

GE Healthcare



**MAC™ 600**  
**Service Manual**  
Product Code SNM

2047426-115 Revision 2



The information in this manual only applies to MAC™ 600 SNM. Due to continuing product innovation, specifications in this manual are subject to change without notice.

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# Contents

## 1

<b>Introduction</b>	<b>1-1</b>
<b>Manual Information</b>	<b>1-2</b>
Revision History	1-2
Manual Purpose	1-2
Intended Audience	1-2
Contraindications	1-3
Warnings, Cautions, and Notices	1-3
Conventions	1-3
<b>Safety Messages</b>	<b>1-4</b>
Responsibility of the Manufacturer	1-4
General	1-4
Equipment Symbols	1-5
<b>Service Information</b>	<b>1-5</b>
Service Requirements	1-5
Equipment Identification	1-5
Serial Number Label Format	1-6
Serial Number Format	1-7
Product Label	1-8

## 2

<b>Equipment Overview</b>	<b>2-1</b>
<b>General Description</b>	<b>2-2</b>
Top View	2-2
Back View	2-3
Side View	2-4
Keypad	2-5
Bottom View	2-6
General Description	2-7

## 3

<b>Troubleshooting</b>	<b>3-1</b>
<b>General Fault Isolation</b>	<b>3-3</b>
Power-up Self-Test	3-3
Poor Quality ECGs	3-3
Visual Inspection	3-4
Performing Diagnostic Tests	3-5
Accessing the System Diagnostics Function	3-5
Testing the System Information	3-6

Testing the Display .....	3-7
Testing the Buzzer .....	3-8
Testing the Keypad .....	3-9
Writer Test .....	3-11
Battery Tests .....	3-12
Communication Tests .....	3-12
Acq. Module Tests .....	3-13
SD Card Tests .....	3-14
PWA Connector Details .....	3-14
<b>Equipment Problems .....</b>	<b>3-16</b>
Paper Error Message .....	3-16
Paper Moving But Not Printing .....	3-17
Printer Door Open Message .....	3-18
Printing Only Baselines .....	3-19
Battery Error Message .....	3-20
Unit Not Turning ON in Battery Mode .....	3-21
External Power LED Not Lighting Up .....	3-22
External Power LED Lights Up But Unit Not Switching ON .....	3-23
Data Does Not Print on Upper and Lower Edges of Paper .....	3-24
Blank or Unstable Display With Color Patches .....	3-25

# 4

## Maintenance ..... 4-1

<b>Preparing System for FRU Replacement .....</b>	<b>4-3</b>
Required Tools and Manuals .....	4-4
Replacing the Battery .....	4-4
Replacing the Thermal Printer .....	4-5
Opening the Device .....	4-6
Reworking the Power Supply (Class II to Class I) .....	4-9
Earth Cable Routing .....	4-10
Changing the Product Label .....	4-11
Replacing the Display .....	4-13
Replacing the Main PCB Assembly .....	4-15
Adding Ferrite to the Power Supply .....	4-15
Replacing the main PCB .....	4-16
Replacing the Daughter PCB assembly .....	4-17
Preventive Maintenance .....	4-18
Recommended Maintenance .....	4-18
Functional Checkout .....	4-20
<b>Check out Procedure .....</b>	<b>4-22</b>
Operational Checks .....	4-22
Diagnostic Tests .....	4-22
Electrical Safety Checks .....	4-22
Electrical Safety Tests .....	4-23
Recommended Test Equipment .....	4-23
Recommended Test Schedule .....	4-23
Ground Resistance Test .....	4-23

Leakage Current Tests .....	4-23
Earth Leakage (AC line) Current Test .....	4-24
Patient Leakage Current Tests .....	4-25
Patient Leakage Current to Ground .....	4-25
Patient Leakage Current, Mains on Applied Part .....	4-26
Saving Setup .....	4-29
Print Setup .....	4-29
Restoring Setup .....	4-29
Serial Number Entry .....	4-29
Application Software Update .....	4-30
BOOT Software Update .....	4-31
System Log .....	4-32
Programming MAC 600 Device Without User Interface .....	4-32
Reset Password .....	4-33

# 5

## Parts and Replacements ..... 5-1

<b>Ordering Parts .....</b>	<b>5-3</b>
General Information .....	5-3
Carry Case .....	5-3
Patient Cables .....	5-3
Electrodes .....	5-4
ECG Clip .....	5-4
Leadwire .....	5-4
Consumable .....	5-5
Writer Paper .....	5-5
Power Cords .....	5-5
MAC 600 Options .....	5-6
Field Replaceable Units (FRUs) .....	5-7
2047328-002 FRU EXTERNAL POWER SUPPLY - CLASS I .....	5-7
Mechanical FRU Kit 1 .....	5-8
FRU - CKT BD MAC 600 CPU Board .....	5-8
FRU LCD Display (TIANMA) with O-Ring Kit MAC600 .....	5-9
FRU - LCD Module Holder - Expedition (For TIANMA and KOE Displays) ..	5-10
FRU - Cover Battery - Expedition .....	5-11
FRU Daughter Board for TIANMA Display- SNM .....	5-12
Printer Door FRU Kit .....	5-13
Cover Top FRU Kit .....	5-14
Cover Bottom FRU Kit .....	5-15
Mechanical FRU Kit 2 .....	5-16
FRU Printer Module .....	5-17
FRU Battery .....	5-17
FRU Software Update - SD Card .....	5-18
FRU Cable Kit .....	5-19
FRU Serial Cable .....	5-20

<b>Technical Specification</b>	<b>A-1</b>
<b>Electromagnetic Compatibility</b>	<b>B-1</b>
Guidance and Manufacturer's Declaration-Electromagnetic Emissions	B-3
Guidance and Manufacturer's Declaration-Electromagnetic Immunity	B-4
Recommended Separation Distance	B-6
<b>Index</b>	<b>Index-1</b>

# 1 Introduction

# Manual Information

## Revision History

Each page of the document has the document part number and revision letter at the bottom of the page. The revision letter identifies the document's update level. The revision history of this document is summarized in the following table.

Table 1-1. Revision history, PN 2047426-115		
Revision	Date	Comment
1	08 March 2021	Initial release of document
F	20 October 2022	Updated the Product Code to SNM. Updated the Display, Daughter Board, Top Cover and Printer FRUs. Updated Label Code Changed in Image, Updated Content in Accessing the System Diagnostics Function, Image updated in Testing System Information, Updated content in Saving Setup, Print Setup, Restoring Setup, Serial Number Entry, Application Procedure Update, Boot Software Update, System Log, Programing MAC 600 Device Without User interface and Table 5-15 Title. Added Reset Password. Removed Substitute Master Password. Updated Leadwire Part Numbers from 2104724-002 to 2104724-006 and 2104724-001 to 2104724-005.

## Manual Purpose

This manual provides technical information for service representatives and technical personnel to maintain the equipment to the assembly level. Use it as a guide for maintenance and electrical repairs considered field repairable. The manual identifies additional sources of relevant information and technical assistance. See the operator's manual for operating instructions.

## Intended Audience

This manual is written for clinical professionals and others who use, maintain, and troubleshoot the MAC 600. The person using the MAC 600 is expected to have a working knowledge of appropriate medical procedures, practices, and terminology used in the treatment of patients.



## Contraindications

- This system is not intended for use as a vital signs physiological monitor or for use during patient transport.
- This device is not intended for use with high-frequency surgical units. Disconnect the device from the patient before using the high-frequency surgical units.
- This device is not intended for use with direct cardiac applications.

## Warnings, Cautions, and Notices

The terms DANGER, WARNING, CAUTION and NOTICE are used throughout this manual to point out hazards and to designate a degree or level or seriousness. Familiarize yourself with their definitions and significance. Hazard is defined as a source of potential injury to a person.

Table 1-2. Hazard terms	
Term	Definition
DANGER	Indicates an imminent hazard which, if not avoided, will result in death or serious injury.
WARNING	Indicates a potential hazard or unsafe practice, which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a potential hazard or unsafe practice, which, if not avoided, could result in minor personal injury or product/property damage.
NOTICE	Indicates a potential hazard or unsafe practice, which, if not avoided, could result in the loss or destruction of property or data.

## Conventions

Table 1-3. Conventions	
<b>Bold text</b>	Indicates keys on the keypad, text to be entered, or hardware terms such as buttons or switches on the equipment.
<i>Italicized text</i>	Indicates terms that identify menu items or options in the system display.

# Safety Messages

Additional safety messages provide appropriate safe operation information.

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**DANGER**

Do not use in the presence of flammable anesthetics.

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**WARNING**

CONNECTION TO MAINS – This is class I equipment. The mains plug must be connected to an appropriately grounded power supply.

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**WARNING**

BATTERY OPERATION – If the integrity of the earth conductor is in doubt, operate the unit from its battery.

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**CAUTION**

EQUIPMENT MALFUNCTION - Any attempt by unauthorized personnel to service the device could result in equipment malfunction and void the warranty. This equipment contains no user-serviceable parts. Contact the authorized service personnel to service the device.

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## Responsibility of the Manufacturer

GE Healthcare is responsible for the effects of safety, reliability, and performance only if:

- Assembly operations, extensions, readjustments, modifications, or repairs are carried out by persons authorized by us.
- The electrical installation of the relevant room complies with the requirements of the appropriate regulations.
- The equipment is used in accordance with the instructions for use.

## General

Failure on the part of the responsible individual, hospital, or institutional users of this equipment to implement a satisfactory maintenance schedule could cause equipment failure and health hazards.

To ensure patient safety, use only parts and accessories manufactured or recommended by GE Healthcare.

Contact GE Healthcare before connecting any devices to this equipment that are not recommended in this manual.

Parts and accessories used must meet the requirements of the applicable IEC 60601 series safety standards, and/or the system configuration must meet the requirements of the IEC 60601-1-1 medical electrical systems standard.

The use of accessory equipment not complying with the equivalent safety requirements of this equipment may lead to a reduced level of safety of the resulting system.

Considerations relating to the choice include:

- Use of the accessory in the patient vicinity.
- Evidence that the safety certification of the accessory has been performed in accordance to the appropriate IEC 60601-1 and/or IEC 60601-1-1 harmonized national standard.

## Equipment Symbols

See the MAC 600 operator's manual for information about the symbols used on this product and its packaging.

## Service Information

### Service Requirements

Refer equipment servicing to GE Healthcare authorized service personnel only. Any unauthorized attempt to repair equipment under warranty voids that warranty. It is the user's responsibility to report the need for service to GE Healthcare or an authorized agent.

## Equipment Identification

Every GE Healthcare device has a unique serial number. The serial number appears on the device label and is formatted as shown.

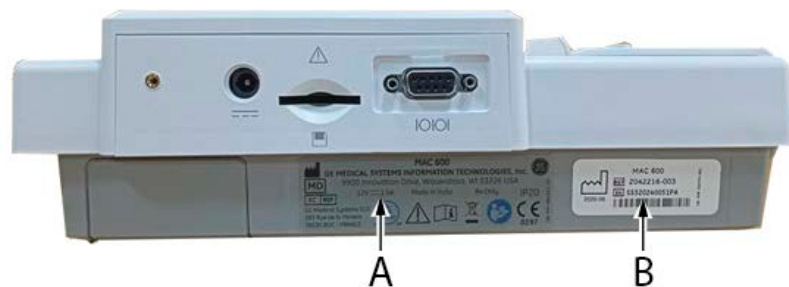


Table 1-4. Equipment Identification

Item	Description
A	Product label
B	Serial number label

## Serial Number Label Format

The serial number label is located on the bottom cover beside the product label.

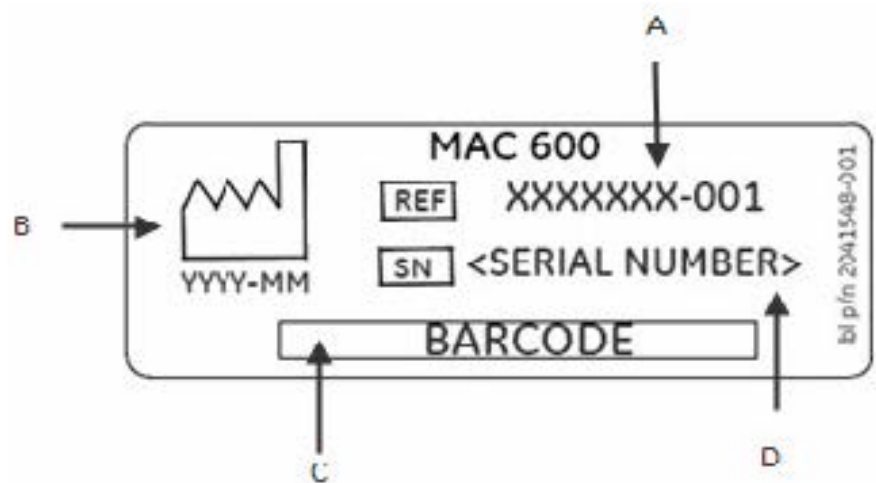


Table 1-5. Serial Number Label Details

Item	Description
A	Product part number
B	Manufacture date in YYYY-MM format
C	Serial number barcode
D	Serial Number

## Serial Number Format

The serial number appears as follows:

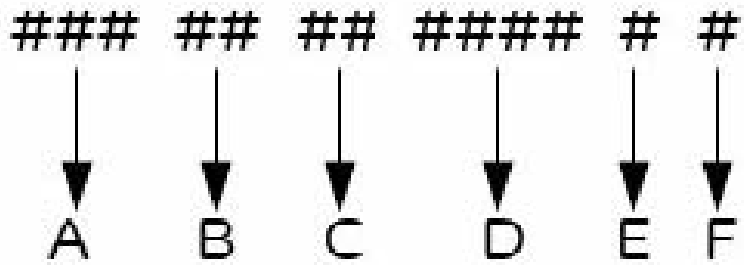


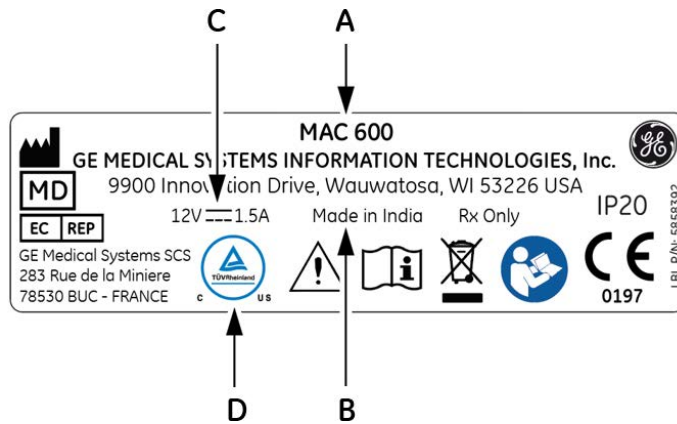
Table 1-6. Serial Number Format	
Item	Description
A	The product code for MAC 600 system is SNM
B	Year Manufactured (00-99) 00 = 2000 01 = 2001 02 = 2002
C	Fiscal Week Manufactured
D	Production Sequence Number
E	Manufacturing Site
F	Miscellaneous Characteristic

## Product Label

The product label is located on the back of the device next to the external power input.

### NOTE

Your product label may vary.



**Table 1-7. Product Label**

Item	Description
A	Product name (MAC 600)
B	Manufacturing Site
C	Input power rating
D	Symbols
See the "MAC 600 Operator's Manual" for a description of the symbols used on this label.	

**For your notes**





# 2 Equipment Overview

## General Description

The MAC 600 Resting ECG Analysis System is a 10-lead, 12-channel device with an integrated 4.3 inch WQVGA color display and three-inch thermal printer. This is a portable device with a lithium ion battery and smart charger. This device supports AC operation with a 12V ACDC medical grade adaptor. The device can support communication and external storage through serial port and SD card options.

### Top View



Table 2-1. Top view

	Name	Description
A	Writer/Printer	Prints ECG Reports
B	Display	View ECGs of different lead/lead group, heart rate, mode of operation, speed, gain, and filter settings.
C	Keypad	Keys to power on the system, change operating parameters or control operations.

## Back View

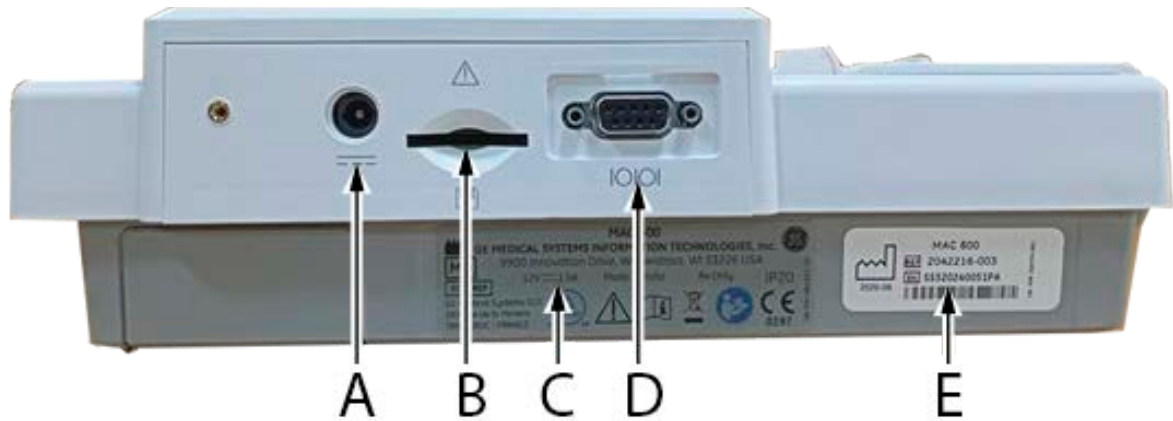


Table 2-2. Back view

Legend	Name	Description
A	DC In Socket	Input socket for connecting external ACDC adaptor.
B	SD Card slot	Slot for using the SD card.
C	Product Label	Displays product name, site of manufacture, power specification, and relevant symbols.
D	Serial Port	Port for connecting serial cable.
E	Serial Number Label	Displays product number, date of manufacture, barcode and serial number of the product.

### **WARNING**

**SYSTEM LEAKAGE CURRENT** – Keep leakage current within acceptable limits when connecting auxiliary equipment to this device. Total system leakage must not exceed 300 microamperes (110V system) or 500 microamperes (220V-250V system).

## Side View



Table 2-3. Side View

Legend	Name	Description
A	ECG signal input connector	Connector for patient cable



## Keypad

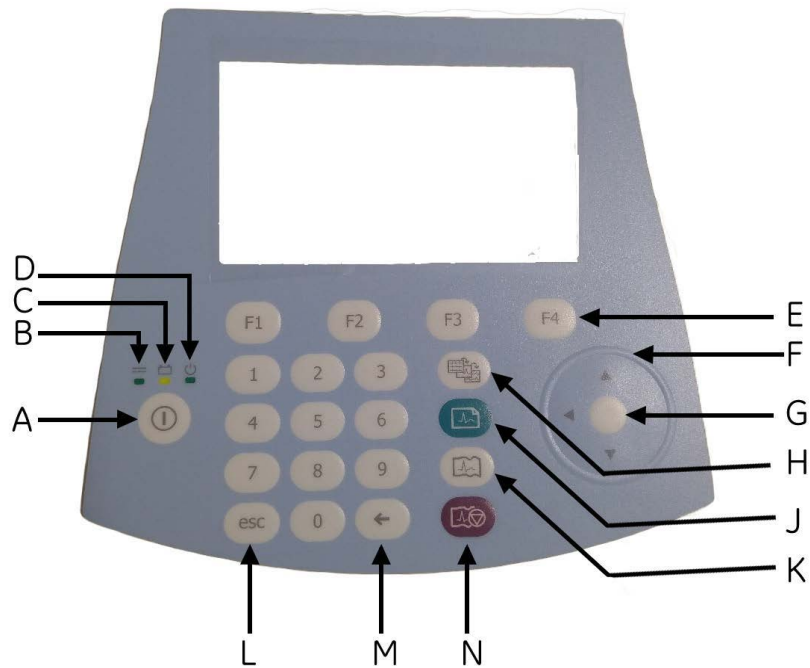


Table 2-4. Keypad

Legend	Name	Description
A	<b>Power</b>	Turns the system on or off.
B	Power LED	Indicates the unit is plugged in and receiving DC power.
C	Battery LED	Indicates various battery states: <ul style="list-style-type: none"> <li>■ Solid amber light indicates that the battery is charging.</li> <li>■ Flashing amber light indicates that the battery is low.</li> <li>■ Off indicates that the battery is fully charged or that the battery is not being charged.</li> </ul>
D	ON/OFF LED	Indicates the system is ON.
E	Function (F1 through F4)	Selects screen menu functions.
F	Arrow pad	Moves the cursor left, right, up, or down.
G	<b>Enter</b> (Trim Pad Enter Key)	Press this key every time you want to confirm a selection.
H	<b>Leads</b>	Scrolls through the leads on display and changes leads during rhythm print.
J	<b>ECG (Green)</b>	Acquires an ECG. Press to acquire a 12SL resting ECG, including measurements and interpretation.
K	<b>Rhythm</b>	Prints a continuous, real-time rhythm ECG strip. Press the <b>Stop</b> key to stop the rhythm strip from printing.
L	<b>esc</b>	To return to the previous menu.

