



Propaq[®] MD Service Manual



ZOLL is a registered trademark, and SurePower is a trademark of ZOLL Medical Corporation. Propaq is a registered trademark of Welch Allyn, Inc. Nellcor is a trademark of Covidien. Oridion, Microstream, and FilterLine are registered trademarks of Oridion Systems, Ltd. All other trademarks and registered trademarks are property of their respective owners.

Copyright © 2010

ZOLL Medical Corporation. All rights reserved.

Table of Contents

Preface

Overview	1
Safety Considerations.....	2
Additional Reference Material.....	2
Conventions	3
Service Policy Warranty	3
Technical Service	3
Technical Service for International Customers	4

Chapter 1 Maintenance Tests

Propaq MD Overview	5
Calibration and Calibration Checks	7
NIBP Valve, Pump, and Tubing Integrity Tests	11
Operational Tests	14
Functional Verification Tests	21

Chapter 2 Troubleshooting

Overview	37
Propaq MD Error Messages	37

Chapter 3 Disassembly Procedures

Overview	47
Required Equipment	47
Safety Precautions.....	48
Modules	48
Removing the Handle	49
Removing the Printer Module	50
Disassembling the Main Unit	52
Removing the Front Enclosure Module	55
Removing the Display Module	57
Removing the EtCO ₂ and NIBP Modules	59
Removing the Monitor Board and SpO ₂ Modules	63
Removing the Defibrillator Board and Capacitor Bank Modules.....	65

Chapter 4 Life Cycle Counters
 Overview 69

Chapter 5 Replacement Parts
 Overview 71
 Replacement Parts 72

Chapter 6 Functional Description
 Overview 75

Appendix A
 Overview 81
 Propaq MD Electrical Hardware Interconnect Diagram 82
 Propaq MD Signal and Power Interconnect Schematic 83

Appendix B
 Overview 85

Preface

Overview

ZOLL Medical Corporation's Propaq MD Service Manual is intended for the trained biomedical technician whose responsibility is to identify malfunctions and/or make repairs at the subassembly level. The Propaq MD Service Manual has six main sections and two appendixes.

Preface—Contains safety warnings and an overview of the manual's contents. Be sure to review this section thoroughly before attempting to use or service the Propaq MD unit.

Chapter 1—Maintenance Tests describes the Annual Calibration Tests for NIBP and EtCO₂ modules, Functional Tests that need to be run when a module has been repaired, and Operational Tests that need to be performed at regular intervals to augment the automatic testing the Propaq MD does to ensure readiness.

Chapter 2—Troubleshooting provides a listing of error messages to help the service technician detect faults and repair them.

Chapter 3—Disassembly Procedures describes step-by-step procedures for removing subassemblies from the Propaq MD unit.

Chapter 4—Life Cycle Counters describes step-by-step procedures for setting life cycle counters after replacing modules in the Propaq MD unit.

Chapter 5—Replacement Parts List displays a complete list of ZOLL part numbers for field replaceable parts available for the Propaq MD unit, allowing the service person to identify and order replacement parts from ZOLL.

Chapter 6—Functional Description provides technical descriptions for the Propaq MD major subassembly modules.

Appendix A—Propaq MD Electrical Hardware Interconnect Diagram and Propaq MD Signal and Power Interconnect Schematic.

Appendix B—Contains simulators and settings that may be used to assess the performance of the NIBP module.

Safety Considerations

The following section describes general warnings and safety considerations for operators and patients. Service technicians should review the safety considerations prior to servicing any equipment and read the manual carefully before attempting to disassemble the unit. Only qualified personnel should service the Propaq MD unit.

Federal (U.S.A.) law restricts this unit for use by or on the order of a physician.

Safety and effectiveness data submitted by ZOLL Medical Corporation to the Food and Drug Administration (FDA) under section 510(K) of the Medical Device Act to obtain approval to market is based upon the use of ZOLL accessories such as disposable electrodes, patient cables and batteries. The use of external pacing/defibrillation electrodes and adapter units from sources other than ZOLL is not recommended. ZOLL makes no representations or warranties regarding the performance or effectiveness of its products when used in conjunction with pacing/defibrillation electrodes and adapter units from other sources. If unit failure is attributable to pacing/defibrillation electrodes or adapter units not manufactured by ZOLL, this may void ZOLL's warranty.

Only qualified personnel should disassemble the Propaq MD unit.

WARNING! This unit can generate up to 2775 volts with sufficient current to cause lethal shocks.

All persons near the equipment must be warned to “STAND CLEAR” prior to discharging the defibrillator.

Do not discharge the unit's internal defibrillator energy more than three times in one minute or damage to the unit may result.

Do not discharge a battery pack except in a ZOLL *SurePower™* Charging Station.

Do not use the Propaq MD in the presence of flammable agents (such as gasoline), oxygen-rich atmospheres, or flammable anesthetics. Using the unit near the site of a gasoline spill may cause an explosion.

Do not use the unit near or within puddles of water.

Additional Reference Material

In addition to this guide, there is a Propaq MD Operator's Guide which is a comprehensive reference work that describes all the user tasks needed to operate the Propaq MD.

Conventions

WARNING! Warning statements describe conditions or actions that can result in personal injury or death.

Caution Caution statements describe conditions or actions that can result in damage to the unit.

Note: Notes contain additional information on using the defibrillator.

Service Policy Warranty

In North America: Consult your purchasing agreement for terms and conditions associated with your warranty. Outside of North America, consult ZOLL authorized representative.

In order to maintain this warranty, the instructions and procedures contained in this manual must be strictly followed. For additional information, please call the ZOLL Technical Service Department 1-800-348-9011 in North America.

Technical Service

If the ZOLL Propaq MD unit requires service, contact the ZOLL Technical Service Department:

Telephone: 1-978-421-9655; 1-800-348-9011

Fax 1-978-421-0010

Have the following information available for the Technical Service representative:

- Unit serial number.
- Description of the problem.
- Department where equipment is used.
- Sample chart recorder strips or electronic log files documenting the problem, if applicable.
- Purchase Order to allow tracking of loan equipment.
- Purchase Order for a unit with an expired warranty.

If the unit needs to be sent to ZOLL Medical Corporation, obtain a service request number (SR#) from the Technical Service representative. Return the unit in its original container to:

ZOLL Medical Corporation
269 Mill Road
Chelmsford, Massachusetts 01824-4105

Attn: Technical Service Department (SR#)

Telephone: 1-800-348-9011; 1-978-421-9655 FAX: 978-421-0010

Technical Service for International Customers

International customers should return the unit in its original container to the nearest authorized ZOLL Medical Corporation Service Center. To locate an authorized service center, contact the International Sales Department at ZOLL Medical at the above address.

Chapter 1

Maintenance Tests

Propaq MD Overview

This chapter includes step-by-step procedures for the following types of maintenance tests:

- Calibration and Calibration Checks
- NIBP Valve, Pump, and Tubing Integrity Tests
- Operational Tests
- Functional Verification Tests

At a minimum, a trained biomedical technician must perform a CO₂ calibration and an NIBP calibration check once per year. A CO₂ calibration check may be performed at any time to verify the CO₂ calibration.

