog output signal: Yellow  
 Analog GND: Blue or White  
 Probe Type: x10  
 Time/Division: 200 mS  
 Volts/Division: 0.2V

There are two Marker Out traces shown below. The upper Marker Out figure references the frequency aspects of the signal. The lower Marker Out figure references the pulse width aspects of the signal.



**DEFIB Sync connector: Marker Out (frequency)**

Digital defibrillator synchronization marker out signal: Black  
 Common GND: Red  
 Probe Type: x10  
 Time/Division: 200 mS  
 Volts/Division: 2V



**DEFIB Sync connector: Marker Out (pulse width)**

Digital defibrillator synchronization marker out signal: Black  
 Common GND: Red  
 Probe Type: x10  
 Time/Division: 5 mS  
 Volts/Division: 2V

**10.3.16 Test completion**

Select **Discharge Patient** or **Reset Case** to discard any changes made to the patient monitor configuration during checkout.

- Complete the Appendix [B. Maintenance check form](#).

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## 10.4 Monitor battery maintenance

The lithium-ion (Li-Ion) battery is a rechargeable battery containing lithium-ion cells. Each battery contains an integrated electronic fuel gauge and a safety protection circuit.

The following are facts about lithium-ion battery technology:

- The battery discharges on its own, even when it is not installed in the equipment. This discharge is the result of the lithium-ion cells and the bias current required for the integrated electronics.
- The capacity loss of the battery degrades significantly at higher temperatures.
- As the battery ages, the full-charge capacity of the battery degrades and is permanently lost. As a result, the amount of charge that is stored and available for use is reduced.

The following terms are used to define the battery capacity:

- Design capacity – The theoretical capacity of the battery cells when the battery is new.
- Full-charge capacity – The actual amount of charge the battery can store and deliver.
- Remaining charge capacity – The amount of full-charge capacity currently remaining in the battery. This is a percent of full-charge capacity.

### 10.4.1 Use recommendations

GE recommends the following methods to improve battery performance:

- Location – Position the equipment in a location that does not artificially increase the operating temperature of the batteries.
- Conditioning guideline – Condition the battery when a **Condition Battery A** or **Condition Battery B** message is shown on the monitor screen. The condition cycle recalibrates the electronic fuel gauge.

### 10.4.2 Storage recommendations

GE recommends storing the battery outside of the device at a temperature between 20°C to 25°C (68°F to 77°F).

### 10.4.3 Testing the battery charge

Before installing a battery, verify the battery's state of charge. Press the green **TEST** button on the battery. The number of charge level indicator LEDs that illuminate indicates the approximate charge remaining in the battery.

- Four LEDs illuminated: 75% – 100% of full-charge capacity.
- Three LEDs illuminated: 50% – 74.9% of full-charge capacity.
- Two LEDs illuminated: 25% – 49.9% of full-charge capacity.
- One LED illuminated: 10% – 24.9% of full-charge capacity.
- One LED flashing: < 10% of full-charge capacity remaining.

### 10.4.4 Charging a battery

The battery is charged whenever it is installed into the patient monitor and the patient monitor is connected to an AC power source. The battery is charging both when the patient monitor is turned on and when it is in the standby mode.

Battery is charging as long as the orange battery charging LED indicator is lit.

To check the battery charge status, select **Monitor Setup > Battery Status > Advanced**.

## 10.4.5 Conditioning a battery

Condition the battery when a **Condition Battery A** or **Condition Battery B** message is shown on the monitor screen. The condition cycle recalibrates the electronic fuel gauge.

Condition the battery by fully discharging and recharging the battery twice according to the following procedure:

NOTE: The patient monitor must be in a discharged state during battery conditioning. Disconnect any acquisition modules from the patient monitor if connected.

1. Turn on the patient monitor. Disconnect the power cord from the wall outlet. Leave the patient monitor on until the battery is fully discharged and the patient monitor turns off automatically.

NOTE: Ignore the **Monitor Battery Low** and **Monitor Battery Empty!** messages when discharging the battery.

2. Reconnect the power cord to the wall outlet and turn on the patient monitor. Leave the patient monitor on until the battery is fully recharged and the orange battery charging indicator LED turns off.
3. Repeat the steps 1 and 2 once.

The battery is now conditioned and ready for use. However if either **Condition Battery A** or **Condition Battery B** message is still shown on the patient monitor screen, repeat the conditioning cycle once more. If the problem persists, replace the battery.

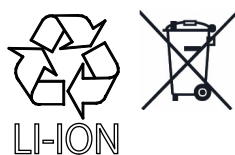
NOTE: Refer to section [11.6. Battery diagnostics](#) and [11.7. Error messages and codes](#) for more detailed information about the battery status and operating condition.

## 10.4.6 Replacing a battery

Replace the battery in the following situations:

- if either **Replace battery A** or **Replace battery B** message is displayed. This message indicates that the full-charge capacity of the used battery has considerably degraded compared to the design capacity of a new battery.
- if either **Battery A failure** or **Battery B failure** message is displayed.

Remove the battery from the patient monitor and install a new battery according to the battery installation instructions in the Hardware Installation section



NOTE: Dispose of the battery according to local, state or country laws.

NOTE: Refer to the section [11.6. Battery diagnostics](#) and [11.7. Error messages and codes](#) for more detailed information about the battery status and operating condition.

NOTE: Refer to the Troubleshooting chapter for more detailed information about the battery diagnostics and error messages.

**WARNING** Do not incinerate a battery or store at high temperatures. Serious injury or death could result.