Table 2-4. Keypad

M	<b>Backspace</b>	Deletes characters
M	<b>Stop</b>	Stops the printing.

## Bottom View



Table 2-5. Bottom View

Legend	Name	Description
A	Battery Compartment	Holds the rechargeable Lithium-Ion battery
B	Option Code Label	Displays the option code label (Optional)

Table 2-6. Option Code Label Contents

Option	Description
1	Measurement
2	Measurement and Interpretation
3	External Storage
4	Color Display
5	Transmission

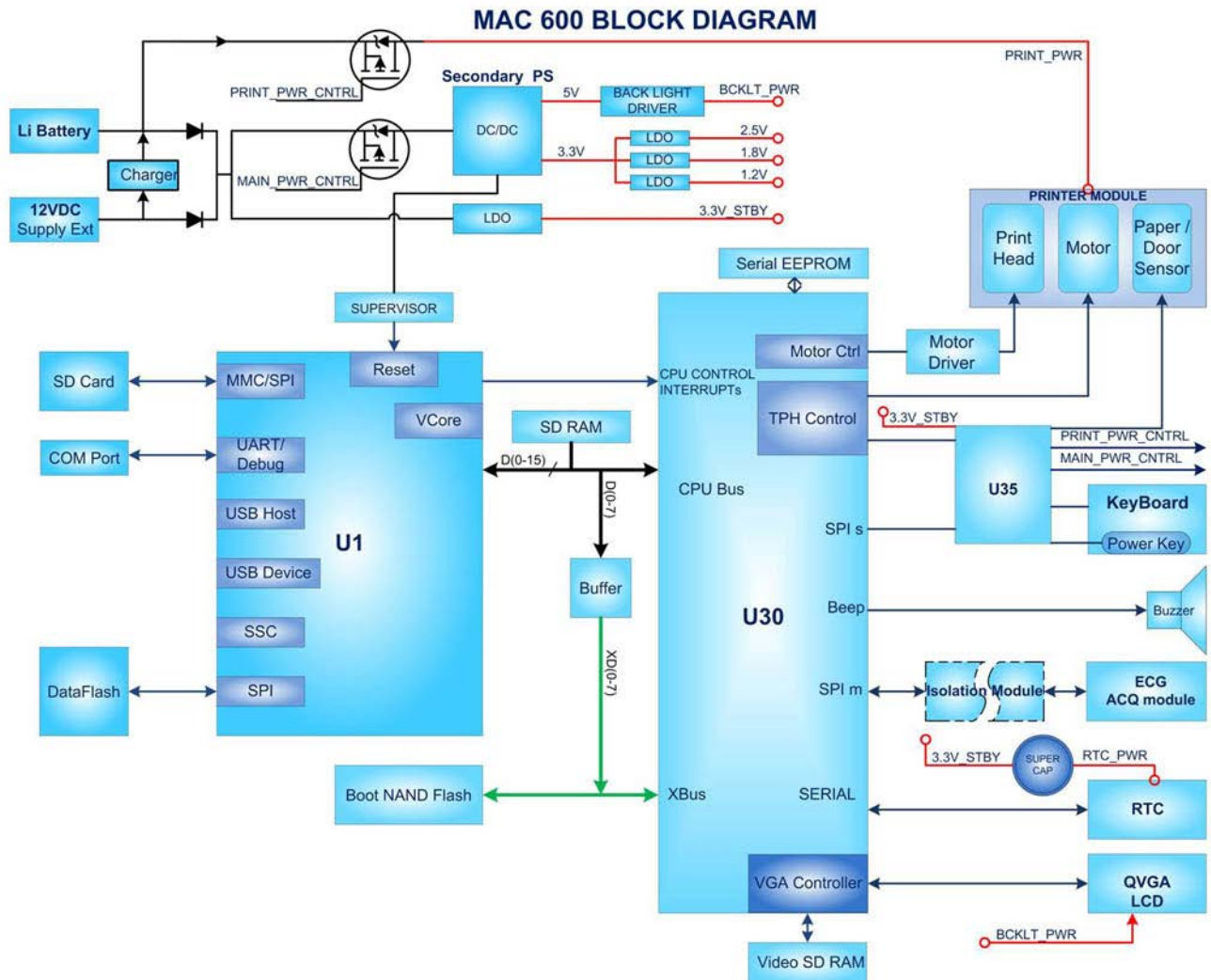
Table 2-6. Option Code Label Contents

6	XML Format
7	PDF Format

**NOTE**

The option label only includes information regarding ordered options. If no options were ordered, this label is not present.

## General Description



### Hardware/Firmware Architecture:

The MAC 600 hardware subsystems include the following:

- CPU board
- Power management
- Printer control
- Display driver and Isolated ECG acquisition

- Display
- Keypad
- Thermal printer
- External ACDC Power supply (of 100V -240V +/- 10% AC and gives single output of 12V @ 1.5 A)
- Housing
- Battery



# 3 Troubleshooting

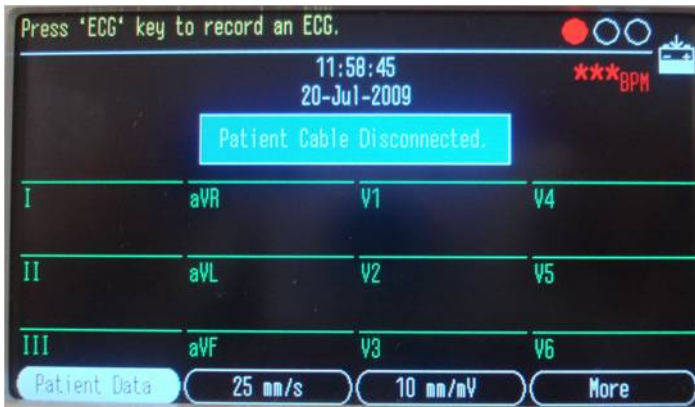
**For your notes**

# General Fault Isolation

## Power-up Self-Test

See *Equipment Overview* in the *MAC 600 Operator's Manual* for information regarding the operation of the device.

On power-up, the start-up screen opens.



### NOTE

Battery charging indication and time may vary.

If the equipment is not working properly:

- Is the unit turned on?
- Have you made changes in usage, location, or the environment that could cause the failure?
- Has the hardware or software been modified since last use?
- Is operator error the cause of the problem?
- Are you following the steps as described in the operator's manual.
- Is the battery installed?
- If connected to the AC wall outlet, is the green external power LED glowing?

## Poor Quality ECGs

Poor quality ECGs can be caused by factors in the environment, inadequate patient preparation, hardware failures related to the acquisition module, lead wires, cables, or problems in the unit.

# Visual Inspection

A visual inspection of the equipment can detect disconnected cables, debris on circuit boards, missing hardware, and loose components. These could cause symptoms, and equipment failures.

## NOTE

Perform the visual checks before starting any troubleshooting procedures.

Table 3-1. Visual Inspection List		
SI No:	Area	Look for:
1	I/O connectors and cables and AC power cord	<ul style="list-style-type: none"> <li>■ Fraying or other damage</li> <li>■ Bent prongs or pins</li> <li>■ Cracked housing</li> <li>■ Loose screws in plugs</li> </ul>
2	Interface cables	<ul style="list-style-type: none"> <li>■ Excessive tension or wear</li> <li>■ Loose connection</li> <li>■ Strain reliefs out of place</li> </ul>
3	Circuit boards	<ul style="list-style-type: none"> <li>■ Moisture, dust, or debris (top and bottom)</li> <li>■ Loose or missing components</li> <li>■ Burn damage or smell of over-heated components</li> <li>■ Socketed components not firmly seated</li> <li>■ PCB not seated properly in edge connectors</li> <li>■ Solder problems: cracks, splashes on board, incomplete feed through, prior modifications or repairs</li> </ul>
4	Ground wires/wiring	<ul style="list-style-type: none"> <li>■ Loose wires or ground strap connections</li> <li>■ Faulty wiring</li> <li>■ Wires pinched or in vulnerable position</li> </ul>
5	Fasteners	Loose or missing screws or other hardware, especially fasteners used as connections to ground planes on PCBs
6	Power source	<ul style="list-style-type: none"> <li>■ Faulty wiring, especially AC outlet</li> <li>■ Circuit not dedicated to system</li> </ul> (Power source problems can cause static discharge, resetting problems, and noise.)
7	Keypad	<ul style="list-style-type: none"> <li>■ Cuts or cracks in keypad membrane</li> <li>■ Illegible labels</li> </ul>
8	LCD display	Scratched or opaque display filter
9	Battery pack	<ul style="list-style-type: none"> <li>■ Cracked, swollen, or leaky battery pack enclosure</li> <li>■ Debris on battery pack electrical contacts</li> </ul>

Table 3-1. Visual Inspection List		
SI No:	Area	Look for:
10	SD card	<ul style="list-style-type: none"> <li>■ Cracked SD card</li> <li>■ Broken gold contacts</li> </ul>

## Performing Diagnostic Tests

Verify that the MAC 600 Resting ECG Analysis System operates properly by running the diagnostic tests. These tests check the operation of the display screen, buzzer, keypad, thermal writer, battery, and communications. Diagnostic tests are useful for troubleshooting problems and the system checkout procedures.

## Accessing the System Diagnostics Function

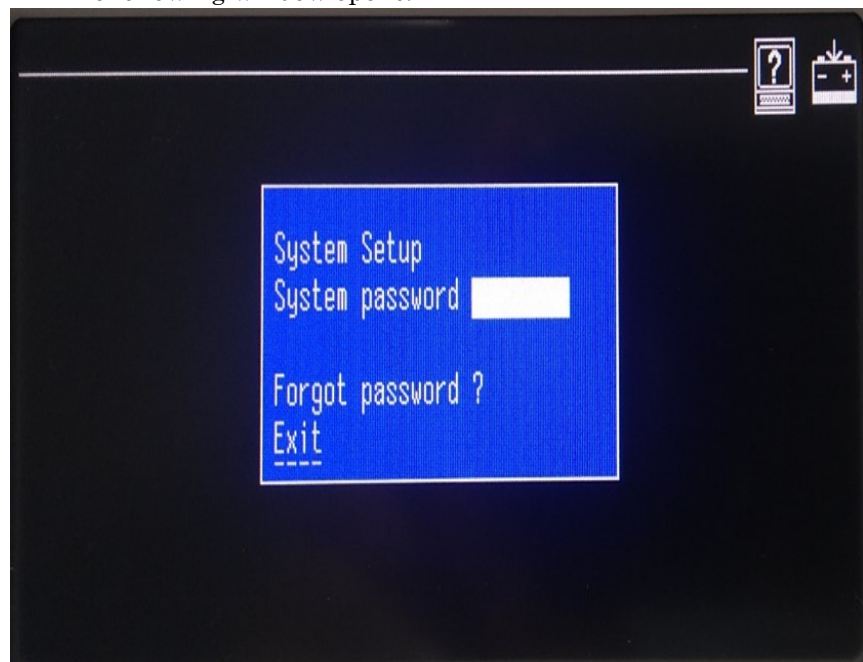
### NOTE

Before performing the diagnostic tests, make sure the language is set to English. Refer to the *MAC 600 Operator's Manual* for more details on language settings.

To access the *System Diagnostics* menu:

1. Press the **Power** button.
2. From the Main Menu, select *Setup*.

The following window opens.



**System Setup 1**

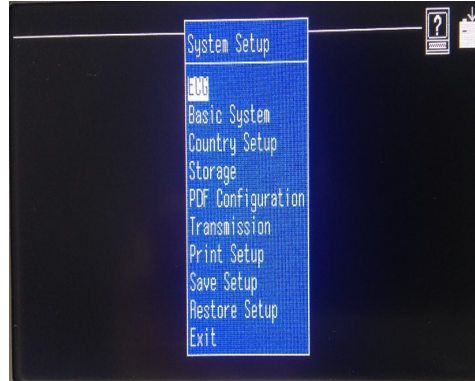
3. Enter the default password **11112222**.

**NOTE**

**11112222** is the factory default password. You can change this password. Use the current password to enter into the *System Setup*.

4. Press **Enter**.

The following window opens.



**System Setup 2**

5. Press the **F1** and **Lead** keys together.

The following window opens.



**System Setup 3**

The following sections describe how to perform the specific diagnostic tests.

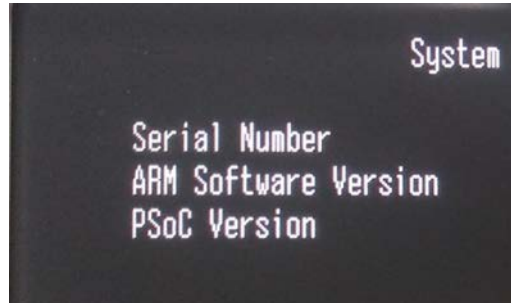
## Testing the System Information

The System Information Test can determine if the MAC 600 system is running the correct software version.



1. From the *System Diagnostics* menu, select *System Information Test*.

The following window opens.



#### Testing System Information

2. Check if the serial number and ARM software version (Application software) are correct.

#### NOTE

Check with manufacturing for the current ARM software (Application software) version.

3. Press **esc** to return to the *System Diagnostics* menu.

## Testing the Display

1. From the *Diagnostics* menu, select *Display Tests*.

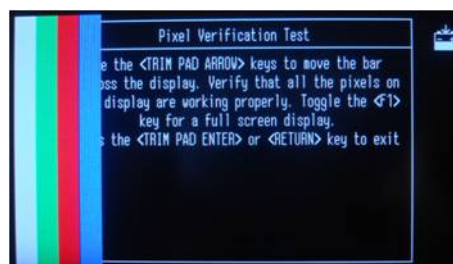
The following window opens.



#### Display Tests

2. From the *Display tests* menu, select *Pixel Verification Test*.

The following window opens.



#### Pixel Verification Test

**NOTE**

If the color option is disabled in the device, display will show a white bar in place of the four color bars.

3. Press the right **arrow** key on the keypad to move the color bars horizontally across the screen.
4. Verify that the color band pattern (white, green, red, blue) scrolls across the screen.
5. Pass the test if the pattern is replicated without discoloration.
6. Press **F1** to cycle through the solid color pane (white, green, red, and blue). For each pane, check for black pixels.

**NOTE**

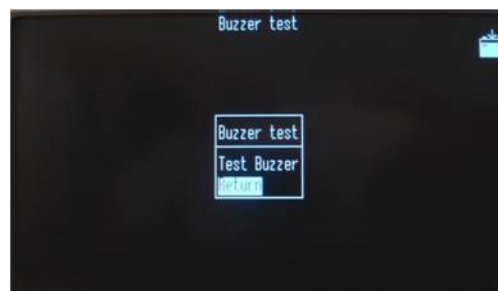
1. Press **F1** while the display is showing blue color pane, the screen will flicker briefly. This is not a problem.
2. Ignore the battery icon area on top right corner of the display while doing this test.
3. If the color option is not enabled, you will see only a white color pane.
7. Pass the test if no more than four black pixels are observed on any single color pane. Note that a black pixel observed on one pane will be observed on every pane.
8. Press **esc** or *return* to return to the *Diagnostics* menu.

**NOTE**

*The Gray Scale Test Patterns* is for manufacturing use only.

## Testing the Buzzer

1. From the *Diagnostics* menu, select *Buzzer Test*.  
The following window opens.



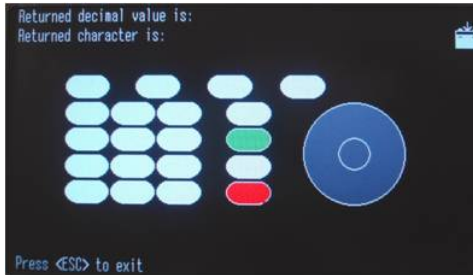
2. From the *Buzzer test* menu, select *Test Buzzer*.
3. Listen for a brief tone.
4. Press **esc** to return to the *Diagnostics* menu.



## Testing the Keypad

1. From the *Diagnostics* menu, select *Keyboard Test*.

The following window opens.



2. Press each key on the keypad and verify that the response appears in the corresponding representation of that key on the screen. When the corresponding key is pressed, a decimal value appears on the screen. That will indicate whether or not the test has passed.

### NOTE

Press **Esc** key in the end, as this will also exit from keyboard test.

See the following table for the decimal value matches that should be present to pass the test.

Table 3-2. : Testing the Keypad			
Key	Returned Decimal Value	Returned Character	Symbol on Display
Number key 1	49	1	1
Number key 2	50	2	2
Number key 3	51	3	3
Number key 4	52	4	4
Number key 5	53	5	5
Number key 6	54	6	6
Number key 7	55	7	7
Number key 8	56	8	8
Number key 9	57	9	9
Number key 0	48	0	0
Key <b>Backspace</b>	8	□	del
Function key <b>F1</b>	1	□	F1

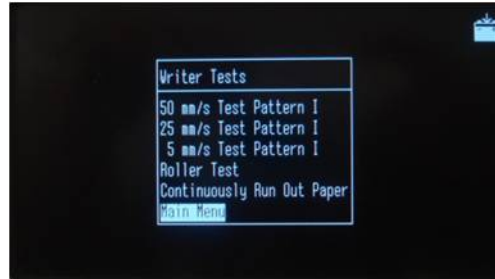
Table 3-2. : Testing the Keypad			
Function key <b>F2</b>	129		F2
Function key <b>F3</b>	130		F3
Function key <b>F4</b>	131		F4
<b>Lead</b> key	134		Lead
<b>Resting ECG</b> key	137		ECG
<b>Rhythm</b> key	5		Rhy
<b>Stop</b> key	139		Stop
<b>Trim Left</b> key	150		^
<b>Trim Up</b> key	150		^
<b>Trim Right</b> key	150		V
<b>Trim Down</b> key	150		V
<b>Trim Center</b> key	149		In
<b>Escape</b> key	27		esc

3. Press **esc** to return to the *Diagnostics* menu.

## Writer Test

1. From the *Diagnostics menu*, select *Writer Tests*.

The following window opens.



2. Perform the *50mm/s Speed Test*.
  - a. Select the *50mm/s Speed Test* button. The writer prints the 50 mm/s speed test report.
  - b. Examine the printed report. Use the following criteria to determine if the writer passed or failed the 50mm/s speed test.
    - ◆ Count the number of subdivisions printed in a 20mm grid.
    - ◆ If the count is between 19-21, the test has passed.

### NOTE

We recommend that you use a wider grid such as 50mm for more accurate readings. For a 50mm span, the expected result is a count of 45-55.

3. Repeat step 2 for the 25mm/s and 5mm/s speed tests. The pass-fail criteria for each of the remaining tests are the same as indicated above.
4. Perform the *Roller Test*.
  - a. Check that the test pattern printing is consistent. A white or black line across the pattern indicates a defective or missing print head dot. Replace the thermal printer assembly. See [“Replacing the Thermal Printer”](#) on page 4-5.
5. Perform the *Continuously Run Out Paper Test*.

This test continuously rolls out the paper. It also shows the number of pages ejected if the unit is set in Z-fold paper mode.

If the number of pages does not increase while in Z-fold paper mode, and if you run out of paper, there is a problem with the Thermal Printer Cue sensor or the paper is not placed correctly. Check the paper placement, if the problem persists replace thermal printer assembly. See [“Replacing the Thermal Printer”](#) on page 4-5.

6. Select *Main menu* and press **Enter** to return to *System Diagnostics*.

## Battery Tests

1. From the *Diagnostics* menu, select *Battery Tests*.

The following window opens.



2. Select *Battery Status*.

The following window opens.



3. Check the battery voltage from this menu along with charging status.

Battery voltage can range from 6.0 – 8.5V.