The Troubleshooting chapter in this manual may recommend performing one of more of the NIBP valve, pump, and tubing integrity tests to help identify and correct potential issues with the NIBP valve, pump, and/or tubing.

It is necessary to perform Functional Verification Tests after a module is repaired to ensure that the functions of the Propaq MD unit work properly.

Because the Propaq MD units must be maintained ready for immediate use, it is important for users to conduct the Operator's Shift Checklist procedure at the beginning of every shift. This procedure can be completed in a few minutes and requires no additional test equipment. (See the ZOLL Propaq MD Operator's Guide for the Operator's Shift Checklist.) It is highly recommended that the Operational Tests be performed at regular intervals to augment the automatic testing the Propaq MD does to ensure readiness.

This chapter describes the following maintenance tests:

Calibration and Calibration Checks

- NIBP Calibration Check
- CO₂ Calibration Procedure
- CO₂ Calibration Check

NIBP Valve, Pump, and Tubing Integrity Tests

- Leak Test
- Deflation Test
- Inflation Test

Operational Tests

- Physical Inspection of the Unit
- Keypad Test
- LED Test
- LCD Test
- RFU Indicator Test
- Audio Test
- Printer Test
- Battery Test
- Fan Test
- NIBP Test

Functional Verification Tests

- Leads Test
- Heart Rate Display Test
- Heart Rate Alarm Test
- Leakage Current Test
- Shock Test
- Synchronized Cardioversion Test
- Pacer Test
- Printer Test
- SpO₂ Monitor Test
- EtCO₂ Monitor Test
- IBP Monitor Test
- NIBP Monitor Test
- Temperature Test


Calibration and Calibration Checks

NIBP Calibration Check

Equipment Single lumen BP hose, a 500 cc volume, and a calibrated manometer or pressure gauge (≤ 1 mmHg accuracy). If a 500 cc volume is not available, an Adult BP cuff wrapped around a rigid cylinder (such as a glass jar) will suffice.

Note: This test is to be performed for the following target pressures: 50 +/- 5 mmHg, 150 +/- 5 mmHg, and 250 +/- 5 mmHg.

Procedure

1. Power on the Propaq MD.
2. Connect the Propaq MD to the single lumen hose and the 500 cc volume. Alternatively, replace the 500 cc volume with a standard Adult cuff wrapped around a rigid cylinder, such as a glass jar. Connect a calibrated manometer to the air line using a T-fitting.
3. On the Propaq MD, do the following to enter the NIBP Test control panel:
 - Press the Setup quick access key (.
 - Use the navigation keys to select **Supervisor>Service>Device Tests>NIBP Test**.
4. From the Propaq MD NIBP Test control panel, use the navigation keys to select:
 - **Close Valve**
 - **Turn Pump On**
5. Monitor the pressure reported by the external pressure standard.
6. Once the pressure reaches the target pressure of 50 +/- 5 mmHg, use the navigation keys to select **Turn Pump Off**.
7. Allow the system to stabilize for at least 10 seconds.
8. Record the pressure reported by the external pressure standard as P_a .
9. Record the pressures reported by the primary and safety transducers (displayed in the NIBP Test control panel) as P_p and P_s , respectively
10. Calculate the absolute pressure differences between the applied pressure (P_a) and each of the transducer pressures.
 - $P_{d-Primary} = \text{abs}(P_a - P_p)$
 - $P_{d-safety} = \text{abs}(P_a - P_s)$
11. From the NIBP Test control panel, select **Open Valve** to release the pressure
12. Repeat steps 3 to 11 to test for the remaining target pressures of 150 +/- 5 mmHg and 250 +/- 5 mmHg.
13. Once complete, use the navigation keys to select **Update NIBP Cal Check Date** to save the date of the most recent calibration check.

Acceptable Results

The unit passes the test if $P_{d-Primary}$ is less than or equal to 3.0 mmHg and $P_{d-Safety}$ is less than or equal to 4.0 mmHg for all three target pressures.


Corrective Action

If readings fail to meet the required accuracy, the NIBP module requires replacement or factory analysis and realignment.

CO₂ Calibration Procedure (required for annual calibration)

Equipment 5% CO₂ calibration gas cylinder with CO₂ sample line (kit available from Scott Medical Products, PN 4653ORF-BD)

Procedure

- On the Propaq MD, do the following to enter the CO₂ Calibration control panel:
 - Press the CO₂ quick access key ().
 - Use the navigation keys to select **Supervisor>Service>Diagnostic>CO₂>Calibration**.
- Connect the Propaq MD to the 5% CO₂ calibration gas cylinder using the sample line included with the calibration kit.
- From the CO₂ Calibration Menu, select **Calibration**.
- Activate the calibration gas flow by pressing the top valve on the calibration gas canister.
- Continue to apply the calibration gas until the status in the CO₂ Calibration control panel displays: *CALIBRATION GAS CAN BE REMOVED*.
 - When the calibration is complete, the status in the CO₂ Calibration control panel displays: *CALIBRATION DONE - OK OR CALIBRATION DONE - ERROR*.
- To verify calibration, perform the CO₂ Calibration Check Procedure page 10.

Acceptable Results

The status in the CO₂ Calibration control panel displays: *CALIBRATION DONE - OK*.

Perform the above calibration check procedure to verify CO₂ accuracy.

The calibration date will be updated upon exiting the CO₂ Test control panel.

Corrective Action

If an error is reported, refer to the table below for possible causes.

If readings fail to meet the required accuracy, the CO₂ module requires replacement or factory analysis and realignment.

The following table describes possible calibration errors and likely causes.


Table 1-1. Calibration Errors

Error Message	Cause
No gas or wrong gas concentration	The concentration of supplied gas is not close to the expected value.
No stable gas flow and Calibration failure	The gas sample is not stable, i.e. due to leak or noise.
Measurement error	Occlusion detection during known gas sampling.
Measurement error	Sample line disconnection during gas sampling.
AZ fail	The Auto Zero that is part of the calibration process failed.
Calibration aborted by user	Calibration mode canceled during gas sampling.

CO₂ Calibration Check Procedure

Equipment 5% CO₂ calibration gas cylinder with CO₂ sample line (kit available from Scott Medical Products, PN 4653ORF-BD)

Procedure

1. On the Propaq MD, do the following to enter the CO₂ Calibration control panel:
 - Press the CO₂ quick access key ().
 - Use the navigation keys to select **Supervisor>Service>Diagnostic>CO₂>Calibration**.
2. Connect the Propaq MD to the 5% CO₂ calibration gas cylinder using the sample line included with the calibration kit.
3. From the CO₂ Calibration control panel, select **Verify Calibration**.
4. Activate the calibration gas flow by pressing the top valve on the calibration gas canister.
5. Continue to apply the calibration gas until the status in the CO₂ Calibration control panel displays: *CALIBRATION GAS CAN BE REMOVED*.
 - When the calibration check is complete, the status in the CO₂ Calibration control panel displays: *VERIFICATION DONE - OK OR VERIFICATION DONE - ERROR*.
 - When the calibration check completes successfully, the measured gas value displays in the CO₂ Calibration control panel.