If connected to mains, the system displays *Charging battery*.

If operating from battery, the system displays *Operating on battery power*.

If the battery is fully charged, the system displays *AC power ON but not charging*.

4. Press **esc** to return to the *Diagnostics* menu.

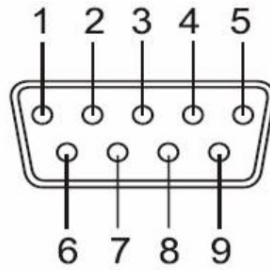
## Communication Tests

1. From the *Diagnostics* menu, select *Communication Tests*.

The following window opens.

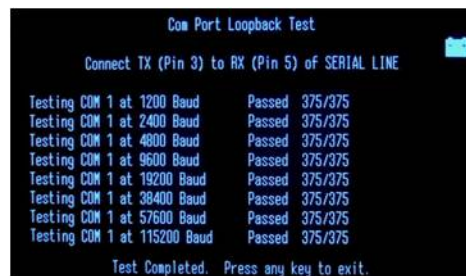


- To run the test, connect pin 3 to pin 2 using a jumper and then press any key to start. (For the connector pin outs, refer to the following figure). The test will return a pass/fail for several baud rates.



PIN	NAME
1	No Connect
2	RxD
3	TxD
4	DTR
5	Gnd
6	DSR
7	RTS
8	CTS
9	+12V

- If the test passes for all baud rates, the following screen appears with the pass status for all baud rates.



- Press **esc** to return to the *Diagnostics* menu.

## Acq. Module Tests

This test is not recommended for service.

## SD Card Tests

1. From the *Diagnostics* menu, select *SD Card Tests*.

The following window opens.



2. The SD Card Tests performs a read/write test on the SD card currently installed. The test will respond with a PASS or FAIL.

### NOTE

If the card is not formatted correctly, an error message will appear at the bottom of the screen. To format an SD card, follow the error message and Press the **F1** key to continue formatting.

3. To fix a defect, replace the CPU board. See [“Replacing the Main PCB Assembly”](#) on page 4-15.
4. Press **esc** to return to the *Diagnostics* menu.

## PWA Connector Details

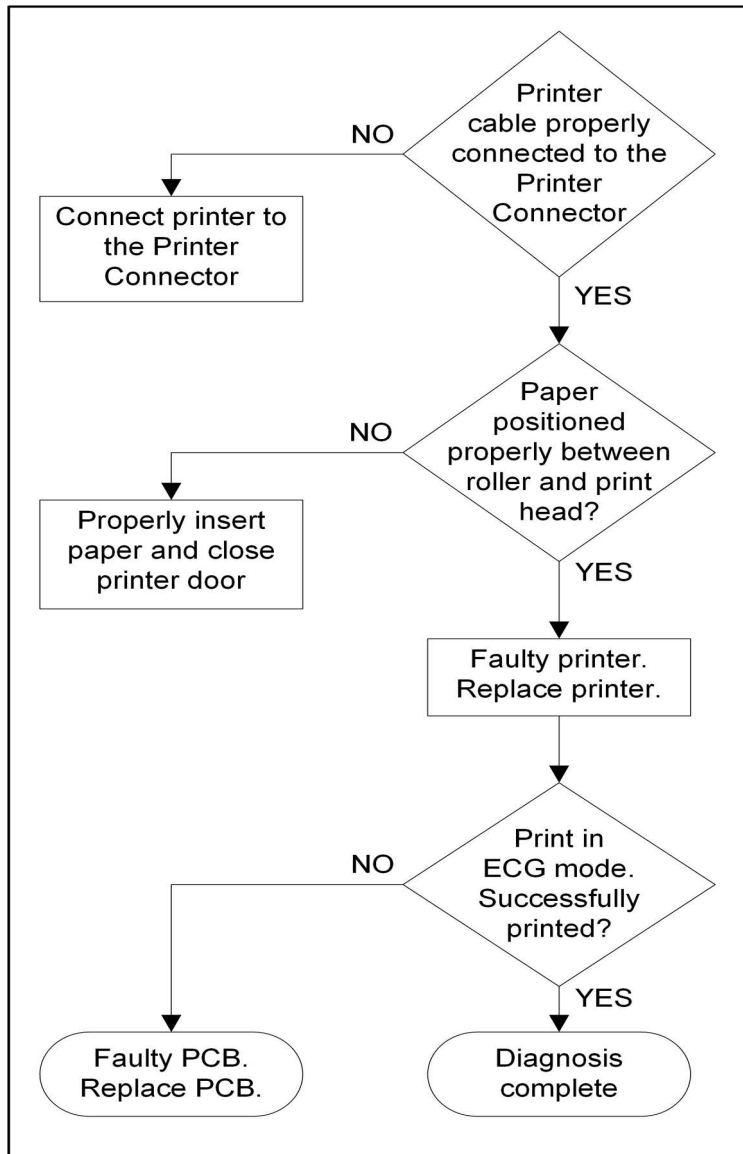
The legends for the PWA Connectors (J1, J2 etc) for the new PWA FRU 2066447-003 are different as compared with the old PWA FRU 2047330-001. Refer the following table for the old and new connector legends:

Connector Description	OLD PWA FRU PN: 2047330-001	NEW PWA FRU PN:2066447-003
Key sheet	J4	J7
Display	J5	J6
Printer	J10	J5
SD Card	J1	J3
Power In	W1	W1
RS232	J2	J2
JATAG	J3	J8
USB	J9	J1
Modem	J12	J9

Connector Description	OLD PWA FRU PN: 2047330-001	NEW PWA FRU PN:2066447-003
Patient Cable	J7	J11
Battery	J11	J10