Acceptable Results

The message displays: *VERIFICATION DONE - OK*.

The measured gas reading passes if it is between 4.8 and 5.2 (Vol%).

Corrective Action

If an error is reported, refer to Table 1-1 on page 9 for possible causes.

If the measured gas reading is outside the acceptable range, or if calibration is due, complete the following CO₂ calibration procedure.


NIBP Valve, Pump, and Tubing Integrity Tests

NIBP Leak Test

Equipment Single lumen BP hose, a 500 cc volume, and a calibrated manometer.

Note: If a 500 cc volume is not available, an Adult BP cuff wrapped around a rigid cylinder (such as a glass jar) will suffice

Procedure

1. Power on the Propaq MD.
2. Connect the Propaq MD to the single lumen hose and the 100 cc volume. Alternatively, replace the 100 cc volume with a standard Adult cuff wrapped around a rigid cylinder, such as a glass jar. If available, connect a calibrated manometer to the air line using a T-fitting.
3. On the Propaq MD, do the following to enter the NIBP Test control panel:
 - Press the Setup quick access key (.
 - Use the navigation keys to select **Supervisor>Service>Device Tests>NIBP Test**.
4. From the Propaq MD NIBP Test control panel, use the navigation keys to select:
 - **Close Valve**
 - **Turn Pump On**
5. Monitor the pressure reported by NIBP Test control panel or the external pressure standard.
6. Select **Turn Pump Off** as soon as the pressure reaches the target pressure of 250 +/- 5 mmHg.
7. Allow the system to stabilize for 10 seconds.
8. Select **Mark P1** to mark the starting pressure. If available, measure the starting pressure reported by the external pressure standard. Record the starting pressure as P_S .
9. Wait 15 seconds.
10. Select **Mark P2** to mark the ending pressure. If available, measure the ending pressure reported by the external pressure standard. Record the ending pressure as P_E .
11. From the NIBP Test control panel, select **Open Valve** to release the pressure.
12. Calculate the leak rate: $L = (P_S - P_E) / (15 \text{ seconds})$.

Note: If using the pressure reported in the NIBP Test control panel, calculate the Leak Rate using the Primary transducer pressures.

Acceptable Results

The unit passes the test if the system leaks less than 5 mmHg over the 15-second time interval (Leak Rate is less than 1/3).

Corrective Action


If the unit fails the test, the most likely cause is damaged or disconnected internal tubing. The device needs to be disassembled to replace or reattach the appropriate segment of NIBP tubing. The NIBP valves should also be inspected.

NIBP Deflation Test

Equipment Single lumen BP hose, a 500 cc volume, a timer, and a calibrated manometer (optional).

Note: Note: If a 500 cc volume is not available, an Adult BP cuff wrapped around a rigid cylinder (such as a glass jar) will suffice.

Procedure

1. Power on the Propaq MD.
2. Connect the Propaq MD to the single lumen hose and the 500 cc volume. Alternatively, replace the 500 cc volume with a standard Adult cuff wrapped around a rigid cylinder, such as a glass jar. If available, connect a calibrated manometer to the air line using a T-fitting.
3. On the Propaq MD, do the following to enter the NIBP Test control panel:
 - Press the Setup quick access key (.
 - Use the navigation keys to select **Supervisor>Service>Device Tests>NIBP Test**.
4. From the Propaq MD NIBP Test control panel, use the navigation keys to select:
 - **Close Valve**
 - **Turn Pump On**
5. Monitor the pressure reported by the NIBP Test control panel or the external pressure standard.
6. Select **Turn Pump Off** as soon as the pressure reaches the target pressure of 265 +/- 5 mmHg.
7. Allow the system to stabilize for 5 seconds.
8. Use the navigation keys to select **Open Valve** and immediately start the timer.
9. Stop the timer as soon as pressure drops below 15 mmHg.
10. Record the Deflation Time as T_D .

Acceptable Results

The unit passes the test if the time to release pressure from 265 +/- 5 mmHg to 15 mmHg is less than 10 seconds.


Corrective Action

If the unit fails the test, the most likely cause is kinked or obstructed internal tubing, or obstructed filter. The device needs to be disassembled to replace or reposition the appropriate segment of NIBP tubing.

NIBP Inflation Test

Equipment Single lumen BP hose, a 250 cc volume, a timer, and a calibrated manometer (optional).

Procedure

1. Power on the Propaq MD.
2. Connect the Propaq MD to the single lumen hose and the 250 cc volume. If available, connect a calibrated manometer to the air line using a T-fitting.
3. In the Propaq MD, do the following to enter the NIBP Test control panel:
4. Press the Setup quick access key ().
5. Use the navigation keys to select **Supervisor>Service>Device Tests>NIBP Test**.
6. Wait 10 seconds to allow the system to vent any residual pressure.
7. Verify that the pressure reported by the NIBP Test control panel or the external pressure standard system is less than 5 mmHg.
8. From the NIBP Test control panel, use the navigation keys to select **Close Valve**.
9. Select **Turn Pump On** and immediately start the timer.
10. Stop the timer as soon as pressure exceeds 210 mmHg.
11. Select **Turn Pump Off**, then **Open Valve**.
12. Record the Inflation Time as T_I .

Note: Note: The pump will automatically turn off if pressure exceeds 310 mmHg during this test.

Acceptable Results

The unit passes the test if the time to increase pressure to 210 mmHg is less than 7 seconds.

Corrective Action

If the unit fails the test, the most likely cause is a faulty pump or a kinked internal hose. The device needs to be disassembled to replace the pump or reposition the appropriate segment of NIBP tubing.

Operational Tests

The Propaq MD comes equipped with routine operational tests that can be performed periodically. With the exception of the Physical Inspection of the Unit test, these tests contain instructions within them provide guidance during the tests.

Physical Inspection of the Unit


Tools Needed None

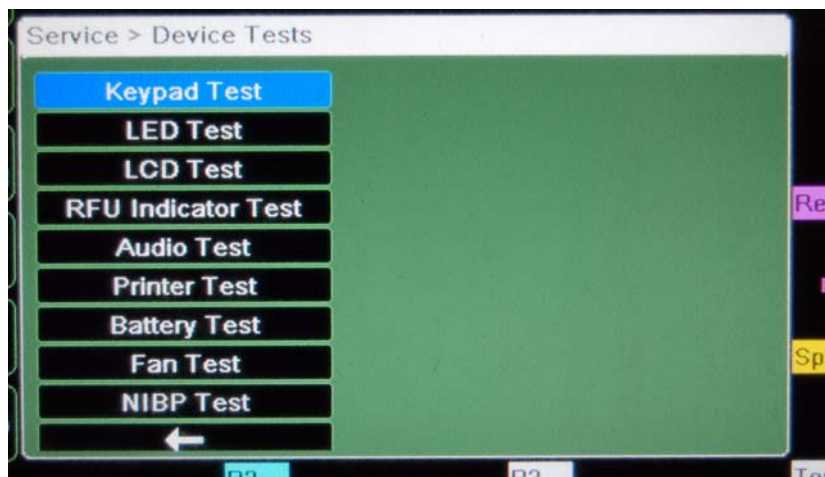
Test Setup None

	Observe this...	Pass/Fail
	Housing	
1.	Is the unit clean and undamaged?	O O
2.	Does the unit show signs of excessive wear?	O O
3.	Does the handle work properly?	O O
4.	Does the recorder drawer open and close properly?	O O
5.	Are input connectors clean and undamaged?	O O
6.	Are there any cracks in the housing?	O O
7.	Do the front panel or selector switches have any damage or cracks?	O O
8.	Are there any loose housing parts?	O O
	Paddles (if applicable)	
9.	Do the adult and pedi plates have major scratches or show signs of damage?	O O
10.	Do the adult shoes slide on and off easily to expose the covered pedi plates?	O O
11.	Are the paddles clean (e.g., fre23 e of gel) and undamaged? (if applicable)	O O
	Cables	
12.	Are all cables free of cracks, cuts, exposed or broken wires?	O O
13.	Are all bend/strain reliefs undamaged and free of excessive cable wear?	O O
	Battery	
14.	Is the Propaq battery fully charged?	O O
15.	Is the battery seated in the battery well correctly?	O O
16.	Is battery housing free of cracks and damage?	O O
17.	Are connectors free of damage and excessive wear?	O O

Accessing the Operational Tests

The operational tests on the unit can be accessed by doing the following:

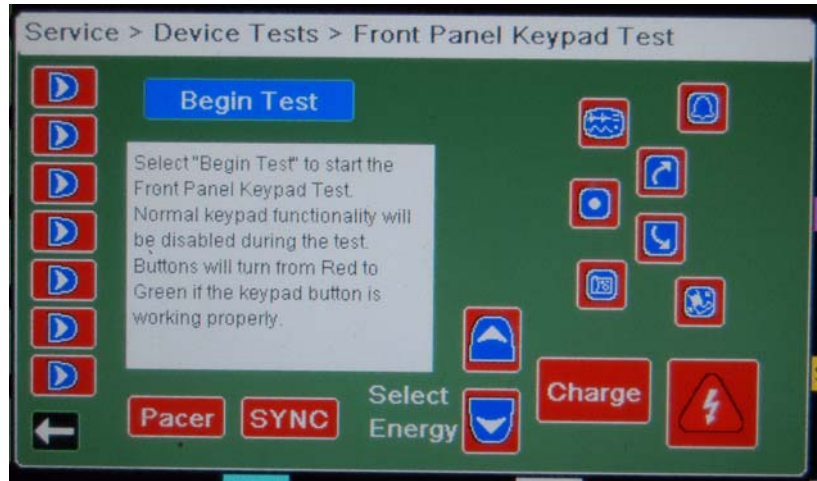
1. Press the Setup quick access key ().
2. Use the navigation keys to select **Supervisor>Service>Device Tests**. The operational tests are displayed. Use the navigation keys to select one of the tests.



Keypad Test

This test checks all the front panel buttons on the unit to make sure they are working correctly.

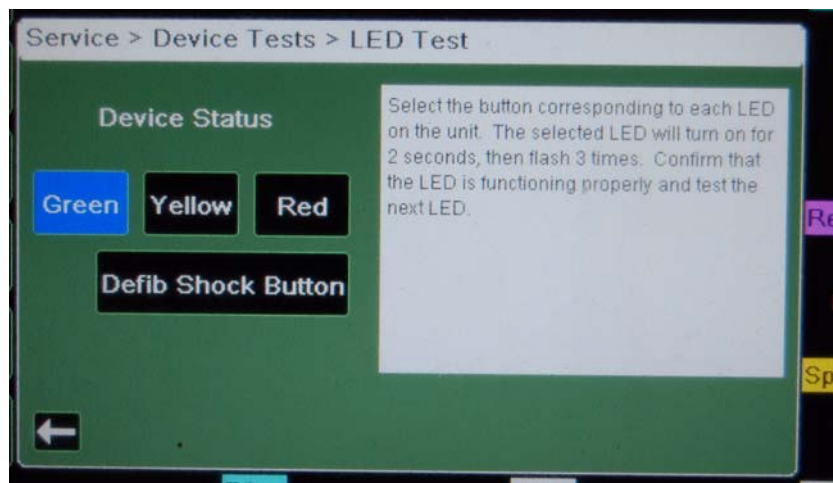
Follow the instructions and use the navigation keys to move around the display and make selections.



LED Test

This test checks all the Light Emitting Diodes in the unit to make sure they are working correctly.

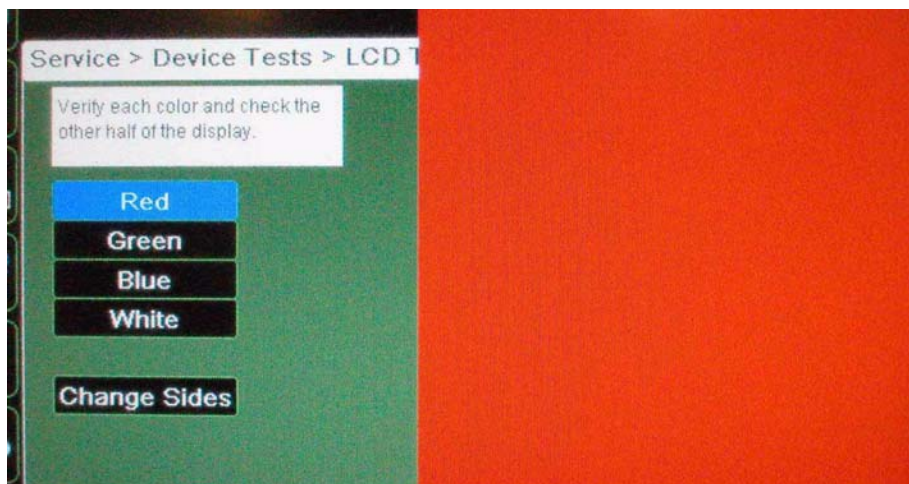
Follow the instructions and use the navigation keys to move around the display and make selections.



LCD Test

This test checks the colors of the Liquid Crystal Display on the unit.

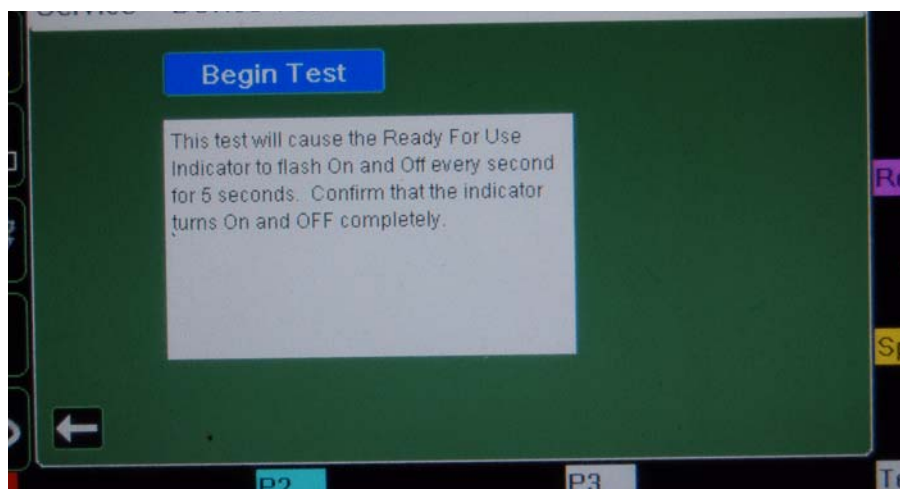
Follow the instructions and use the navigation keys to move around the display and make selections.