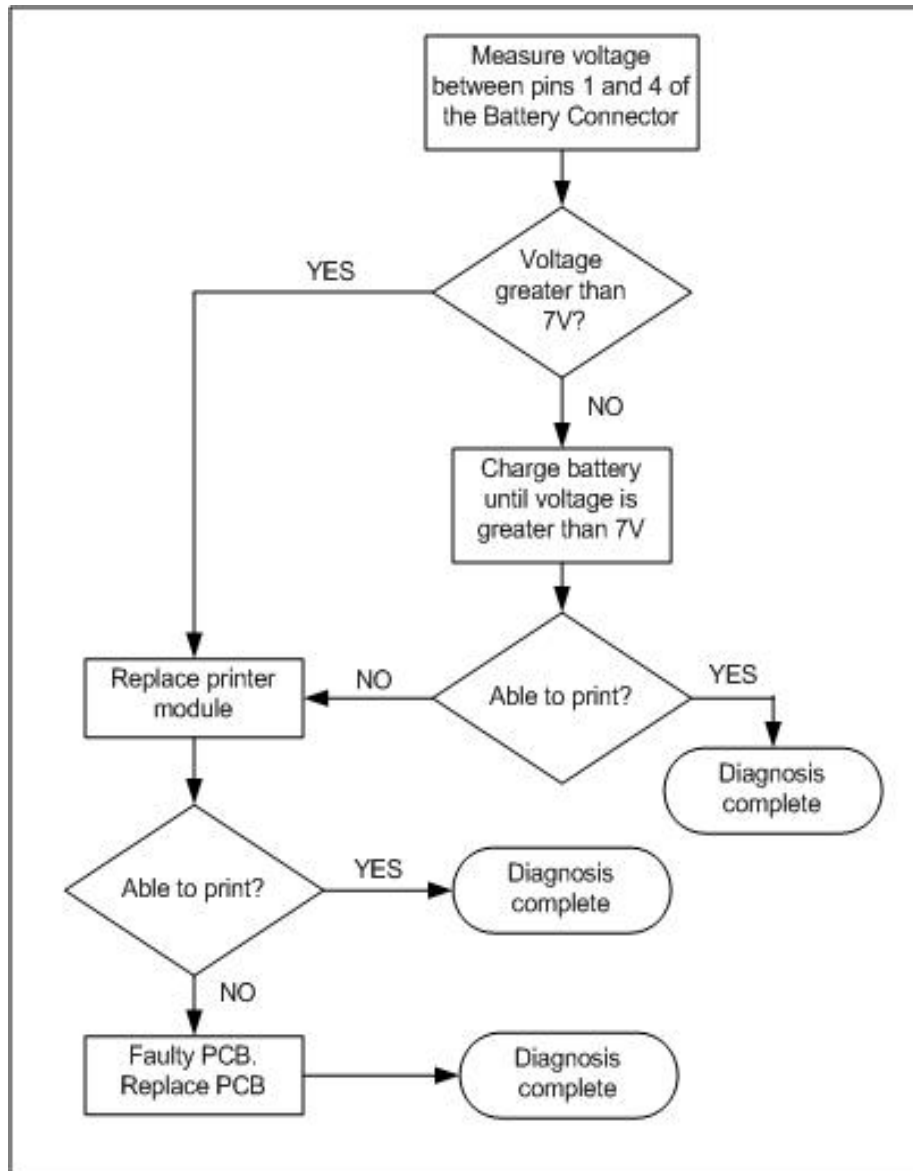
# Equipment Problems

## Paper Error Message

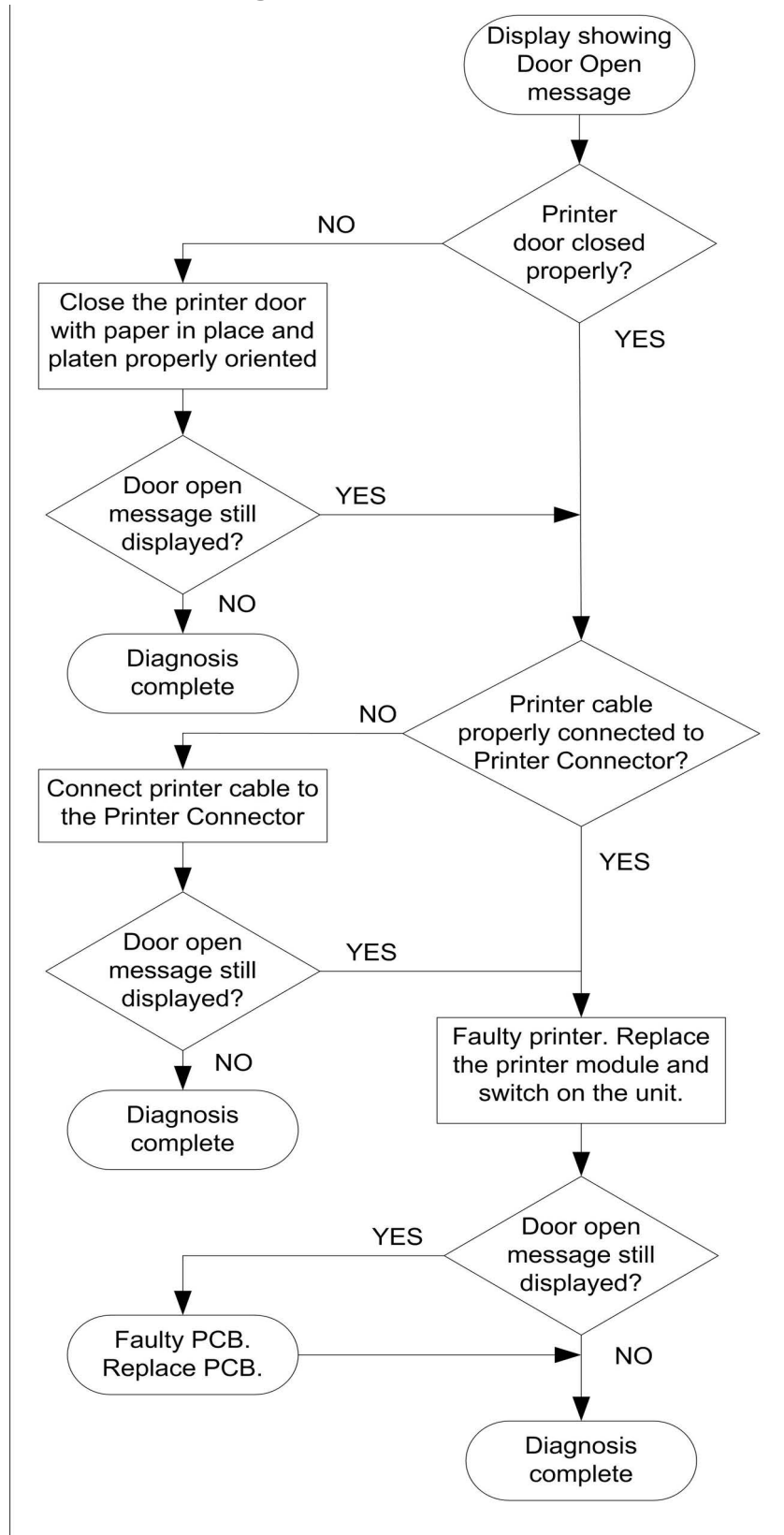




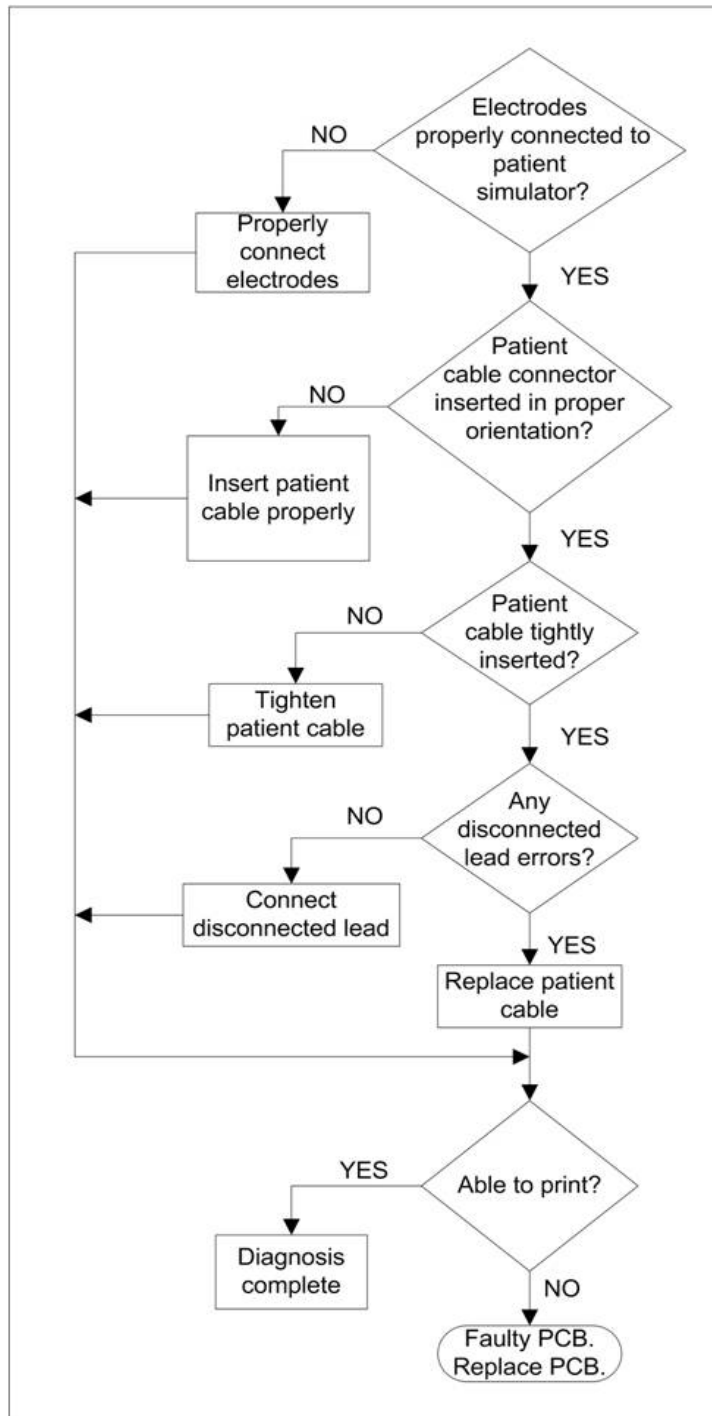
## Paper Moving But Not Printing



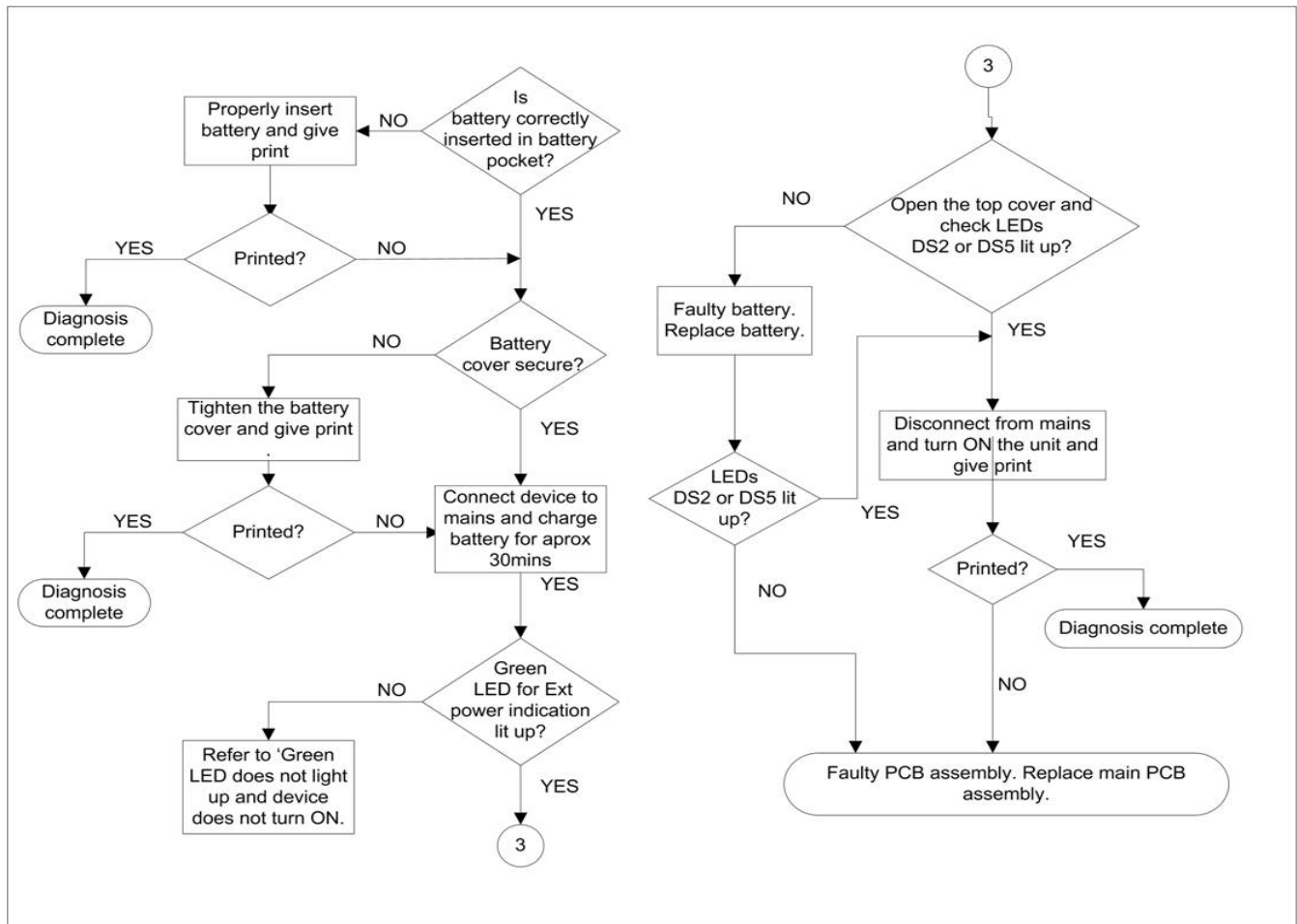
## Printer Door Open Message



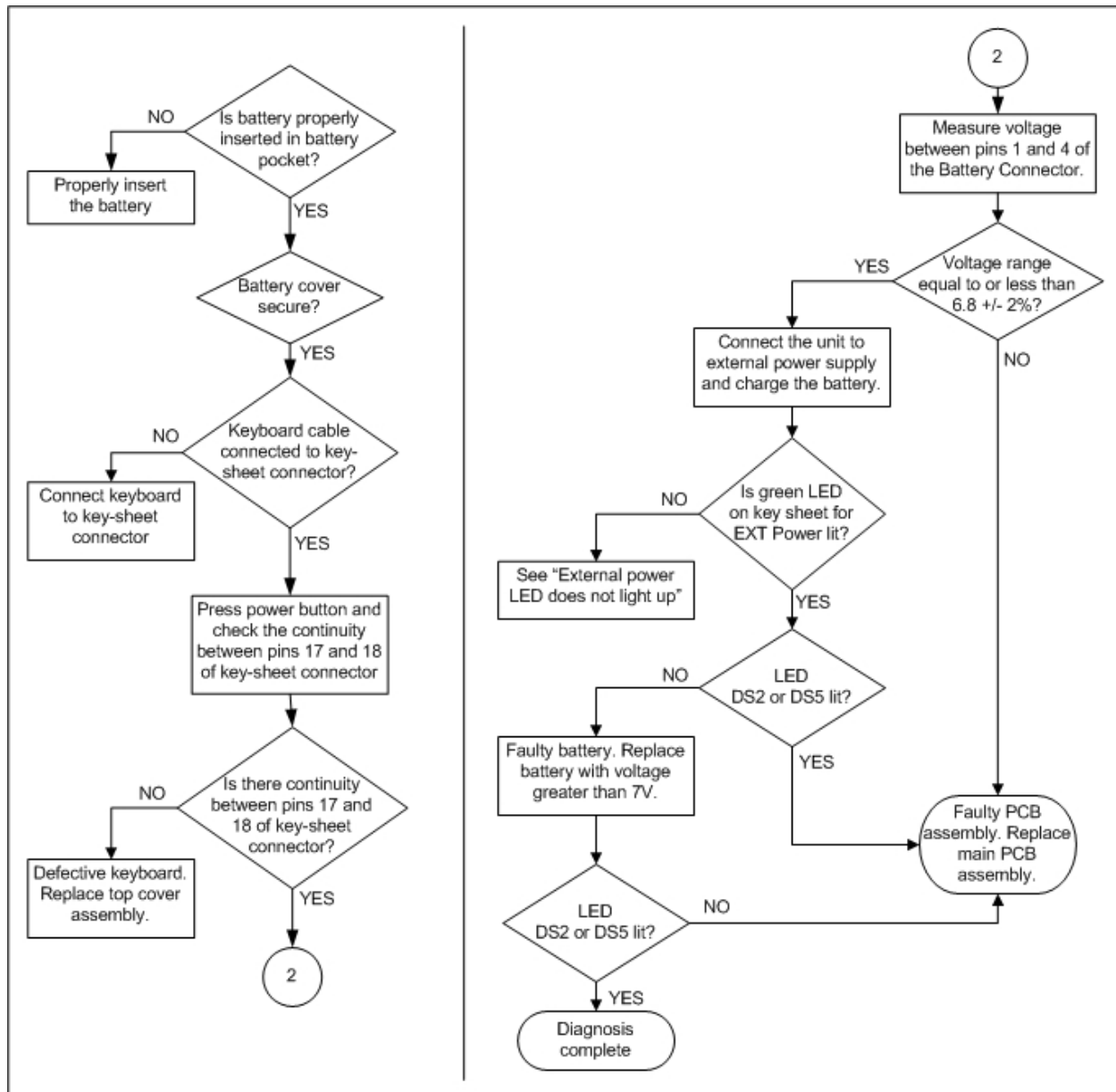
## Printing Only Baselines



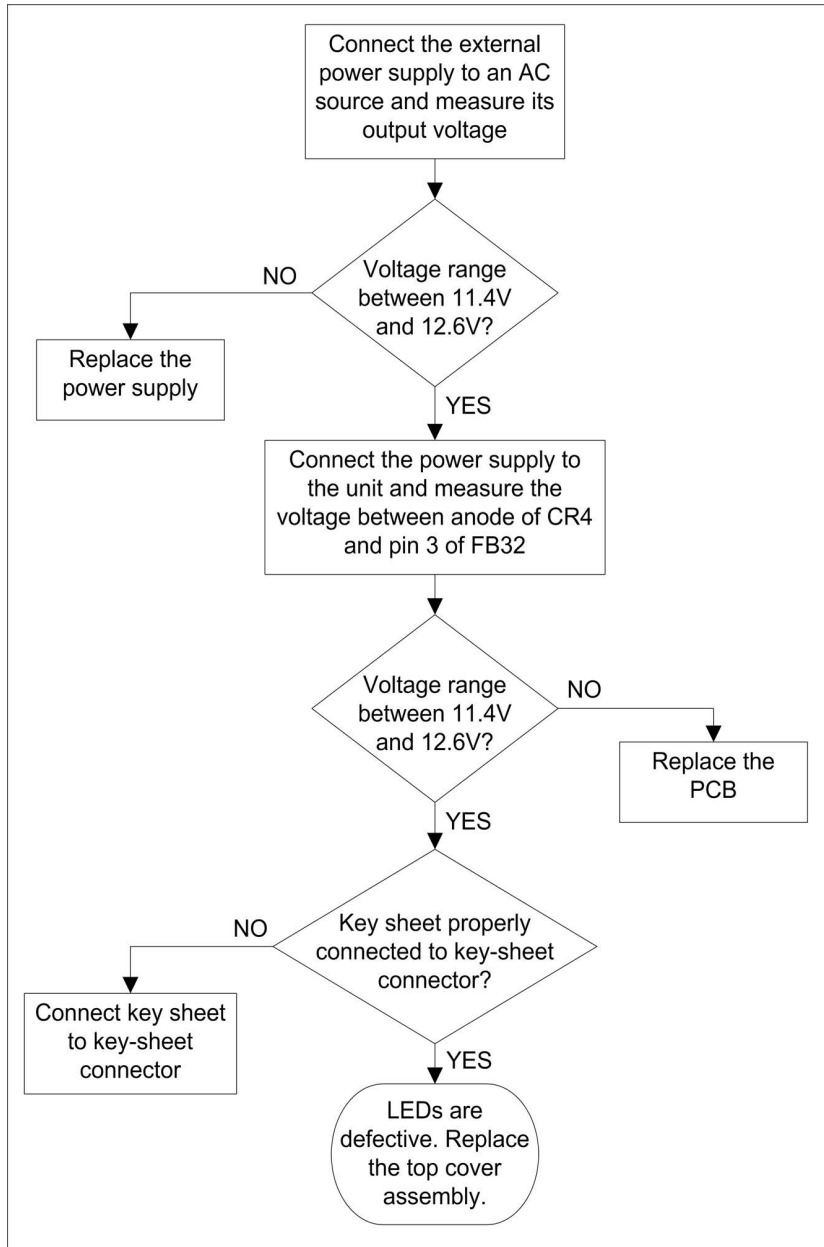
## Battery Error Message



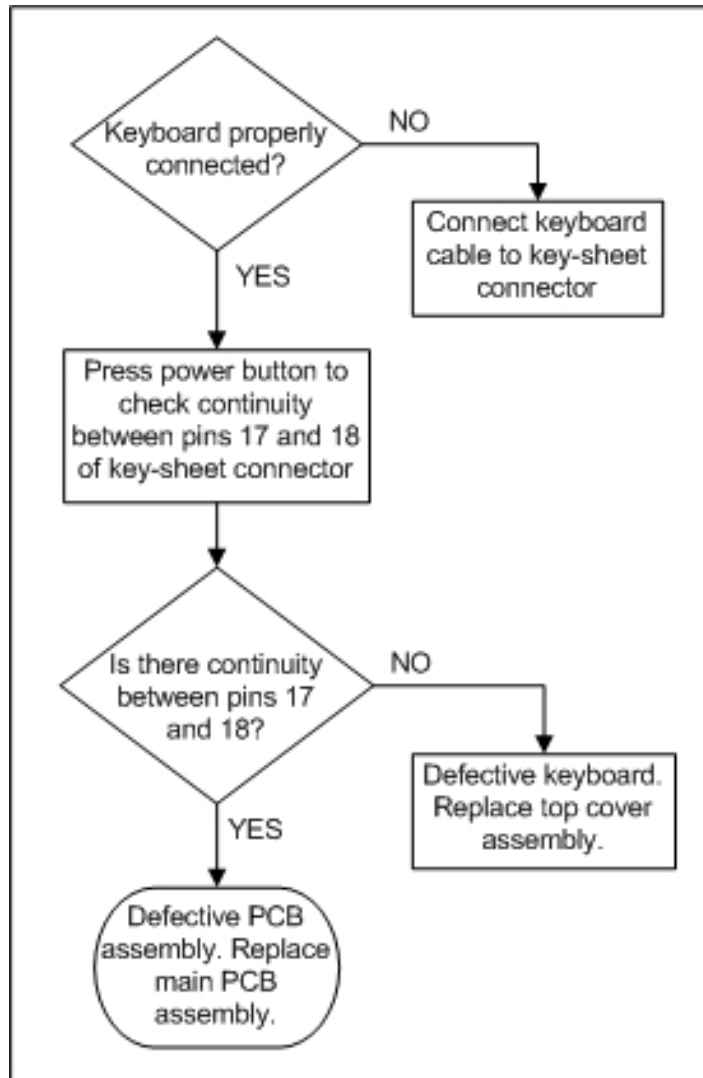
## Unit Not Turning ON in Battery Mode



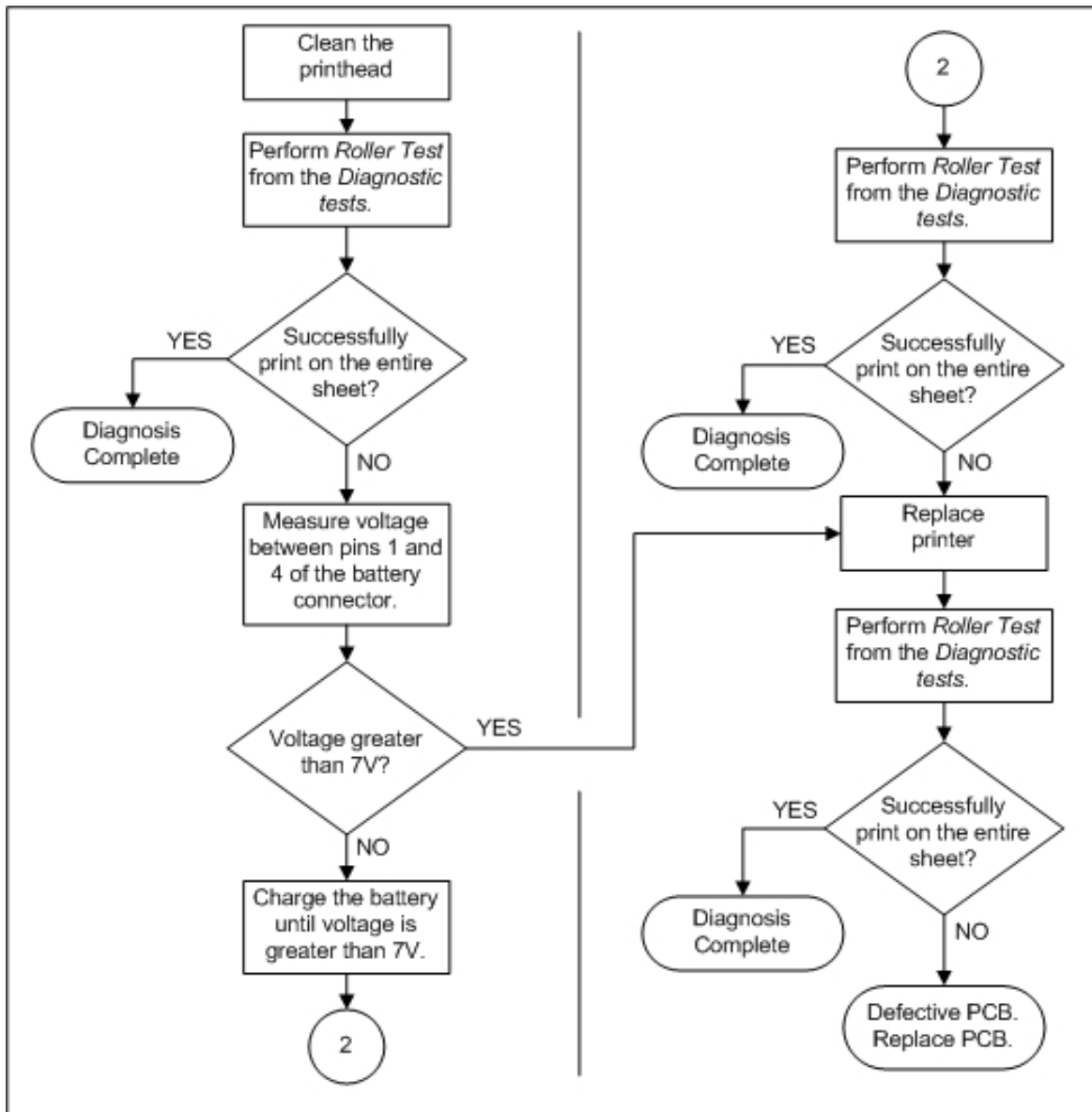
## External Power LED Not Lighting Up



## External Power LED Lights Up But Unit Not Switching ON

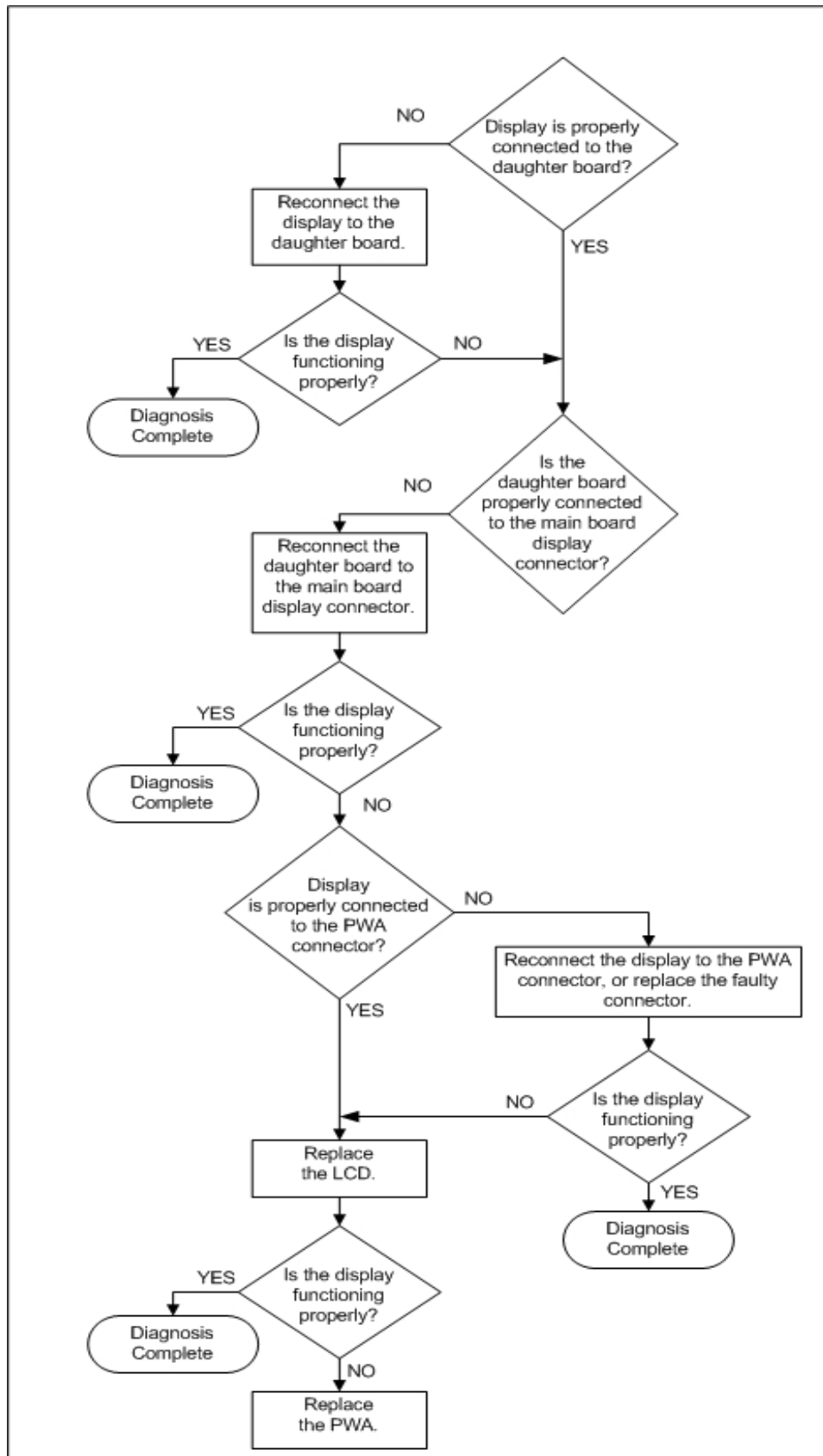


## Data Does Not Print on Upper and Lower Edges of Paper





## Blank or Unstable Display With Color Patches





# 4 Maintenance

**For your notes**

# Preparing System for FRU Replacement

Prior to performing any disassembly procedure, perform these steps.

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**CAUTION**

Take strict precautions against electrostatic discharge damage while replacing field replaceable units.

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Only approved personnel may conduct repairs.

1. Power off the system.
2. Disconnect the unit from the AC wall outlet.
3. Disconnect the power cord from the ACDC adaptor.
4. Disconnect the patient cable from the unit.
5. Remove the battery as described in “Replacing the Battery” on page 4-4.
6. When replacing FRUs, implement ESD protection if applicable.
7. Defective or empty LI-Ion batteries should be disposed of in accordance with the applicable legal stipulations or returned to the factory.

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**WARNING**

OPERATOR SAFETY — Repairing the device when powered on may cause injury. Necessary Personal Protective Equipment are recommended while performing maintenance.

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**WARNING**

To ensure patient safety, use only parts and accessories manufactured or recommended by GE Healthcare.

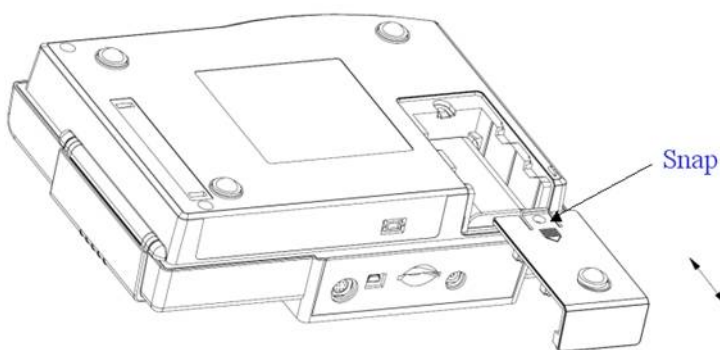
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## Required Tools and Manuals

Table 4-1. Required tools and manuals	
SI no:	Description
1	Phillips screwdriver
2	Anti-static wrist strap
3	Service manual as needed for reference
4	Safety tester for measurements according to 60601-1
5	Connecting wires and clips required for electrical safety tests (optional)
6	Multi-meter
7	Multi Lead ECG simulator
8	MAC 600 Operator's Manual for reference
9	Nose Plier
10	Recommended SD card

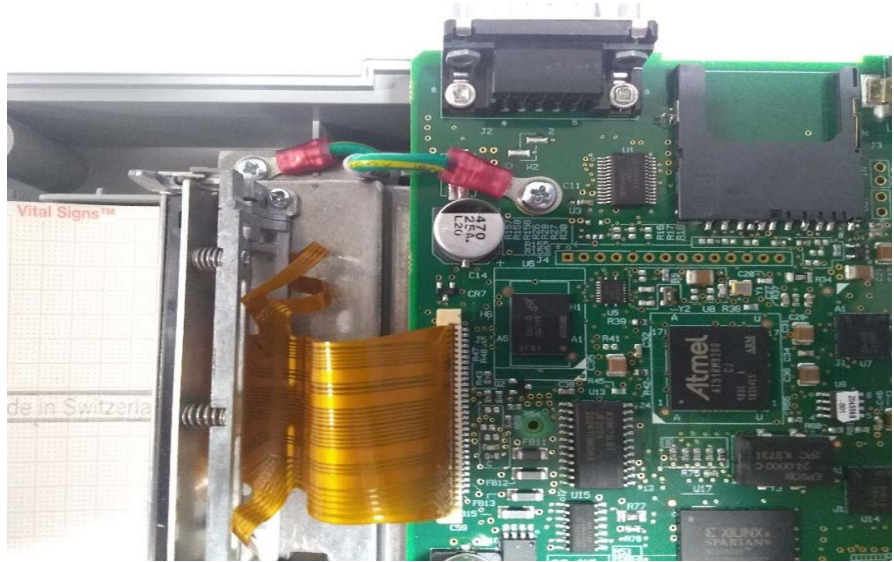
## Replacing the Battery



1. Lift the snap region in the battery cover and slide it out of the bottom cover.
2. Remove the battery from its compartment.
3. Place the new battery into the battery compartment with the battery label facing downwards, and the battery terminals facing the battery contacts on the PCB. Reverse voltage protection is implemented mechanically.