RFU Indicator Test

This test checks the Ready For Use Indicator on the unit to make sure it is working correctly.

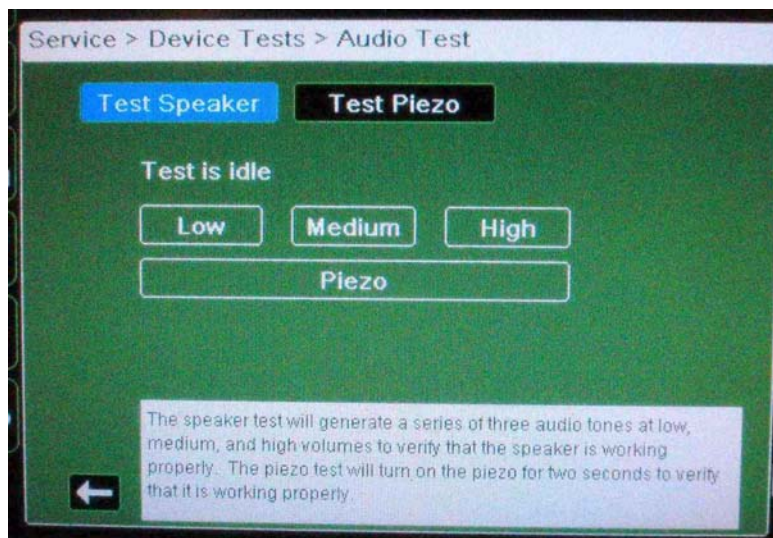
Follow the instructions shown on the display.



Audio Test

This test checks the audio tones on the unit to make sure they are working correctly.

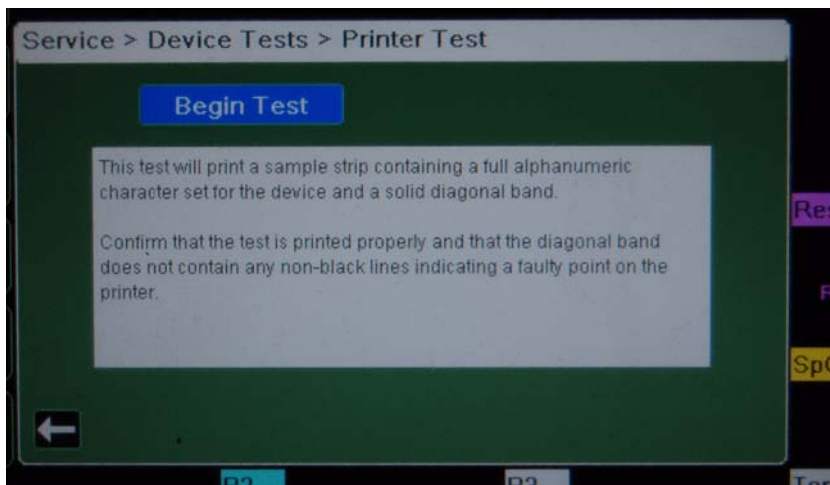
Follow the instructions and use the navigation keys to move around the display and make selections.



Printer Test

This test checks the printer to make sure it is working correctly.

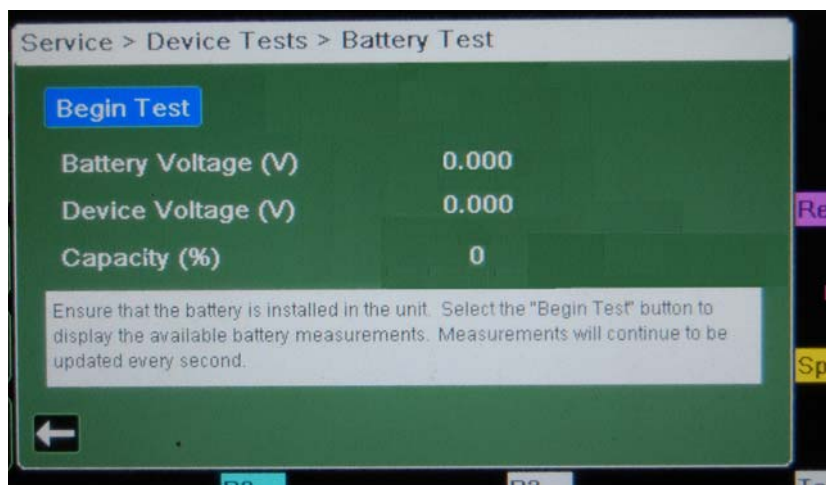
Follow the instructions shown on the display.



Battery Test

This test checks the battery to make sure it is working correctly.

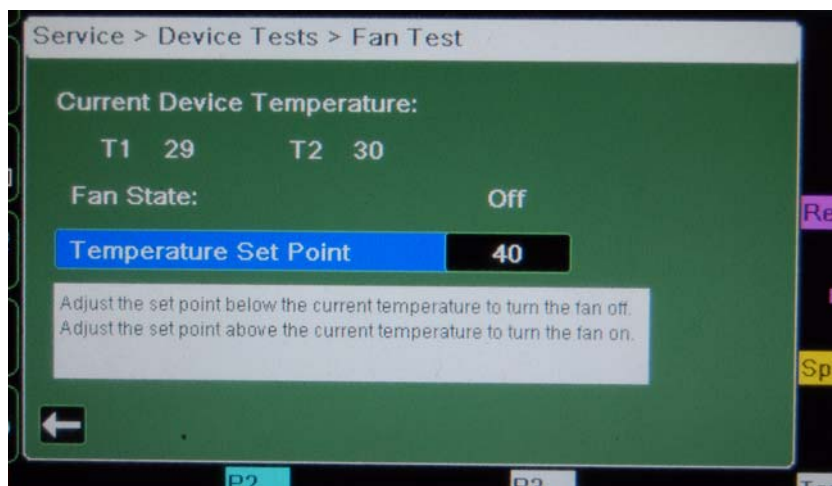
Follow the instructions on the display.



Fan Test

This test checks the fan in the unit to make sure it is working correctly.

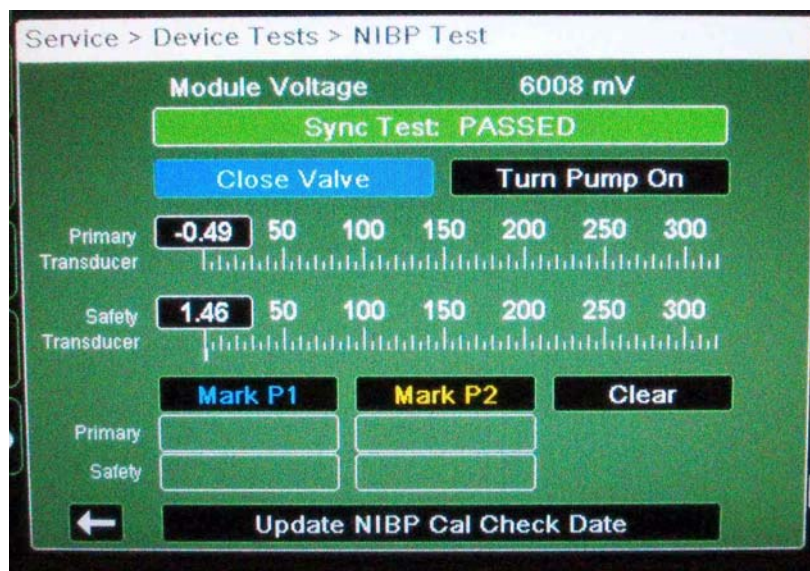
Follow the instructions and use the navigation keys to move around the display and make selections.



NIBP Test

This allows the operator to perform various checks of the NIBP module to make sure it is working correctly.

Follow the instructions in the NIBP Calibration Check procedure and other procedures outlined in this manual. Use the navigation keys to move around the display and make selections as required to execute the procedures.



Functional Verification Tests

Before You Begin the Functional Verification Tests

- Assemble the tools listed in following section, “Equipment You Need to Perform the Functional Verification Tests.”
- Keep an extra fully charged Propaq MD battery available.
- Schedule an hour to conduct the entire maintenance test.
- Perform the tests in the order presented.
- Perform all the steps of each test procedure.
- Complete all the steps of the procedure before evaluating the test results.

Equipment You Need to Perform the Functional Verification Tests

For testing purposes, you can substitute an equivalent device.

- Fluke Impulse 7000DP Analyzer, or equivalent, with appropriate interface adapter (Dynatech Nevada Inc. part number 3010-0378)
- IBP/Temp Simulator, or equivalent
- NIBP Simulator
- Single or dual lumen NIBP hose
- Adult NIBP cuff and a rigid cylinder to wrap it around
- 5% CO₂ calibration gas cylinder with CO₂ sample line (kit available from Scott Medical Products, PN 4653ORF-BD)
- ECG Simulator; 12 Lead Simulator for 12 Lead test (e.g., Symbio CS1201)

Accessories You Need for the Propaq MD Options Functional Verification Tests




- 3-lead, 5-lead and 12-lead ECG cables. (12-lead cable needed if 12-lead option is installed.)
- NIBP cuff and hose
- IBP cable
- SpO₂ cable and sensor
- EtCO₂ cable and sensor
- Paddles
- Printer paper
- Battery
- Auxiliary power source

Leads Test

Tools Needed 3-lead, 5-lead, and 12-lead cables

Test each cable separately.

Test Setup Connect the lead wires appropriate to each test to the Fluke Impulse 7000DP Analyzer or equivalent.

	Do this...	Observe this...	Pass/Fail
1.	Press the power switch to turn on the Propaq MD.	No ECG LEAD FAULT message displayed.	O O
2.	Disconnect one lead from the simulator.	The ECG LEAD FAULT message displays within 3 seconds (if configured).	O O
3.	Reconnect the lead. Repeat step 2 with the remaining leads.	Wait for ECG LEAD FAULT message to clear from the display (if configured).	O O
4.	Repeat steps 2 and 3 for 5 lead and 12 lead cables.	Note: If heart rate alarm sounds, on the Propaq MD: <ul style="list-style-type: none"> • Press the Next quick access key () key to access the second set of quick access keys. • Press the Alarm quick access key (). • Press the Alarm Suspend key (). 	O O

Heart Rate Display Test

Tools Needed ECG simulator







ECG Cable (3-lead, 5-lead or 12-lead)



Test Setup Press the power switch to turn on the Propaq MD. Press Lead quick access key until **II** displays.
Connect the ECG leads to the ECG simulator.
Connect the ECG cable to the unit.

	Do this...	Observe this...	Pass/Fail
1.	Set the ECG Simulator to 120BPM.	The Heart Rate displays as 120 +/- 4 bpm	<input type="radio"/> <input type="radio"/>

Heart Rate Alarm Test

Tools Needed ECG simulator

	Do this...	Observe this...	Pass/Fail
1.	Press the power button on the Propaq MD to turn the unit on. Connect the ECG leads to the ECG simulator. Set the simulator to 120 BPM and press the Leads quick access key () on the Propaq MD unit and select lead II.	II displays next to the Leads quick access key.	O O
2.	On the Propaq MD: <ul style="list-style-type: none"> Press the Next quick access key () key to access the second set of quick access keys. Press the Alarm quick access key (). Press the Limits softkey. 	The Alarm Settings menu displays.	O O
3.	On the Propaq MD, select HR/PR Alarm in the Alarm Settings menu and use the navigation keys to do the following: <ul style="list-style-type: none"> Set the Upper Limit Enable to ON. Set the Lower Limit Enable to ON. Set the Lower limit to 30. Set the Upper limit to 150. Use the navigation keys to exit the Alarm Settings menu.		
4.	On the Propaq MD, press the Alarm Suspend key ().	The red alarm suspension timer displays at the top of the next to the message area.	
5.	Remove a lead wire from the ECG simulator.	The <i>ECG LEAD FAULT</i> message displays.	O O
6.	On the Propaq MD, press the Alarm Suspend key ().	The Alarm Suspend key flashes.	
7.	Reattach ECG Lead wire to ECG simulator.	The <i>ECG LEAD FAULT</i> message no longer displays.	O O
	Set simulator to 20 BPM or lower.	Heart Rate Value is highlighted and the alarm tone sounds. The <i>HR/PR LOW ALARM</i> message displays.	
8.	On the Propaq MD, press the Alarm Suspend key ().	The Alarm Suspend key flashes. The red alarm suspension timer displays at the top of the screen next to the message area.	O O
9.	Set the simulator to 120 BPM.		

	Do this...	Observe this...	Pass/Fail
10.	On the Propaq MD, press the Alarm Suspend key ().	Alarm is enabled. The alarm suspend key flashes. The alarm suspension timer disappears.	O O
10.	Set simulator to 160 BPM or higher.	Heart Rate Value is highlighted and the alarm tone sounds. The <i>HR/PR HIGH ALARM</i> message displays.	O O
11.	On the Propaq MD, press the Alarm Silence/Reset button ().	Alarm is suspended for 90 seconds. The alarm suspension timer appears in black.	O O

Leakage Current Test

Tools Needed See the manufacturer's instructions or supplied specifications for the leakage tester you use.

Setup See the manufacturer's instructions or supplied specifications for the leakage tester you use. Repeat leakage test with accessories: MFC, external paddles, internal paddles, and anterior/posterior paddles. Perform these tests at the line-power voltage and frequency used in your installation.