## Replacing the Thermal Printer

Class I - Earth cable routing:



1. Open the device and printer door as described in “Opening the Device” on page 4-6.
2. Open connector J10 for the old PWA and J5 for the new PWA (refer “PWA Connector Details” on page 4-8) to disconnect the flat ribbon printer cable.
3. Remove the roller from the printer door.
4. Remove the Earthing Cable connecting the printer base with the PCB.
5. Remove the two fasteners fastening the base of the printer to the printer bracket.
6. Align the mounting holes of the new printer with those on the printer bracket.
7. Use the screws to fasten the printer onto the printer enclosure.
8. Connect the flat ribbon cable to the printer connector on the PCB.
9. Align the roller on the printer door and press it into position.

### NOTE

Ensure that the roller gear aligns with the gears of the thermal printer.

## Opening the Device



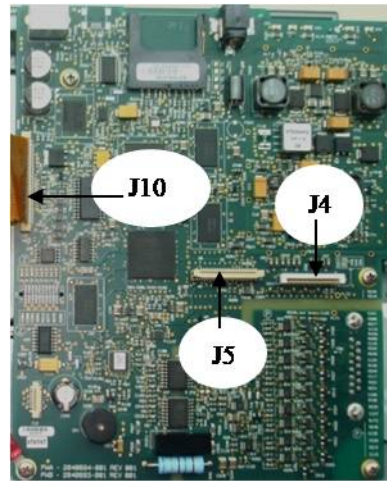
**Table 4-2. Opening the Device**

Legend	Description
1	Detach key sheet FPC from main board
2	Detach display FPC from main board

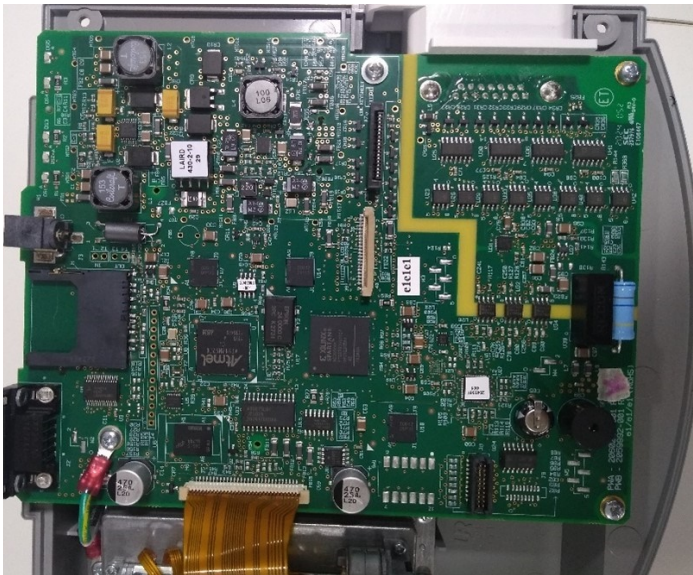
1. Remove all cables from the unit, if connected.
2. Remove the battery as described in [“Replacing the Battery”](#) on page 4-4.
3. Turn the device upside down and remove the four fastening screws on the bottom.
4. With the keypad facing up, open the printer door along with the roller.
5. Raise the top cover of the housing and disconnect the keypad cable from the J4 connector and Display cable from the J5 connector for the old PWA or the keypad cable from the J7 connector and Display cable from the J6 connector for the new PWA connector. Refer the following figure for PWA connector details.



PWA Connectors for FRU PN 2047330-001 (old PWA).



PWA Connectors for FRU PN 2066447-003 (new PWA).



PWA Connector Details

Table 4-3. PWA Connectors		
Connector Description	OLD PWA FRU PN: 2047330-001	NEW PWA FRU PN:2066447-003
Key sheet	J4	J7
Display	J5	J6
Printer	J10	J5
SD Card	J1	J3
Power In	W1	W1
RS232	J2	J2
JATAG	J3	J8
USB	J9	J1
Modem	J12	J9
Patient Cable	J7	J11
Battery	J11	J10

## Reworking the Power Supply (Class II to Class I)

The MAC600 Class II Power Supply (PS) FRU P/N 2047328-001 is obsolete. The new power supply is qualified as Class I and the P/N is 2047328-002. In order to use the Class I power supply in the MAC600, the safety classification of MAC600 device needs to change from Class II to Class I.



Table 4-4. Power Supply Labels

Legend	Description
1	Class II Power Supply label
2	Class I Power Supply label

Depending on the Serial number of the device different levels of rework are required. See the following table for further details.

### NOTE

All MAC 600 shipments to China are Class I. Therefore, further rework is not required. For China, see **“2047328-002 FRU EXTERNAL POWER SUPPLY - CLASS I”** on page 5-7.

If Serial Number is:	Then Perform:
less than or equal to SF713346059PA	<ol style="list-style-type: none"> <li>1. <b>“Earth Cable Routing”</b> on page 4-10</li> <li>2. <b>“Changing the Product Label”</b> on page 4-11</li> <li>3. Change the Power Supply FRU (P/N 2047328-002).</li> </ol>
between SF713346060PA and SF713496708PA	<ol style="list-style-type: none"> <li>1. <b>“Changing the Product Label”</b> on page 4-11</li> <li>2. Change the Power Supply FRU (P/N 2047328-002).</li> </ol>
equal to or greater than SF713500001PA	<ol style="list-style-type: none"> <li>1. Change the Power Supply FRU (P/N 2047328-002).</li> </ol>

# Earth Cable Routing

Verify the earth cable routing is as shown in the following figure. It should connect screw A and screw B. This is the Class II Earth (ground) cable routing. To change the cable routing to comply with Class I requirements, perform the following procedure.

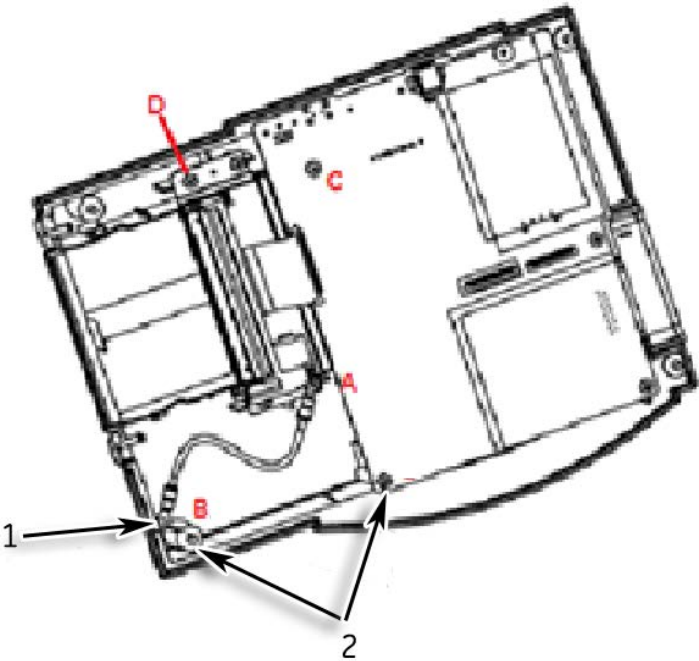


Table 4-5. Routing the Earth Cable

Legend	Description
1	Assembly of the earthing cable with main PCB assembly
2	Earthing cable assembly location
A and B	Class II Earth cable routing
C and D	Class I Earth cable routing

1. Open the device and printer door as described in “Opening the Device” on page 4-6.
2. Remove the screws from location A and B.
3. Remove the earth cable (2033817-001).
4. Using the cable and screws from steps 2 and 3, place the cable on location C and D. The other end D can be connected to either of the screw points on the printer base. Ensure the cable does not touch any components on the PCB board and secure it in place with the screws.

- 
- A close-up photograph of a custom printed circuit board (PCB) assembly. A yellow ribbon cable is connected to a multi-pin connector on the left. The PCB is populated with various electronic components, including a large integrated circuit (IC) labeled 'Amel' (likely a microcontroller), several resistors, capacitors, and smaller ICs. A silver cylindrical component, possibly a battery or a capacitor, is visible near the top. The assembly is mounted on a metal frame, and a white label with the text 'Vital Signs™' is partially visible in the background.

- ## Changing the Product Label

The image shows the rear of the MAC 600 device. On the left, there is a gold-colored coaxial port, a black circular port, and a VHS tape slot. To the right of the VHS slot is a D-sub connector. Below these ports are several warning and safety icons. On the far right, there is a label with technical specifications and a barcode. Two arrows, labeled 'A' and 'B', point to the label. Arrow 'A' points to the top section of the label, and arrow 'B' points to the bottom section of the label.

Table 4-6. Product Labels

Legend	Description
A	Product label
B	Serial number label

1. The existing product label shows the product is class II (the double square box on the following label indicates that the device is Class II). Remove this label from the device.





2. The new Class I product label is as follows. Place the new label on the back panel (the label is part of the 2047328-002 FRU).







Table 4-7. Replacing the Display	
Legend	Description
1, 2, 3, 4, 5	Sequence of snap detachment.
	Dotted line direction of snap pull.
	Continuous line direction of display holder pull.

1. Open the device as described in [“Opening the Device”](#) on page 4-6.
2. Raise the top cover of the housing and disconnect:
  - ◆ The keypad cable from the J4 connector for the old PWA, or J7 connector for the new PWA
  - ◆ The display cable from the J5 connector for the old PWA, or J6 connector for the new PWA (refer [“PWA Connectors for FRU PN 2066447-003 \(new PWA\).”](#) on page 4-8)
  - ◆ The display cable connector from the J2 connector on the Daughter PCB.
3. Remove the daughter board from the display holder as described in [“Replacing the Daughter PCB assembly”](#) on page 4-17.
4. Start with snap number 1, pull the snap out and push the display holder in the direction of the arrow. Follow the same procedure for snaps number 2, 3 and 4.
5. Once snaps number 1, 2, 3 and 4 are detached, lift the left side of the display holder and remove the LCD Module from the cover top pocket.
6. Pull out the display holder to the left to detach it from snaps number 5 and 6.
7. Make sure the O-ring is in place or replace it with the new one.
8. Replace the new LCD module in the pocket of cover top, with the cable on the bottom side.
9. Place the display holder on the cover top with all the snaps aligned.
10. Press the display holder at each snap region, to assemble the display holder to the cover top.
11. Connect the display cable connector to the J2 connector on the daughter PCB.
12. Snap the daughter board to the display holder.
13. Re-connect the display cable to J5 for the old PWA or J6 for the new PWA and the keypad cable to J4 for the old PWA or J7 for the new PWA.



14. Re-attach the upper section of the device to the lower section with the four screws.

## Replacing the Main PCB Assembly



### NOTE

If possible, save the current settings before replacing the PCB assembly. For information about saving system setup, see [“Saving Setup”](#) on page 4-29.

## Adding Ferrite to the Power Supply

If you are replacing an old PWA with a new PWA, follow these steps to add ferrite to the power supply.

1. Switch off the mains supply to the unit.
2. Disconnect the ACDC adapter from the mains power cord.
3. Disconnect the ACDC adapter cable from the MAC600.
4. Unlock the ferrite (74271131) present in the FRU kit using the key (2055233-001) shown in the following figure.



5. Put a turn inside the ferrite core near the tip of the ACDC adapter cable that connects the unit, as shown.



6. Press the ferrite to close the lock.
7. Reconnect the cables.
8. Perform functional tests associated with the adapter change.

## Replacing the main PCB

### NOTE

Before replacing the main PWA we recommend that you update the SW (refer to [“Programming MAC 600 Device Without User Interface”](#) on page 4-32) and check if the problem can be resolved.


1. Open the device as described in [“Opening the Device”](#) on page 4-6.
2. Disconnect the display cable from J5, for the old PWA or J6 for the new PWA, the keypad cable from J4 for the old PWA or J7 for the new PWA, and the printer cable from J10 for the old PWA or J5 for the new PWA. (refer [“PWA Connector Details”](#) on page 4-8).
3. Remove the four screws fastening the PCB assembly to the bottom cover.
4. Return the PCB assembly to the factory in the ESD packaging.
5. Attach the new main PCB assembly by aligning the mounting holes with those in the bottom cover, and fastening the new PCB assembly to the bottom cover with the screws.
6. Connect the display cable to J5 for the old PWA or J6 for the new PWA, the keypad cable to J4 for the old PWA or J7 for the new PWA, and the printer cable to J10 for the old PWA or J5 for the new PWA (refer [“PWA Connector Details”](#) on page 4-8).
7. Attach the upper section of the device to the lower section with the four screws.

8. Replace the battery in the battery compartment, slide on the cover.
9. Enter the serial number and option code (optional) as described in **“Restoring Setup”** on page 4-29.
10. Adjust the time and date. See *MAC 600 operator’s Manual* for setting date and time.
11. If possible, set the configuration to the previous user settings. If not, select the default settings.

## Replacing the Daughter PCB assembly



Table 4-8. Replacing the Daughter PCB Assembly

Legend	Description
	Press the snap using a nose plier. Lift the PCB board up.

1. Open the device as described in **“Opening the Device”** on page 4-6.
2. Remove the top cover assembly from the bottom cover.
3. Disconnect the display cable connector from the J2 connector on the daughter PCB. (refer **“PWA Connector Details”** on page 4-8).
4. Press the snap for daughter board using the nose pliers and lift the daughter board to detach from the snap.

5. Repeat step 4 for all the 3 snap features to completely remove the daughter board from the display holder snap fit mechanism.
6. Align and fix the new daughter board to the daughter board-mounting bracket snap fit mechanism.
7. Fix the ferrite with double-sided tape in line with J1.
8. Connect the display cable connector to the J2 connector on the daughter PCB.
9. Connect the display cable to J5 for the old PWA and J6 for the new PWA and the keypad cable to J4 for the old PWA and J7 for the new PWA (refer “[PWA Connector Details](#)” on page 4-8).
10. Attach the upper section of the device to the lower section with the four screws.

## Preventive Maintenance

The MAC 600 system does not require any periodic calibration.

GE Healthcare does not recommend any preventive maintenance for this system. However, the user may perform the following preventive maintenance steps.

- Recommended Maintenance
- Diagnostic Tests
- Electrical Safety Tests

If further technical assistance is required, contact the nearest GE Healthcare Service Center.

## Recommended Maintenance

This section contains the following recommended maintenance:

- Visual inspection
  - ◆ Check the device and accessories for mechanical defects, which can impair their functioning.
  - ◆ Ensure that the labels and inscriptions on the device relating to safety are clearly legible.
  - ◆ See “[Visual Inspection List](#)” on page 3-4 for other parts inspection.
- Exterior cleaning
  - ◆ Clean the exterior surfaces once per month, and more frequently if needed.
  - ◆ Use a clean, soft cloth and water with a mild detergent. Wring excess water from the cloth and wipe down the exterior surfaces of the device.
  - ◆ Dry the surfaces with a clean cloth or paper towel.
- Interior cleaning
  - ◆ Check for dust on the interior components and clean as needed.
  - ◆ Clean the thermal print head periodically to ensure good print

quality and longer printer life. To clean the thermal print head:

1. Use a disposable wrist strap to avoid static electricity.
2. Open the printer door.
3. Wipe the glazed surface of the thermal print head gently with wringed swabs dipped in ethyl alcohol.
4. When the surfaces are dry, close the printer door.

**NOTE**

Do not hit the thermal print head with anything hard.

Do not use sand paper on the thermal print head.

Do not add any unnecessary force on the thermal print head.

■ Battery maintenance

Refer to the *Battery Maintenance* section of the “MAC 600 operator’s manual”.

■ Calibration check

Refer to the *Calibration Check* section of the “MAC 600 operator’s manual”.

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**WARNING**

PROPER MAINTENANCE REQUIRED — Failure to implement the recommended maintenance schedule may cause equipment failure and possible health hazards. All responsible individuals employing the use of this device assume the responsibility for performing the recommended maintenance unless an Equipment Maintenance Agreement exists.

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## Functional Checkout

The functional checkout procedures apply to all MAC 600 systems.

### NOTE

The FRU checkout procedure for any listed FRU also applies to its internal PCBs and components.

FRU replacement procedures are contained within this chapter of the manual.

Table 4-9. FRU Replacement			
FRU Description	Tools. Refer Table 4-1, "Required tools and manuals," on page 4-4	Visual Inspection. Refer Table 3-1, "Visual Inspection List," on page 3-4	Checkout Procedure
Battery assembly	3, 8	9	1, 4, 5, 11
Main PCB assembly	1-5, 8, 10	1-5	1-3, 5-15
Top cover assembly (top cover, key sheet, back panel, key sheet ferrite)	1-3, 8-10	1-8	1, 6, 9, 10
LCD assembly ((LCD, O-ring, LCD holder, Daughter board, Display cable, display cable ferrite)	1-3, 8-10	3-8	1, 6, 9, 10
Printer module assembly or Printer base	1-4, 8-10	4, 5	1, 10, 14, 15
Printer door assembly	3, 8, 9	5	1, 10
Bottom cover assembly	1-5, 8-10-1-3,	3-6 and 9	5-15
Axle for paper roll assembly	3	N/A	N/A
Power supply	3, 4, 8	1, 6	1, 11, 14, 15
Battery cover	3	9	1
Serial cable (2047566-001)	3	1	

Table 4-10. Other Service Events			
Service Event	Tools	Visual Inspection	Checkout Procedure
No parts replaced	3, 8	1-10	N/A
Software update - Enable option	3, 8	N/A	1-13

Table 4-10. Other Service Events			
Post Installation Checkout	3, 8	N/A	1-5, 10, 11
Annual Electrical Safety tests	3, 4, 8	1-10	1-15

# Check out Procedure

## Operational Checks

Perform the functional checkout procedures that are applicable to the replacement procedure that was performed.

1. Verify the power-up self-test passed. See [“Power-up Self-Test”](#) on page 3-3.
2. Verify the serial number restored successfully. See [“Serial Number Entry”](#) on page 4-29.
3. For units with the option enabled, verify the option enabled again successfully (Enabled options will have in front of the options in option activation window). See *MAC 600 Operators Manual* for “option entry” details.
4. Verify that the new battery was charged successfully by checking the battery full indicator after it has been charged for 2-3 hours charging. See *MAC 600 Operator’s Manual*.
5. Verify the time and date were set successfully. See *“Setting the date and time”* in the *MAC 600 Operator’s Manual*.

## Diagnostic Tests

1. Verify the System /Firmware Version was successful. See [“Testing the System Information”](#) on page 3-6 for more information.
2. Verify the Display Test was successful. See [“Testing the Display”](#) on page 3-7 for more information.
3. Verify the Buzzer Test was successful. See [“Testing the Buzzer”](#) on page 3-8 for more information.
4. Verify the Keypad Test was successful. See [“Testing the Keypad”](#) on page 3-9 for more information.
5. Verify the Writer Tests was successful. See [“Writer Test”](#) on page 3-11 for more information.
6. Verify the Battery Tests was successful. See [“Battery Tests”](#) on page 3-12 for more information.
7. Verify the Communication Tests was successful. See [“Communication Tests”](#) on page 3-12 for more information.
8. Verify the SD card test was successful. See [“SD Card Tests”](#) on page 3-14 for more information.

## Electrical Safety Checks

1. Leakage current tests.
2. Ground continuity test.



## Electrical Safety Tests

The suggested safety analysis tests comply to the international standard IEC 60601-1. The tests should be performed with safety testing instruments with measuring circuits calibrated according to IEC 60601-1. To ensure personal safety, refer to the “*testing instrument’s user documentation*”.

Perform the tests under normal ambient conditions of temperature, humidity and pressure, with line voltage.

The leakage currents correspond to 110% of rated voltage for the tested unit. If this is not taken into account when performing leakage tests, the measured values must be calculated.

## Recommended Test Equipment

- Safety tester for measurements according to 60601-1.

## Recommended Test Schedule

- After initial setup.
- Once every 12 months, thereafter, as part of a regular maintenance plan.
- Whenever power sources are affected by servicing.