Maximum Leakage Acceptance Limits			
	Patient Leakage		Mains on Applied Part
	Normal	Single Fault	Single Fault
ECG	10 μ A	50 μ A	100 μ A
MFC	10 μ A	50 μ A	100 μ A

	Normal	Single Fault
Earth Leakage	2500 μ A	5000 μ A

Shock Test

Tools Needed Fluke Impulse 7000 DP Analyzer, or equivalent

Test Setup None

	Do This...	Observe This...	Pass/Fail
1.	Turn on the Analyzer.		
2.	On the Analyzer, select the DEFIB function.		
3.	On the Analyzer, select ENERGY.		
4.	Connect the Propaq MD MFE connector to the pads connection.		
5.	On the Propaq MD, apply power to the unit using a battery or an AC adapter.		
6.	On the Propaq MD, connect the MFE cable.		
7.	Press the power button to turn on the Propaq MD.		
8.	On the Propaq MD, set energy level to 200J by pressing the Select Energy UP arrow.		
9.	On the Propaq MD, press the CHARGE button.	The unit charges to 200J, the red Shock button lights up and a ready tone is heard.	O O
10.	On the Propaq MD, press the SHOCK button.		
11.	On the Analyzer, observe and record the energy measurement.	Energy is delivered at 200J. Verify that the delivered energy is within 15% based on the values in the following table.	O O

Table 2. Delivered Energy at 200J Defibrillator Setting into a Range of Loads

Selected Energy	Load							Accuracy*
	25Ω	50Ω	75Ω	100Ω	125Ω	150Ω	175Ω	
200 J	142 J	230 J	249 J	253 J	269 J	261 J	260 J	±15%


Note: For a complete listing of Propaq MD Delivered Energy at Every Defibrillator Setting into a Range of Loads, see Appendix A in the *Propaq MD Operator's Guide*.

Synchronized Cardioversion Test

Tools Needed Fluke Impulse 7000DP or equivalent defibrillator analyzer.

Test Setup Connect the cable to the defibrillator analyzer.

Select cardioversion on analyzer. Input 1mV ECG signal at 60 -120 BPM.

	Do this...	Observe this...	Pass/Fail
1.	Press the power switch to turn on the Propaq MD, and press the Leads quick access key () to select PADS .		
2.	Press the SYNC softkey on the defibrillator. Enter synchronized cardioversion timing test mode on the defibrillator analyzer.	Sync appears on display. Sync markers display on the monitor. The sync marker appears as an S over the ECG R-wave peaks on strip chart and display.	O O
3.	Select 200J.		
4.	Press the CHARGE button. When the SHOCK button lights, press and hold the SHOCK button.	Observe that the R-wave to shock delay (sync delay) is less than 60 milliseconds on the analyzer display. Defibrillator discharges.	O O

Pacer Test

Tools Needed Fluke Impulse 7000 DP Analyzer, or equivalent



Test Setup None

	Do This...	Observe This...	Pass/Fail
1.	Turn on the Analyzer.		
2.	On the Analyzer, select the PACER function per test equipment instructions.		
3.	On the Analyzer, press F2 to select PACER JACKS.		
4.	Connect the MFC connector to the Analyzer.		
5.	On the Propaq MD, apply power to the unit using a battery or an AC adapter.		
6.	Press the power button to turn on the Propaq MD.		
7.	On the Propaq MD, press the PACER button.		
8.	On the Propaq MD, use the navigation keys to do the following: •Set Rate to 30. •Set Output to 10. •Select Start Pacer.	•Pacer Rate PPM (28.5ppm-31.5ppm) •Pacer amplitude output (5mA-15mA) •Pacer pulse width (38ms to 42ms)	O O
9.	On the Impulse 7000 DP Analyzer, record the following: •pulse rate •pacer amplitude output •pacer pulse width		
10.	On the Propaq MD, use the navigation keys to do the following: •Set Rate to 180. •Set Output to 140. •Select Start Pacer.	•Pacer Rate PPM (162ppm-198ppm) •Pacer amplitude output (133mA-147mA) •Pacer pulse width (38ms to 42ms)	O O
11.	On the Impulse 7000 DP Analyzer, record the following: •pulse rate •pacer amplitude output •pacer pulse width		

Printer Test

Tools Needed None

Test Setup None

	Do this...	Observe this...	Pass/Fail
1.	On the Propaq MD, install the paper tray on the left side of the unit.		
2.	Press the Print quick access key () to start the recorder. Note: If the printer fails to start, check <i>setup</i> for <i>printer=yes</i> .		
3.	Press the Print quick access key () to stop the recorder after approximately 10 seconds.	The recorded waveforms on the strip chart are clear and dark.	O O

SpO₂ Test

Tools Needed SpO₂ Simulator: Fluke Index 2 or equivalent, Nellcor™ SpO₂ finger probe


Test Setup Disconnect any ECG cable or IBP probes from the Propaq MD.

	Do This...	Observe This...	Pass/Fail
1.	Power on the Propaq MD without the SpO ₂ sensor attached.	Verify that the SpO ₂ numeric displays INITIALIZING, changes to SEARCHING, then goes blank.	
2.	Connect the SpO ₂ sensor to the Propaq MD.	Verify that SpO ₂ numeric displays SEARCHING.	
3.	Set the simulator to 70% SpO ₂ and 60 PPM. Attach the SpO ₂ sensor to the simulator.	Verify that after a brief period of initialization, the SpO ₂ numeric displays an SpO ₂ value between 67% and 73%. Verify that the displayed pulse rate reads 60 +/- 3 bpm.	0 0 0 0
4.	Set the simulator to 80% SpO ₂ and 60 PPM.	Verify that after a brief period of initialization, the SpO ₂ numeric displays an SpO ₂ value between 77% and 83%. Verify that the displayed pulse rate reads 60 +/- 3 bpm.	0 0 0 0
5.	Set the simulator to 90% SpO ₂ and 60 PPM.	Verify that after a brief period of initialization, the SpO ₂ numeric displays an SpO ₂ value between 87% and 93%. Verify that the displayed pulse rate reads 60 +/- 3 bpm.	0 0 0 0

EtCO₂ Test

Tools Needed CO₂ sampling line airway adapter

Test Setup None

	Do this...	Observe this...	Pass/Fail
1.	On Propaq MD, install the airway adapter set and sampling line in the connector at the side of the unit.		
2.	Press the CO ₂ quick access key () to activate the CO ₂ trace.	The CO ₂ trace is on the display.	<input type="radio"/> <input type="radio"/>
3.	On Propaq MD, gently blow into the airway adapter set while observing the display.	The CO ₂ waveform changes on the display.	<input type="radio"/> <input type="radio"/>

IBP Test

Tools Needed IBP patient simulator (with accuracy better than ± 1 mmHg), or equivalent

Setup Connect the test cables to IBP patient simulator.