## Ground Resistance Test

Connect the power cord to the ACDC adaptor and adaptor out put to the unit. Check for the resistance between power cord ground and printer metal base. If the value of resistance is greater than 1 Ohm, then it results in failure.

### NOTE

The MAC600 is categorized as a Class I device.

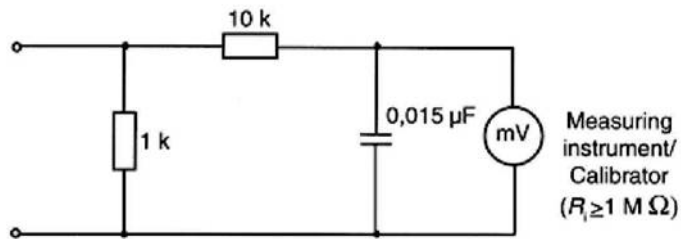
### NOTE

All shipments of MAC 600 devices to China are Class I. However, for all other countries, the MAC 600 installed base is Class II if the serial number is less than SF713500001PA.

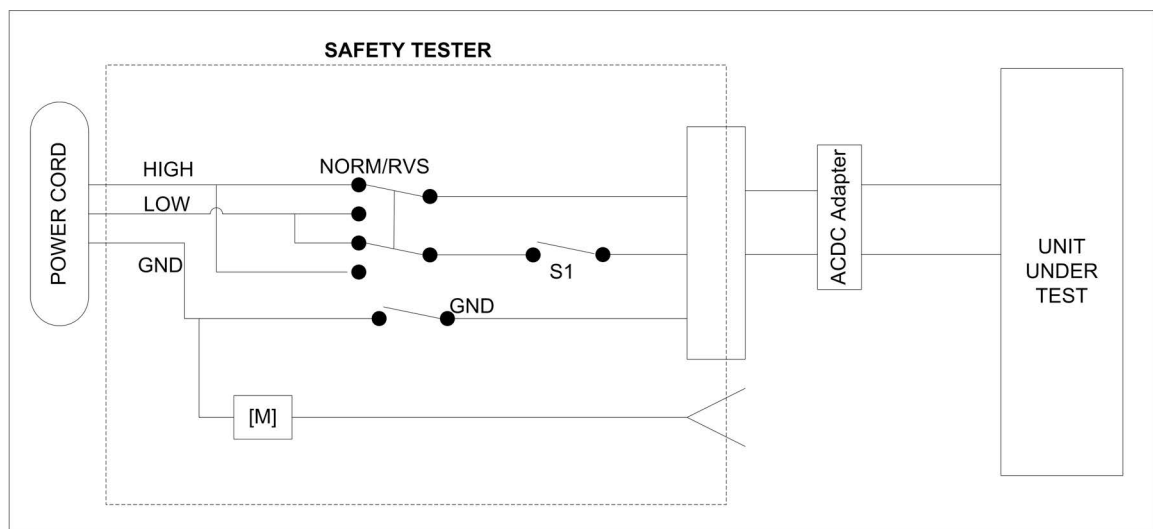
## Leakage Current Tests

The following electrical diagram shows the Measuring Circuit [M] required for leakage current. The reading in mV corresponds to mA (leakage current). The safety tester instruments generally work with this

Measuring Circuit [M] and the displayed values are converted to leakage current.



## Earth Leakage (AC line) Current Test



This test measures leakage current of the device. The device has to be turned on and off, and connected to your safety-testing equipment.

Measurements should be taken under the following conditions (refer to “**Electrical Safety Tests**” on page 4-23):

- Device in ON state
- Polarity switch NORM and RVS
- S1 (neutral) closed and open
- GND switch open

The test has failed if the measured values are greater than:

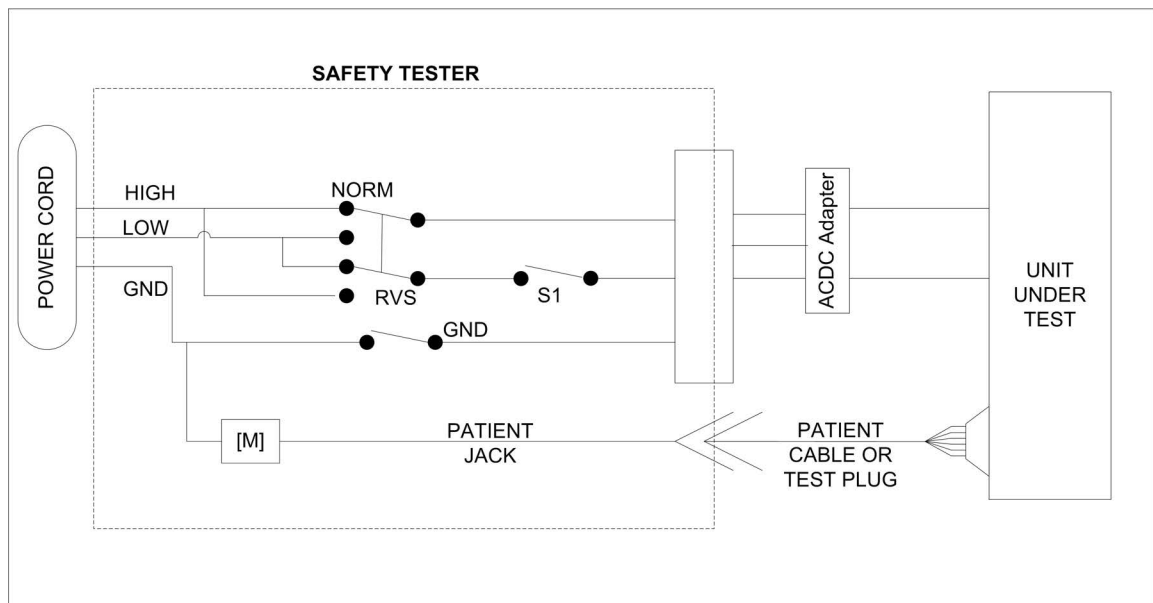
N.C.	S.F.C
Polarity: NORM & RVS S1 (neutral): closed GND: open	Polarity: NORM & RVS S1 (neutral): open GND: open
Total tests/combinations: 2	Total tests/combinations: 2

N.C.	S.F.C
500 $\mu$ A (IEC)	1,000 $\mu$ A (IEC & UL)
150 $\mu$ A (UL)	

## Patient Leakage Current Tests

These tests measure leakage current of the device's floating inputs (patient connections ground).

### Patient Leakage Current to Ground



This test measures leakage current from the floating input (patient connection) to ground during normal condition (N.C.) and single fault condition (S.F.C). In all cases, the leakage current is measured from the floating input to ground: The device has to be turned on and off, and connected to your safety testing instrument.

During N.C., measurements should be taken under the following conditions (refer to “[Electrical Safety Tests](#)” on page 4-23):

- Device in ON state
- Polarity switch NORM and RVS
- GND switch GND closed
- S1 (neutral) closed

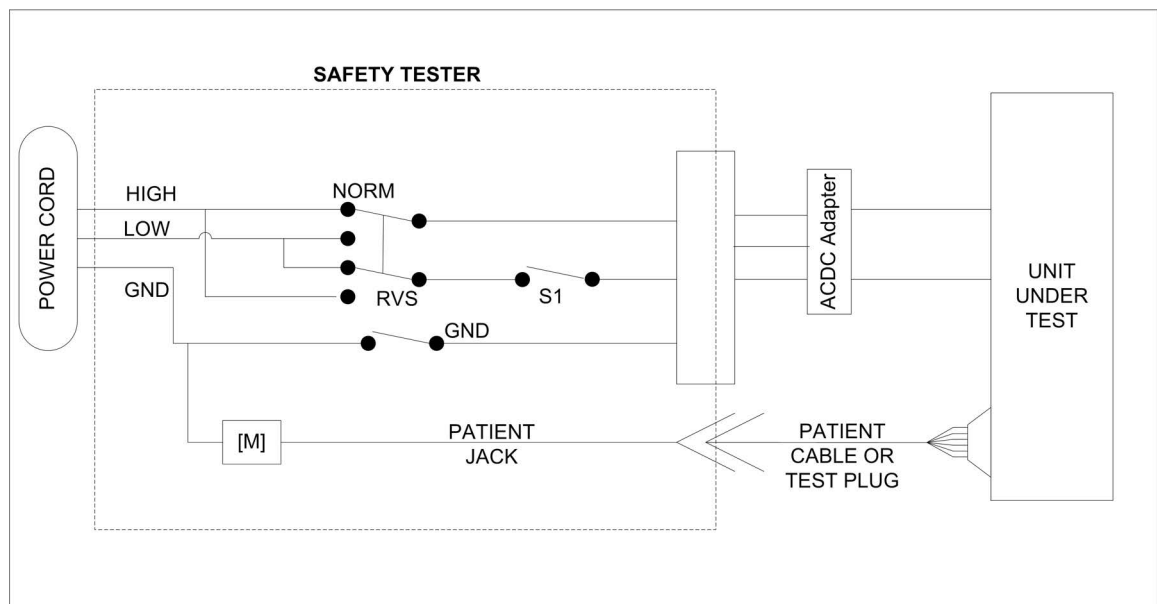
During S.F.C., measurements should be taken under the following conditions (refer to “[Electrical Safety Tests](#)” on page 4-23):

- Device in ON state
- Polarity switch NORM and RVS
- GND switch closed, S1 (neutral) open
- GND switch open, S1 (neutral) closed

The test has failed if the measured values are greater than:

N.C.	S.F.C
Polarity: NORM & RVS S1 S1 (neutral): closed GND: closed	Polarity: NORM & RVS S1 (neutral): closed I open GND: open I
Total tests/combinations: 2	Total tests/combinations: 4
10 uA (IEC & UL)	50 uA (EC & UL)

## Patient Leakage Current, Mains on Applied Part



### WARNING

**PERSONAL SAFETY — MAINS VOLTAGE** is applied to floating input (patient connection) and patient cables/test plug conductors and safety tester PATIN JACK. For the protection of the person performing these tests, the following values of resistor R may be used:

- ◆ Type CF — 100 kOhm (220 to 240 V)

Disconnect safety tester from line voltage before connecting patient cable/test plug to device.

- ◆ After line voltage has been disconnected, connect the patient cable/test plug to device.

This test performs leakage current tests during single fault conditions (S.F.C.) with line voltage applied to the floating (patient connection) inputs.

In all cases, the leakage current is measured from the floating (patient) inputs jack of the device to ground. To setup the leakage current test:

1. Disconnect the safety tester from the line voltage.
2. Ground all signal input/output connections (all SIPs/SOPs connected to ground).
3. Connect the patient cable/test plug to device.
4. Connect the patient cable/test plug to the safety tester.
5. Ensure that the person/tester is not touching the patient cable/test plug or floating (patient) input or device conductive surfaces.
6. Connect the safety tester to the line voltage.

---

**WARNING**

PERSONAL SAFETY — MAINS VOLTAGE is applied to floating input (patient connection) and patient cables/test plug conductors and safety tester PATIN JACK. For the protection of the person performing these tests, the following values of resistor R may be used:

- ◆ Type CF — 100 kOhm (220 to 240 V)

Disconnect safety tester from line voltage before connecting patient cable/test plug to device.

- ◆ After line voltage has been disconnected, connect the patient cable/test plug to device.
- 

During S.F.C., measurements should be taken under the following conditions (refer to “**Electrical Safety Tests**” on page 4-23):

- Device in ON state
- Polarity switch NORM and RVS
- S1 (neutral) open
- GND switch closed

The test has failed if the measured values are greater than:

N.C.	S.F.C
N/A	Polarity: NORM & RVS S1 (neutral): open open GND: closed
Total tests/combinations: 0	Total tests/combinations: 2
N/A	50 uA (EC & UL)

After completing this test, disconnect the safety tester from line voltage before disconnecting the patient cable/test plug and/or the device.

Verify the current leakage test results meet the requirements. Perform electrical safety checks when indicated. All indicated electrical safety checks require a pass/ fail indication for the steps performed. Record the measurement values in your debrief.

1. Verify the equipment does not propose any health hazard. See “**Earth Leakage (AC line) Current Test**” on page 4-24 and “**Patient Leakage Current Tests**” on page 4-25, for more information.
2. Verify all exposed metal is properly grounded. See “**Ground Resistance Test**” on page 4-23 for more information.

**Table 5. Electrical Safety Checks**

Step		Condition	UUT - ON	Result	Leakage Current Limits
<b>Earth Leakage Current</b>					
1	Forward Polarity	NC	_____ uA	Pass/Fail	150 uA
2	Neutral Open, Forward Polarity	SFC	_____ uA	Pass/Fail	1000 uA
3	Neutral Open, Reverse Polarity	SFC	_____ uA	Pass/Fail	1000 uA
4	Reverse Polarity	NC	_____ uA	Pass/Fail	150 uA
<b>Patient Leakage Current To Ground</b>					
1	Forward Polarity	NC	_____ uA	Pass/Fail	10 uA
2	Neutral Open, Forward Polarity	SFC	_____ uA	Pass/Fail	50 uA
3	Ground Open, Forward Polarity	SFC	_____ uA	Pass/Fail	50 uA
4	Ground Open, Reverse Polarity	SFC	_____ uA	Pass/Fail	50 uA
5	Neutral Open, Reverse Polarity	SFC	_____ uA	Pass/Fail	50 uA
6	Reverse Polarity	NC	_____ uA	Pass/Fail	10 uA
<b>Ground Resistance</b>					
1	AC mains power cord ground prong to exposed metal surface (ground lug)	N/A	_____ Ω	Pass/Fail	Less than 1 Ohm

NC = Normal Condition; SFC = Single Fault Condition; N/A = Not Applicable

UUT = Unit Under Test

## Saving Setup

For saving System set up to an SD card, the SD card option need not be enabled.

1. Select *Setup*.
2. Enter the current setup password.
3. Press **Enter**.
4. Select *Save Setup* using the arrow and press the **Enter** key.
5. Insert the blank SD card without write protection enabled.
6. Select *To SD Card* using the arrow and press the **Enter** key.
7. Remove the SD card and press the **esc** key to return to the *System Setup Menu*.

## Print Setup

1. Select *Setup*.
2. Enter the current set up password.
3. Press **Enter**.
4. Select *Print Setup* using the arrow and press the **Enter** key.

## Restoring Setup

### From the SD Card:

1. Insert the SD card where *Setup* is stored.
2. Select *Setup*.
3. Enter the current set up password.
4. Press **Enter**.
5. Select *Restore Setup* using the arrow and press the **Enter** key.
6. Select *From SD Card* using the arrow and press the **Enter** key.
7. The system will restore set up and return to the *System Setup Menu*.

### Manually restoring the settings :

Refer to the “MAC 600 Operator’s Manual” for instructions on manually restoring the settings.

## Serial Number Entry

1. Select *Setup*.
2. Enter the current set up password.
3. Press **Enter**.
4. Press the **Lead** and **F2** keys together.



5. If the serial number already exists, the system displays the stored serial number on the screen. Press the **Enter** key again if you wish to change the serial number or press the **esc** key to exit the serial number entry screen.
6. Enter the serial number using keys 1-10 and by selecting the required character from the corresponding drop-down menu using the **arrow** keys and the **Enter** key. (Use the **back space** key to erase a wrong entry)
7. Go to *Return* and press **Enter** to exit the service menu.

**NOTE**

When you change the serial number, the device will reset to factory default settings including password and encryption keys. And stored ECG Files will not be accessible. Hence before changing the serial number it is recommended to take backup of ECG files.

To verify if the serial number entry is correct or not, go to system information ("**Testing the System Information**" on page 3-6) and verify that the serial number displayed matches the one on the serial number label.

## Application Software Update

Follow the below procedure to update the application software.

**NOTE**

Before software update it is recommended to take the backup of the patient data by using Transmission or Storing.

1. Connect the external power supply and then switch ON the unit.
2. Insert the SD card formatted in FAT 16 file system with the released MAC 600 software.
3. Select *Setup* using the function key.
4. Enter the current setup password (Default password is **11112222**).
5. Press the **Enter** key.
6. Press the **Lead** and **F3** keys together.

A screen will open with the current SW and new SW version.

7. Press the **Enter** key to begin programming.
8. The system displays the following messages and then switches OFF.

*Copying code to Main memory*

*Programming Flash*

*Programming over*

*System Shutting Down*

Wait for 80 seconds to make sure that the device is programmed and ready to use.



### NOTE

If you are updating the device software from V1.02.SP03 or V1.02 SP04 to V1.02 SP05, follow the below steps.

- a. After the step#8, without removing SD card just power-on the unit.
  - b. Wait for 4 minutes.  
The unit will switch OFF automatically.
  - c. The device is programmed and ready to use.
9. If any error messages are displayed, please correct them accordingly as per the message displayed and press the Enter key to restart programming. To exit programming during error conditions, press the **esc** key.
  10. Perform the Restore Setup procedure go to “**Restoring Setup**” on page 4-29.

### NOTE

If Boot SW is also updated from the one in the device, the system will display *Update Boot SW* on the screen. Press the Enter key to program Boot.

Do not remove the SD card until programming is complete. After programming is completed, remove the SD card and restart the device for normal operation.

11. To verify the correctness of programming, go to “**Testing the System Information**” on page 3-6 and check if the displayed ARM Software Version is the latest or not.

### NOTE

Once the device is updated to V1.02 SP05 software OR if the device is downgraded to lower versions, it would make existing ECG in SD Card unreadable.

## BOOT Software Update

1. Select *Setup*.
2. Enter the current setup password (Default password 11112222).
3. Press **Enter**.
4. Press the **Lead** and **F2** keys together.
5. Press **Enter**.
6. Select *Update Primary Boot* using the **down arrow** key.
7. Select *Yes* using the **Enter** and **arrow** keys.

A new window opens, asking you to confirm whether to continue or not.

8. Select *Yes* using the **arrow** and **Enter** keys.
9. Select *Return* using the **arrow** key and press **Enter**.
10. The system displays the following messages:

### *Programming Primary boot*

### *Primary boot programming Over*

11. Press the **esc** key to exit service only Setup.

#### **NOTE**

Boot SW update is applicable only if the Boot version has changed from the previous version in the device and is not already programmed during ARM software update.

## System Log

1. Select *Setup*.
2. Enter the current set up password.
3. Press **Enter**.
4. Press the **Lead** and **F4** keys together.
5. Insert the blank SD card without write protection enabled.
6. Press the **Enter** key to store the Sys log or the **esc** key to exit the screen.

#### **NOTE**

The SD card needs to be formatted in FAT 16 file system before use (manufacturer validated SD card is 2GB Transcend and SanDisk). If the SD card is not formatted, the system will display *Format SD Card*. You may format it by pressing the Enter key and storing the system log or press the esc key to exit without formatting the SD card.

## Programming MAC 600 Device Without User Interface

1. Copy the released MAC 600 software to an empty SD card that has been formatted in a FAT 16 file system.
2. In the root folder on the SD card, create a file named *Update.com*.
3. Insert the SD card into the device.
4. Connect and switch on the external power supply.
5. Switch on the device. The battery LED located on the keypad will start blinking in 10 seconds.
6. Wait for 2 minutes. The unit will switch OFF automatically.
7. Remove the SD card.

#### **NOTE**

If you are updating the device software from V1.02 SP03 or V1.02 SP04 to V1.02 SP05, follow the below steps.

- a. After Step 5, without removing SD card just power-on the unit.
- b. Wait for 4 minutes, the unit will switch OFF automatically

The device is programmed and ready to use.

**NOTE**

If the battery LED does not blink within 10 seconds, then Program Failure is indicated.

Downgrade to lower version of software is not possible thru this procedure

## Reset Password

If you forget password, you can reset password using the below steps

1. On **System Setup Password**, highlight **Forget Password** and press the **Enter** key.

**NOTE**

Forgot password will reset to factory default settings including the encryption key and stored ECG Files will not be assessable.



2. In the Forget Password window, the below message appear:

This will restore system setup to default factory settings and stored ECG Files will not be assessable.

**Press Lead + F3 keys to continue.**



3. Enter the New Password.



4. Confirm the New Password.



# 5 Parts and Replacements

**For your notes**

# Ordering Parts

## General Information

This chapter identifies the FRU parts and FRU kits with part numbers and images. You can order parts for the assemblies, stand-alone FRUs, and FRU kits that are considered field-serviceable. Only items, assemblies, and kits, which have part numbers, provided in this chapter are available as FRUs. To order parts, contact GE Healthcare Service or a GE Healthcare approved vendor.

### Carry Case

Table 5-1. Carry Case	
Part Number	Description
2047356-001	CARRY CASE

### Patient Cables

Table 5-2. Patient Cables	
Part Number	Description
2104722-001	TRUNK CABLE 10-LEAD IEC
2104723-001	TRUNK CABLE 10-LEAD AHA
2104726-001	ECG VALUE CABLE 10 LEAD CABLE/LEADWIRE IEC
2104727-001	ECG VALUE CABLE 10 LEAD CABLE/LEADWIRE AHA
22341808	CABLE TRUNK 10-LEAD ML IEC
22341809	CABLE TRUNK 10-LEAD ML AHA
2029890-001	MAC500/1200 VALUE 10LD CABLE/LEADWIRE IEC
2029893-001	MAC500/MAC1200 VALUE 10LD CABLE AHA

## Electrodes

Table 5-3. Electrodes	
Part Number	Description
2104778-001	ECG TAB ELECTRODE SM HYDROGEL ADHESIVE 10/STRIP 100/POUCH 1000/BOX 4000/CASE
2106911-001	ECG TAB ELECTRODE MED HYDROGEL ADHESIVE 10/STRIP 100/POUCH 1000/BOX 4000/CASE
2104780-001	ECG TAB ELECTRODE LG HYDROGEL ADHESIVE 10/STRIP 100/POUCH 1000/BOX 4000/CASE
2104783-001	REUSABLE VALUE BULB ELECTRODE 6/SET
2104784-001	CLAMP LIMB AHA VALUE 4/SET
2104785-001	CLAMP LIMB IEC VALUE 4/SET
9623-810P	SILVER MACTRODE PLUS RESTING ECG ELECTRODES, 10/CARD, 100/PACK, 1000/CASE
2029891-001	CLAMP LIMB IEC VALUE 4/SET BOXED W/LBL
2029892-001	REUSABLE BULB ELECTRODE 6/SET BOXED W/LBL
2029894-001	CLAMP LIMB AHA VALUE 4/SET BOXED W/LBL

## ECG Clip

Table 5-4. ECG Clip	
Part Number	Description
2104729-001	ADAPTER CLIP, DCAR, WIDE MOUTH CLIP, 14 PACK
2056813-010	ECG CLIP, SURE-LOCK, 10/PKG
2066867-010	ECG CLIP, MACTRODE, 10/PKG

## Leadwire

Table 5-5. Leadwire	
Part Number	Description
2104724-002	LEADWIRE SET, BASE 10, DCAR, BANANA, IEC
2104724-001	LEADWIRE SET, BASE 10, DCAR, BANANA, AHA
38401816	SET LEADWIRE ML 4MM 10-LEAD 0.7M/1.3M IEC
38401817	SET LEADWIRE ML 4MM 10-LEAD 0.7M/1.3M AHA



## Consumable

Table 5-6. Consumable	
Part Number	Description
21708318	ELECTRODE CREAM, 250ML BOTTLE

## Writer Paper

Table 5-7. Writer Paper	
Part Number	Description
2104773-001	PAPER 80MM WIDE, RED GRID 75MM WIDE, Z-FOLD, BLOCK QUEUE, 280 SHEETS, 10 PACKS
2030887-001	PAPER THR 80X90 CONTR F-GRID FF 10X280SH

## Power Cords

Table 5-8. Power Cords		
Part Number	Description	Country
405535-006	Power supply cord RA Hospital Grade 13A 125 V 10 FT	North America/ Central America
401855-018	Power Cord ST CHINA RA PLUG 10A 250V 2.5M	China
401855-101	Power Supply Cord ST CONT EURO 10A 250V 2.5M	Europe
401855-102	Power Supply Cord ST BRITISH 10A 250V 2.5M FSD	Britain
401855-103	Power Supply Cord ST ITALIAN 10A 250V 2.5M	Italy
401855-104	Power Supply Cord ST ISRAELI 10A 250V 2.5M	Israel
401855-107	Power Supply Cord ST SWISS 10A 250V 2.5M	Switzerland
6736108-2	Power Supply Cord ST INDIAN 6A 250V 2.5M	India
401855-109	Power Supply Cord ST DANISH 10A 250V 2.5M	Denmark
40185-110	Power Supply Cord ST AUSTRALIAN 10A 250V 2.5M	Australia
405535-011	PWR SPLY CRD ST-RA PSE 10A 250V 10FTROHS	Japan
401855-005	PWR SPLY CRD ST HARNESS 10A 125V 2M	America Others

## MAC 600 Options

Table 5-9. MAC 600 Options	
Part Number	Description
2047228-001	MAC 600 STARTER PKG 12SL
2047228-002	MAC 600 ADVISOR PKG 12 SL EXT MEMORY
2047228-009	MAC 600 COMM PKG 12SL EXT MEM COMM W/O SERIAL CABLE

Table 5-10. MAC 600 Upgrade Options	
Part Number	Description
2048913-003	MAC 600 UPGRADE PHTM COLOR OPTION
2048913-004	MAC 600 UPGRADE PHTM MSRMT
2048913-005	MAC 600 UPGRADE PHTM MSRMT+INTRPT
2048913-006	MAC 600 UPGRADE PHTM EXT STORAGE TRANS
2048913-007	MAC 600 UPGRADE PHTM EXT STOR+SERIAL CBL
2048913-008	MAC 600 UPGRADE PHTM XML FORMAT OUTPUT
2048913-009	MAC 600 UPGRADE PHTM PDF FORMAT OUTPUT



# Field Replaceable Units (FRUs)

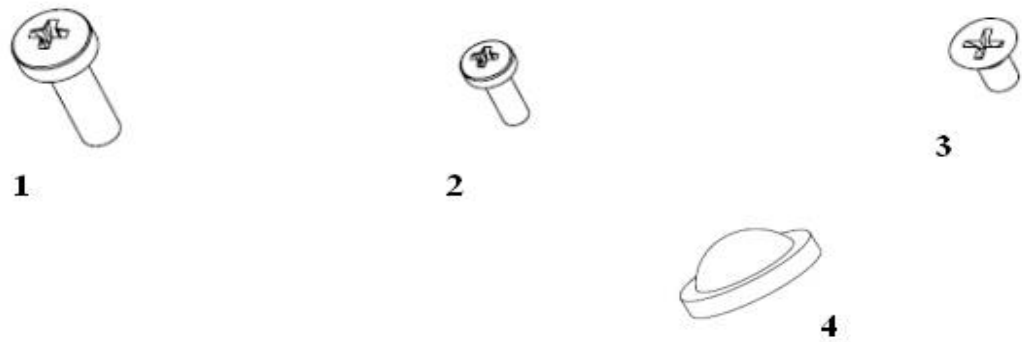
## 2047328-002 FRU EXTERNAL POWER SUPPLY - CLASS I



Table 5-11. Power Supply FRU Kit	
ITEM	ITEM DESCRIPTION
1	PWR Sply SW 18W SL Power
2	Product Label - Expedition
3	Replacement Instructions for Power Supply FRU for MAC 600

See the instructions for “[Reworking the Power Supply \(Class II to Class I\)](#)” on page 4-9.

Mechanical FRU Kit 1



2047329-001	MECHANICAL FRU KIT 1
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Table 5-12. Mechanical FRU Kit 1	
ITEM	ITEM DESCRIPTION
1	SCR DIN7985-M3X10-4.8-Z-A2F (ISO7045)
2	SCR DIN7985-M2X6-4.8-Z-A2F (ISO7045)
3	SCR FH #4-40X1/4" ZINC AHNL.DIN965
4	BUMPON SJ-6125, 15.9MM DIA, 6.35MM THK

FRU - CKT BD MAC 600 CPU Board



FRU Part Number	Description	Applicable for Product Code	Note
2066447-003	FRU-PWA MAC 600 NEW	SNM,SS5 and SPY	2066447-003 is the latest PWA used in MAC 600 devices with Product Code SNM, SS5 and SPY. This FRU is fully backward compatible and replaces earlier FRUs 2047330-001 and 2066447-002.

Table 5-13. FRU-PWA KIT FOR MAC 600 NEW	
ITEM	ITEM DESCRIPTION
1	MAC 600 PWA
2	BACK PANEL - EXPEDITION
3	CORE FERRITE RING
4	KEY TO UNLOCK FERRITE

FRU LCD Display (TIANMA) with O-Ring Kit MAC600

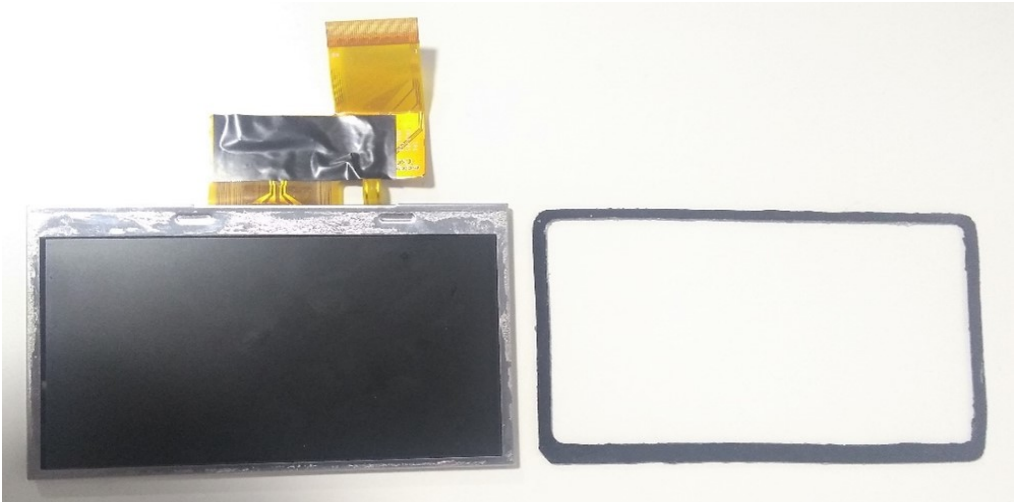
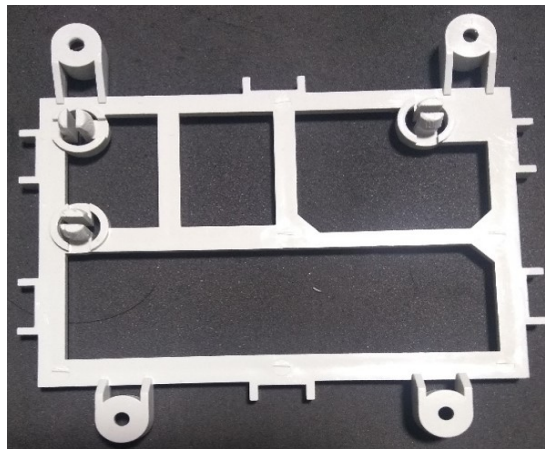


Table 5-14. Display FRU Kit-SNM		
ITEM	ITEM DESCRIPTION	APPLICABLE FOR PRODUCT CODE
5854422	FRU LCD DISPLAY (TIANMA) WITH O-RING KIT MAC600	SNM
	a 4.3" LCD Display (TIANMA)	
	b Display O-Ring - Expedition	

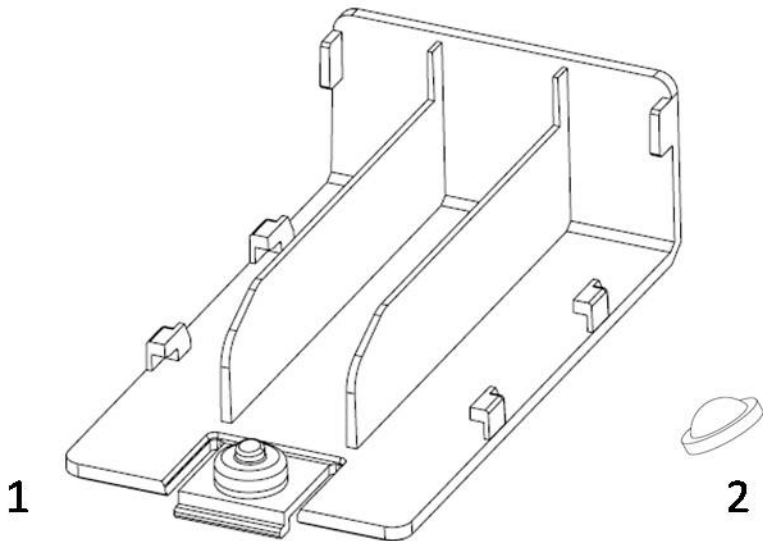
Table 5-15. Display Fru Kit for other Product Codes			
ITEM	ITEM DESCRIPTION	APPLICABLE FOR PRODUCT CODE	NOTE
2100910-001	LCD FRU Kit (KOE)	SPY and SS5	LCD FRU Kit (KOE) is available as long as stocks last. Once KOE display stock depletes, upgrade to TIANMA display using the upgrade kit which will be released shortly.

## FRU - LCD Module Holder - Expedition (For TIANMA and KOE Displays)



FRU Part No	FRU Description	Applicable for Product Code	Notes
2100912-001	LCD MODULE HOLDER (NEW) - FRU	SNM, SS5, and SPY	Compatible with TIANMA and KOE Displays

FRU - Cover Battery - Expedition



2047333-001	FRU - COVER BATTERY - EXPEDITION
-------------	----------------------------------

Table 5-16. FRU - Cover Battery - Expedition	
ITEM	ITEM DESCRIPTION
1	COVER BATTERY - EXPEDITION
2	BUMPON SJ-6125, 15.9MM DIA, 6.35MM THK

## FRU Daughter Board for TIANMA Display- SNM



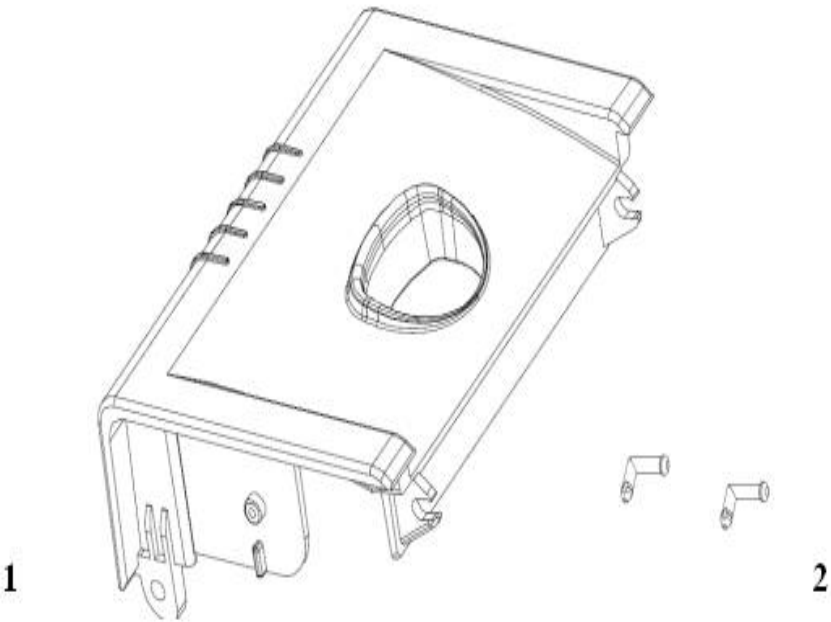
FRU PART NUMBER	DESCRIPTION	APPLICABLE FOR PRODUCT CODE
5854424	FRU - DAUGHTER BOARD FOR TIANMA DISPLAY MAC600	SNM

Table 5-17. Daughter Board for Older Products (with KOE Displays)

FRU PART NUMBER	FRU DESCRIPTION	APPLICABLE FOR PRODUCT CODES	NOTES
2100913-001	FRU - DAUGHTER BOARD FOR LCD MODULE - EXPD'N (KOE)	SPY and SS5	Compatible with KOE Display



Printer Door FRU Kit



2047335-001	PRINTER DOOR FRU KIT
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Table 5-18. Printer Door FRU Kit	
ITEM	ITEM DESCRIPTION
1	PRINTER DOOR - EXPEDITION
2	PRINTER DOOR - HINGE COMPONENT

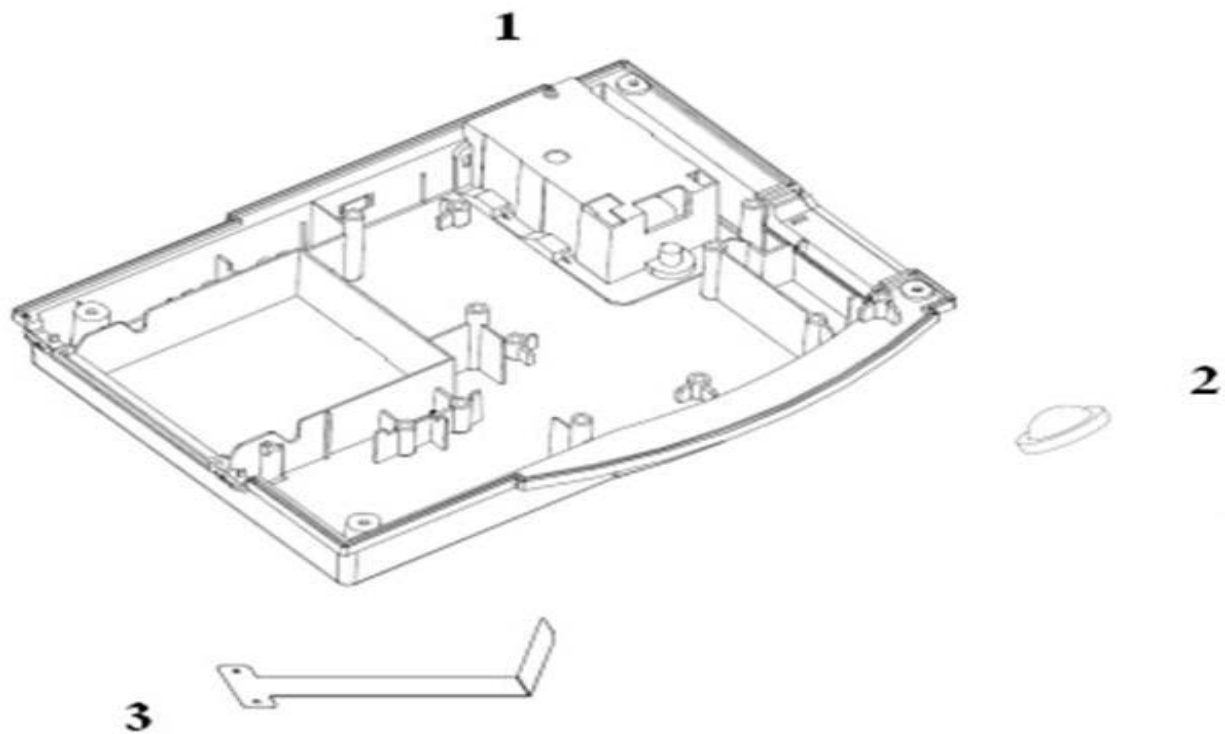
Cover Top FRU Kit



ITEM NUMBER	FRU PART NUMBER	DESCRIPTION	APPLICABLE FOR PRODUCT CODE
1	5854423	FRU TOP COVER AND KEYSHEET (WITH OVERLAY) ASSEMBLY KIT MAC600	SNM

Table 5-19. TOP COVER FRU KIT FOR OLDER PRODUCT CODES			
FRU PART NUMBER	DESCRIPTION	APPLICABLE FOR PRODUCT CODE	Notes
2047336-001	COVER TOP FRU KIT	SF7, SP5, SPY, AND SS5	Compatible for KOE and NEC displays

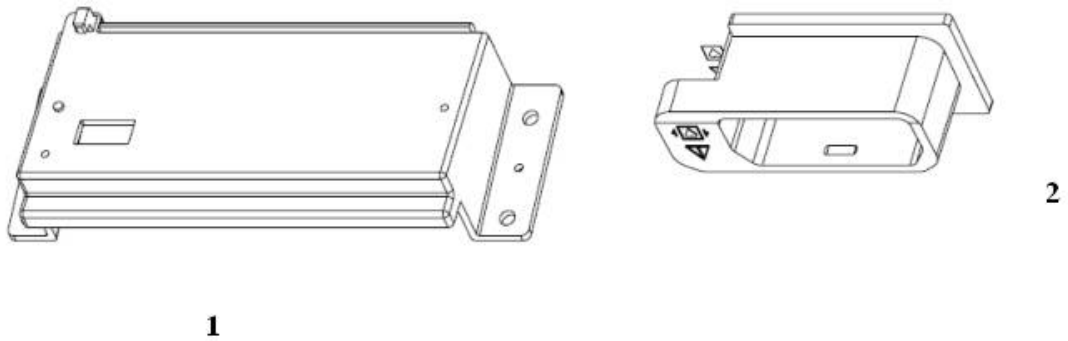
Cover Bottom FRU Kit



2047337-001	COVER BOTTOM FRU KIT
-------------	----------------------

Table 5-20. Cover Bottom FRU Kit	
ITEM	ITEM DESCRIPTION
1	COVER BOTTOM - EXPEDITION
2	BUMPON SJ-6125, 15.9MM DIA, 6.35MM THK
3	PAPER LIFTING TAPE

Mechanical FRU Kit 2



2047338-001	MECHANICAL FRU KIT 2
-------------	----------------------

Table 5-21. Mechanical FRU Kit	
ITEM	ITEM DESCRIPTION
1	PRINTER MOUNTING BASE
2	PATIENT CABLE CONNECTOR HOLDER



FRU Printer Module



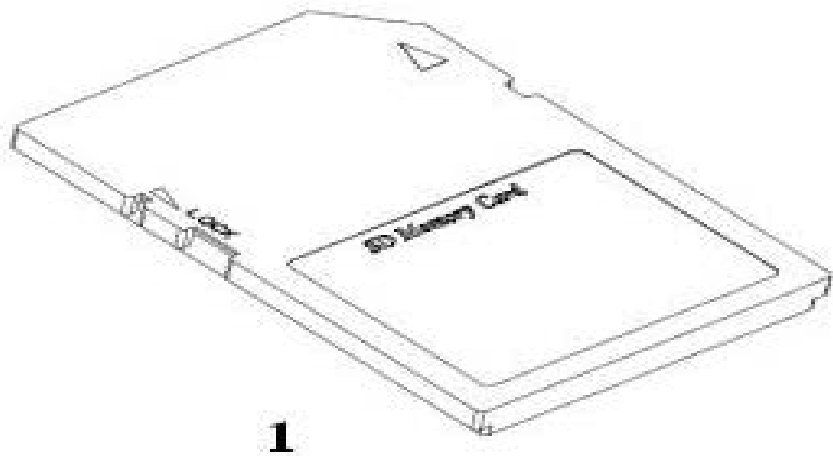
FRU PART NUMBER	DESCRIPTION	APPLICABLE FOR PRODUCT CODE
5854425	FRU PRINTER MODULE KIT (PRT MAKE) MAC600	SF7, SP5, SPY, SS5, SNM

FRU Battery



2111133-001	FRU LI-ION BATTERY 7.2V, 3350MAH
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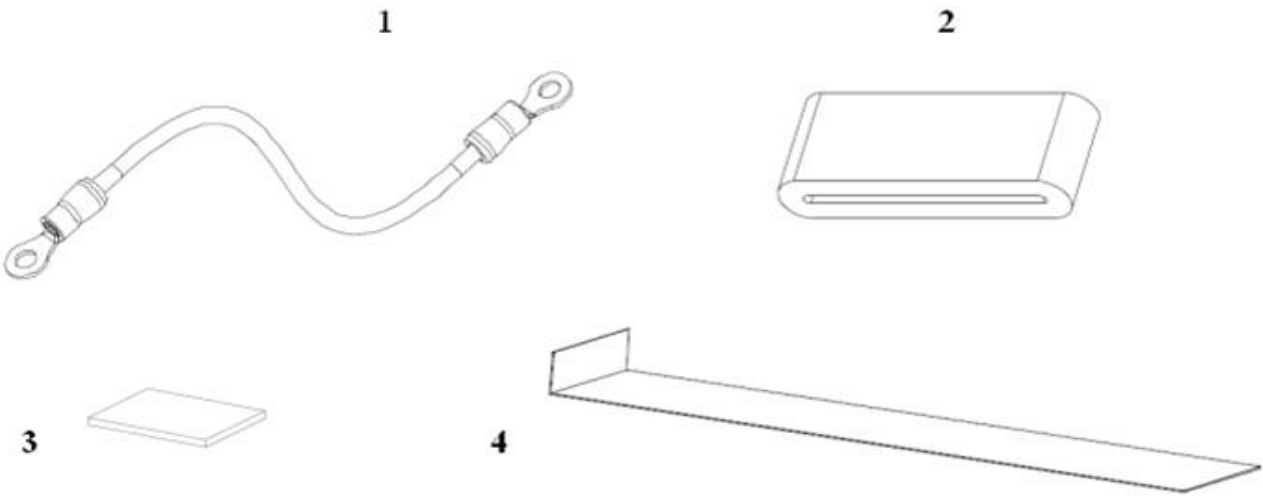
FRU Software Update - SD Card



2047358-002	FRU MAC600 V1.02 SP4 SOFTWARE UPDATE - SD CARD
2047358-003	FRU MAC600 V1.02 SP5 SOFTWARE UPDATE - SD CARD

Table 5-22. FRU Software Update - SD Card	
ITEM	ITEM DESCRIPTION
1	CARD SECURE DIGITAL - 2GB

FRU Cable Kit



2047359-001	FRU CABLE KIT
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Table 5-23. FRU Cable Kit	
ITEM	ITEM DESCRIPTION
1	CABLE FOR EARTHING
2	FERRITE - (7427212)
3	PAD, FLOPPY MAC SERIES (Adhesive)
4	CABLE MAC 600LCD CA

FRU Serial Cable



22336203	CABLE RS232 INTERFACE EBIKE I II III TO CASE/PC
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# A Technical Specification

<b>Instrument Type</b>	
Microprocessor augmented automatic electrocardiograph; 10-leadwire, 12 lead simultaneous acquisition with programmable lead configuration.	
<b>Processing</b>	
ECG Interpretation:	Marquette™ 12SL ECG Analysis Program for Adults and Pediatrics
Computerized measurements:	12-lead analysis
ECG analysis frequency:	500 samples/second (sps)
Digital sampling rate:	2,000 samples/second/channel
ECG on-screen preview:	On-screen preview of acquired 10 second ECG waveform and optional 12SL measurement and interpretation.
Acquisition mode:	Pre-acquisition or post-acquisition, provides 10 seconds of instantaneous ECG acquisition
Dynamic range:	AC Differential $\pm 5\text{mV}$ , DC offset $\pm 300\text{ mV}$
Resolution:	4.88 $\mu\text{V/LSB}$ at 500 sps
Frequency response:	-3 dB at 0.01 to 150 Hz
Low cut-off frequency:	0.01 Hz, 0.02 Hz, 0.16 Hz or 0.32 Hz (-3 dB limits)
High cut-off frequency:	Configurable at 20 Hz, 40 Hz, 100 Hz or 150 Hz
Adaptive AC filter:	47 Hz to 53 Hz when set to 50Hz 57 Hz to 63 Hz when set to 60 Hz
Common mode rejection:	>100 dB (with AC filter switched on)
Input impedance:	>10 M $\Omega$ at 10Hz, defibrillator protected
Patient leakage:	<10 $\mu\text{A}$
Special acquisition functions:	Disconnected lead detection except RL, excessive AC noise, baseline wander and muscle tremor messages
Heart rate meter:	30 to 300 BPM $\pm 10\%$ or $\pm 5\text{ BPM}$ , whichever is greater. Heart rates outside this range will not be displayed
Start-up time	Less than 7 seconds
<b>Patient Information</b>	
Supported patient information	Patient ID, Secondary ID, Age, Date of Birth, Gender Alphanumeric entry in T9 type for patient ID and secondary ID
<b>Communication (optional)</b>	
MUSE™ Cardiology Information System compatible	
Serial cable	ECG Transmission to MUSE™ Cardiology Information System
Serial cable	ECG transmission in XML format
SD card interface	Compatible with MUSE V7 or later

## Technical Specification:

Cardiosoft™ interface	
SD card interface	Compatible with Cardiosoft V6.51 or later
Serial cable	ECG transmission over serial line to CardioSoft V6.61 or above
MobileLink RC WiFi Interface	
MobileLink RC	ECG wireless transmission through a communicator module attached to the device
<b>Storage (optional)</b>	
ECG Storage Format	GE™ storage format for MUSE and Cardiosoft XML storage format. PDF storage format
PDF File name format	User configurable file name, which includes patient ID, secondary ID, Date of Birth, ECG recording date and time.
<b>Display</b>	
Display type:	4.3 inch (110 mm) diagonal, TFT LCD with LED graphics backlit (color optional)
Display resolution:	480 X 272 pixels with scrolling waveform
Display data:	Heart rate, patient ID, clock, battery power indicator, waveforms, lead labels, speed, gain and filter settings, warning messages, information messages, prompts. 12 leads standard display.
<b>Writer</b>	
Writer technology:	Thermal dot array
Writer speed:	5, 12.5, 25, & 50 mm/s
Number of traces:	3 leads + 1 Rhythm or 3 leads; user selectable
Writer sensitivity/gain:	2.5, 5, 10, 20, 10/5 (split calibration) mm/mV
Writer speed accuracy:	±5%
Writer amplitude accuracy:	±5%
Writer resolution:	Horizontal 40 dots/mm at 25 mm/s, 8 dots/mm vertical
Paper type:	Thermal. Z-fold perforated, 80 mm width, 280 sheets/pack. Roll paper 15.7 m
<b>Report formats</b>	
Thermal printer report formats:	4 by 2.5s 4 by 2.5s + 1 rhythm lead 4 by 3s 4 by 10s Autorhythm (10 second ECG data for 3 leads) Printing of 4 by 10s or Autorhythm for abnormal ECG Continuous 3 channel rhythm

## Technical Specification:

PDF report format (A4 format):	4 by 2.5s (A4 format) 4 by 2.5s + 1 rhythm lead 2 by 5s 2 by 5s + 1 rhythm lead 2 by 5s at 50mm/s 4 by 10s Autorhythm (12 lead)
<b>Keyboard</b>	
Type:	Membrane keyboard with tactile feedback
<b>Electrical</b>	
Power Supply:	External ACDC adaptor or battery operation
External adaptor specifications	
Input voltage:	100 to 240 VAC $\pm 10\%$
Input current:	Maximum 0.6A at 90 VAC, 0.3A at 240 VAC
Operating frequency:	50 to 60 Hz $\pm 3\text{Hz}$
Output voltage:	12 $\pm 5\%$
Battery specifications	
Battery type:	Replaceable and rechargeable, Lithium Ion
Battery capacity:	7.2V typical, 3.35 AH $\pm 10\%$ 450 minutes of continuous operation without recording or 350 ECGs in 2.5 X 4 format at 25 mm/S and 10 mm/mV or 150 minutes continuous rhythm print at 25 mm/S and 10 mm/mV
Battery charge time:	Approximately 4 hours from total discharge (with display off)
<b>Physical specification</b>	
Height:	81 mm
Width:	263 mm
Depth:	208 mm
Weight:	1.2 Kg including battery, without paper
<b>Environmental specification</b>	
Temperature	
Operating:	5° to 40°C
Transport/storage:	-15°C to 50 °C
Humidity	
Operating:	25% to 95% RH non-condensing
Transport/storage:	25% to 95% RH non-condensing
Pressure	

## Technical Specification:

Operating:	700 to 1060 hPA
Transport/storage:	500 to 1060 hPA

### Certification

Class I, type CF defibrillator proof  
UL 60601-1 Medical Electrical Equipment, part 1:General Requirements for Safety  
CAN/CSA C22.2 No. 601.1 General Requirements for Safety  
CE marking for Council Regulation (EU) 2017/745 concerning medical devices  
IEC 60601-1 General Requirements for Safety  
IEC 60601-1-1 General Requirements for Safety Medical Electrical systems  
IEC 60601-2-25 Particular Requirements for the Safety of Electrocardiographs  
IEC 60601-2-51 Particular requirements for safety, including essential performance, of recording and analyzing single channel and multi channel electrocardiographs  
IEC 60601-1-2 General Requirements for Safety Electromagnetic Compatibility  
IEC 60601-1-4 General Requirements for Safety – Programmable electrical medical systems  
IEC 60601-1-6 General Requirements for basic safety and essential performance – Collateral Standard: Usability – Edition 2.0  
Meets applicable AAMI EC-11 requirements and AAMI EC 13 (Clause 4.2.7 only)



# B Electromagnetic Compatibility

Changes or modification to the MAC 600 system not expressly approved by GE Healthcare could cause EMC issues. This system is designed and tested to comply with applicable regulations regarding EMC and needs to be installed and used according to the EMC information stated as follows.

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**CAUTION**

**RADIO FREQUENCY INTERFERENCE** — Use of portable phones or other radio frequency (RF) emitting equipment near the system may cause unexpected or adverse operation.

Do not use RF emitting equipment near the device.

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**CAUTION**

**EQUIPMENT INTERFERENCE** — If adjacent or stacked use is necessary, the equipment or system should be tested to verify normal operation in that configuration.

The equipment or system should not be used adjacent to, or stacked with, other equipment.

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## Guidance and Manufacturer's Declaration- Electromagnetic Emissions

Emissions test	Compliance	Electromagnetic environment-guidance
RF emissions EN 55011	Group 1	The MAC 600 uses RF energy for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions EN 55011	Class B	
Harmonic Emissions EN 61000-3-2	Class A	
Voltage fluctuations/Flicker emissions EN 61000-3-3	Complies	

# Guidance and Manufacturer's Declaration- Electromagnetic Immunity

Immunity test	EN60601 test level	Compliance level	Electromagnetic environment-guidance
Electrostatic discharge (ESD) IEC 61000-4-2	$\pm 6$ kV contact $\pm 8$ kV air	$\pm 6$ kV contact $\pm 8$ kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast Transient/ burst IEC 61000-4-4	$\pm 2$ kV for power supply lines	$\pm 2$ kV for power supply lines	Mains power should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	$\pm 1$ kV line(s) to line(s)	$\pm 1$ kV line(s) to line(s)	Mains power should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5% $U_t$ (>95% dip in $U_t$ ) for 0.5 cycles 40% $U_t$ (60% dip in $U_t$ ) for 5 cycles 70% $U_t$ (30% dip in $U_t$ ) for 25 cycles <5% $U_t$ (>95% dip in $U_t$ ) for 5 sec	<5% $U_t$ (>95% dip in $U_t$ ) for 0.5 cycles 40% $U_t$ (60% dip in $U_t$ ) for 5 cycles 70% $U_t$ (30% dip in $U_t$ ) for 25 cycles <5% $U_t$ (>95% dip in $U_t$ ) for 5 sec	Mains power should be that of a typical commercial or hospital environment. If the user of the MAC i requires continued operation during power mains interruptions, it is recommended that the MAC 600 be powered from an uninterruptable power supply or a battery.
Power frequency(50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristics of a typical location in a typical commercial or hospital environment.

Immunity test	EN60601 test level	Compliance level	Electromagnetic environment-guidance
Conducted RF EN 61000-4-6	3 Vrms 150 KHz to 80 MHz	3 Vrms 150 KHz to 80 MHz	Portable and mobile RF communications equipment should be used no closer to any part of the MAC 600, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.  Recommended separation distance $d = 12 \sqrt{P}$
Radiated RF EN 61000-4-3	3V/m 80 MHz to 2.5 GHz	3V/m 80 MHz to 2.5 GHz	$d = 1.2 \sqrt{P}$ 80 MHz to 800 MHz $d = 2.3 \sqrt{P}$ 800 MHz to 2.5 GHz where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer, and d is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey <sup>a</sup> , should be less than the compliance level in each frequency range <sup>b</sup> . Interference may occur in the vicinity of equipment marked with the following symbol: 
<p><b>Note 1:</b> At 80 MHz and 800 MHz, the higher frequency range applies.</p> <p><b>Note 2:</b> These guidelines may not apply in all situations. Electromagnetic propagation is affected by reflection from structures, objects and people.</p>			
<p>Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radio, amateur radio, AM and FM radio broadcast, and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the MAC 600 is used exceeds the applicable RF compliance level above, the MAC 600 should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the MAC 600.</p>			
<p>Over the frequency range 150 KHz to 80 MHz, field strengths should be less than 3 V/m.</p>			

## Recommended Separation Distance

The following table provides the recommended separation distances (in meters) between portable and mobile RF communication equipment and the MAC 600 system. The MAC 600 system is intended for use in the electromagnetic environment on which radiated RF disturbances are controlled. The customer or the user of the MAC 600 system can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the MAC 600 system as recommended below, according to the maximum output power of the communications equipment.

Rated maximum output power of transmitter in watts (W)	Separation distance in meters (m) according to frequency of transmitter			
	150KHz to 80MHz outside ISM bands $d = 1.2 \sqrt{P}$	150KHz to 80MHz outside ISM bands $d = 1.2 \sqrt{P}$	80MHz to 800MHz d $= 1.2 \sqrt{P}$	800MHz to 2.5GHz d $= 2.3 \sqrt{P}$
0.01	0.12	0.12	0.12	0.23
0.1	0.38	0.38	0.38	0.73
1	1.2	1.2	1.2	2.3
10	3.8	3.8	3.8	7.3
100	12	12	12	23
Note 1: At 80MHz and 800MHz the separation distance of high frequency range applies.				

For transmitters rated at a maximum output power not listed above, the recommended separation distance [d] in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (w) according to the transmitter manufacturer.

### NOTE

These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

# Index

- A**
- Accessing the System Diagnostics Function 5
  - Accessory kits 3
  - Acq. Module Tests 13
  - Application Software Update 21
- B**
- Back View 4
  - Battery error 19
  - Battery Tests 11
  - Blank or unstable display with color patches 25
  - BOOT Software Update 21
  - Bottom side view 7
- C**
- Check out Procedure 13
  - Communication Tests 12
  - Consumables 5
- D**
- Data does not print on upper and lower edges of paper 23
  - Detailed description 8
  - Diagnostic Tests 13
- E**
- Earth Leakage (AC line) Current Test 15
  - Electrical Safety Checks 13
  - Electrical Safety Tests 14
  - Electrodes 4
  - Equipment identification 5
  - Equipment problems 15
  - Equipment symbols 5
  - External power LED lights up but unit not switching ON 22
  - External power LED not lighting up 21
- F**
- Field Replaceable Units (FRUs) 8
  - Functional checkout 11
- G**
- General description 3
  - General Fault Isolation 3
  - General fault isolation 3
  - General Information 3
- I**
- Intended audience 2
- K**
- Keypad 6
- L**
- Leakage Current Tests 14
- M**
- MAC 600 Options 7
  - Manual information 2
  - Manual purpose 2
- O**
- Opening the Device 5
  - Operational Checks 13
  - Operator's guides 5
  - Ordering Information 6
  - Ordering Parts 3
- P**
- Paper Error problem 15
  - Paper moving but not printing 16
  - Patient Cables 4
  - Patient Leakage Current Tests 16
  - Patient Leakage Current to Ground 16
  - Patient Leakage Current, Mains on Applied Part 17
  - Performing Diagnostic Tests 5
  - Performing diagnostic tests 5
  - Poor Quality ECGs 3
  - Power cords 6
  - Power-up Self-Test 3
  - Preparing System for FRU Replacement 3
  - Preventive Maintenance 10
  - Printer Door Open Message 24
  - Printer door open message 17
  - Printing only base lines 18
  - Product label (B ) 7
  - Programming MAC 600 Device Without User Interface 22
- R**
- Recommended maintenance 10
  - Recommended Test Equipment 14
  - Recommended Test Schedule 14
  - Replacing the Battery 5
  - Replacing the Daughter PCB assembly 9
  - Replacing the Display 7
  - Replacing the Main PCB Assembly 8
  - Replacing the Thermal Print 6
  - Required Tools and Manuals 4
  - Restoring Setup 20
  - Revision history 2
- S**
- Safety messages 3
  - Saving Setup 19
  - SD Card Tests 14
  - Serial Number Entry 20
  - Serial number format (A) 6
  - Service manua 5
  - Service requirements 5
  - Side view 5
  - System Log 22
- T**
- Testing the Buzzer 8
  - Testing the Display 7

Testing the Keypad 8  
Testing the System Information 6  
Top View 3

**U**

Unit not turning ON in battery mode 20

**V**

Visual Inspection 4

**W**

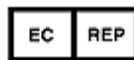
Warnings, cautions, and notes 3  
Warranty 6  
Writer paper 5  
Writer Test 10







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