	Do This...	Observe This...	Pass/Fail
1.	Connect the IBP patient simulator to the Propaq P1 channel.		
2.	Set the IBP patient simulator to 0 mmHg.		
3.	On the Propaq MD, press > IBP.		
4.	On the Propaq MD, Press > P1->0<-. 	Display of 0/0(± 2) in the P1 box at the bottom of the display (P1 is zeroed). The waveform for channel 1 is present.	<div>O O</div> <div>O O</div>
5.	Set the IBP patient simulator to 200 mmHg (or as close to 200 mmHg as your simulator allows).	Display of 200/200(± 5) in the P1 box at the bottom of the display as xxx/yyy where yyy=diastolic (P1 diastolic pressure is 200 (± 5)).	<div>O O</div>
6.	Repeat steps 1 through 5 of this procedure for P2 and P3 channels.		

NIBP Test

Tools Needed NIBP simulator, single or dual lumen hose, adult, NIBP cuff, rigid cylinder

Test Setup Connect the Propaq MD to the NIBP simulator using the single or dual lumen hose. Wrap the NIBP cuff around a rigid cylinder, such as a glass jar.

Note: Refer to Appendix B for information on simulators and settings that you may use to assess the performance of the NIBP module.

	Do This...	Observe This...	Pass/Fail
1.	On the Propaq MD, ensure the patient mode is set to Adult.		
2.	Set the simulator to the 80/50 simulator preset.		
3.	Take a manual reading.	Confirm that the NIBP measurement reported is within +/- 10 mmHg of the expected simulator performance.	O O
4.	Set the simulator to the 120/80 simulator preset.		
5.	Take a manual reading.	Confirm that the NIBP measurement reported is within +/- 10 mmHg of the expected simulator performance.	O O
6.	Set the simulator to the 200/150 simulator preset.		
7.	Take a manual reading.	Confirm that the NIBP measurement reported is within +/- 10 mmHg of the expected simulator performance.	O O

Temperature Test

Tools Needed IBP Temp Simulator, or equivalent

Test Setup None

	Do this...	Observe This...	Pass/Fail
1.	Connect the temperature simulator to the Propaq MD T1 channel.		
2.	On the IBP Temp Simulator, Select 98.6 Degree F (36 Degree C) or a setting as close as possible as your simulator allows.	The displayed temperature value is within 0.2 F or 0.1 C of the simulator setting.	O O
3.	Repeat steps 1 and 2 of this procedure for the T2 channel.		

Chapter 2

Troubleshooting

Overview

This chapter contains a list of error messages that users may see if the unit is not operating properly.

If the errors you encounter are not listed below, call ZOLL Medical Corporation's Technical Service Department for further assistance. (See "Technical Service" on page 3 for contact information.)

Propaq MD Error Messages

The following is a list of the Propaq MD error messages that may appear on your display. The "Technical Action" column describes what you as a technician can do to correct the situation.

Error Message	Explanation	Technical Action
SW SHUTDOWN WARNING	Indication that the battery has reached the software shutdown capacity.	Charge the battery.
HW SHUTDOWN	Voltage threshold exceeded the minimum working threshold of the device. There is no warning.	Charge the battery.

Error Message	Explanation	Technical Action
QUICK ACCESS SW 1 SHORT	Quick access key 1 is stuck.	Replace the front panel.
QUICK ACCESS SW 2 SHORT	Quick access key 2 is stuck.	Replace the front panel.
QUICK ACCESS SW 3 SHORT	Quick access key 3 is stuck.	Replace the front panel.
QUICK ACCESS SW 4 SHORT	Quick access key 4 is stuck.	Replace the front panel.
QUICK ACCESS SW 5 SHORT	Quick access key 5 is stuck.	Replace the front panel.
QUICK ACCESS SW 6 SHORT	Quick access key 6 is stuck.	Replace the front panel.
QUICK ACCESS SW 7 SHORT	Quick access key 7 is stuck.	Replace the front panel.
SCREEN CYCLE SHORT	Display/home key is stuck.	Replace the front panel.
ALARM SILENCE SHORT	Alarm Silence/Reset key is stuck.	Replace the front panel.
NAV PAD UP SHORT	Up/Clockwise Navigation key is stuck.	Replace the front panel.
NAV PAD SELECT SHORT	Select key is stuck.	Replace the front panel.
NAV PAD DOWN SHORT	Down/Counterclockwise Navigation key is stuck.	Replace the front panel.
SNAPSHOT SHORT	Snapshot key is stuck.	Replace the front panel.
FP DEFIB ENERGY UP SHORT	Defib energy Select Up (Increase) key is stuck.	Replace the front panel.
FP DEFIB ENERGY DOWN SHORT	Defib energy Select Down (Decrease) key is stuck.	Replace the front panel.
FP DEFIB CHARGE SHORT	Keys are stuck.	Replace the front panel.
FP DEFIB FIRE SHORT	Keys are stuck.	Replace the front panel.
PS DEFIB ENERGY UP	Paddle set keys are stuck.	Replace the paddle set or MFC.
PS DEFIB ENERGY DOWN	Paddle set keys are stuck.	Replace the paddle set or MFC.

Error Message	Explanation	Technical Action
PS DEFIB CHARGE SHORT	Paddle set keys are stuck.	Replace the paddle set or MFC.
PS DEFIB RECORDER SHORT	Paddle set keys are stuck.	Replace the paddle set or MFC.
PS DEFIB FIRE SHORT	Paddle set keys are stuck.	Replace the paddle set or MFC.
PRINTER OFFLINE	Printer module is off-line.	If it remains off-line, try checking the connectors or power to the printer. If it persists, replace the printer module.
PRINTER OUT OF PAPER	If there is paper in the device, probably a paper sensor problem.	Replace the printer module.
PRINTER PLATEN OPEN	If printer door is closed, probably a problem with the micro switch.	Replace the printer module.
ECG DEVICE FAILURE	ECG software detected a problem with the ECG data that is most likely a hardware issue.	Replace the main board.
TEMP DEVICE FAILURE	Temp software detected a problem with the temperature data that is most likely a hardware issue.	Replace the main board.
TEMP PROBE1 SHORTED	An A/D value was detected that indicated the probe was shorted.	Replace the temperature probe or adapter cable. If problem persists, replace the right side panel.
TEMP PROBE2 SHORTED	An A/D value was detected that indicated the probe was shorted.	Replace the temperature probe or adapter cable. If problem persists, replace the right side panel.
TEMP1 CIRCUIT FAILURE	The software detected an out-of-range A/D converter.	Remove probe, power cycle. If problem persists, replace main board.
TEMP2 CIRCUIT FAILURE	The software detected an out-of-range A/D converter.	Remove probe, power cycle. If problem persists, replace main board.

Error Message	Explanation	Technical Action
IBP DEVICE FAILURE	IBP software detected a problem with the IBP data that is most likely a hardware issue.	Replace the main board.
IBP PROBE1 SHORTED	An A/D value was detected that indicated the probe was shorted.	Replace the IBP probe. If problem persists, replace the right side panel.
IBP PROBE2 SHORTED	An A/D value was detected that indicated the probe was shorted.	Replace the IBP probe. If problem persists, replace the right side panel.
IBP PROBE3 SHORTED	An A/D value was detected that indicated the probe was shorted.	Replace the IBP probe. If problem persists, replace the right side panel.
IBP PROBE1 CIRCUIT FAILURE	An unsupported probe was inserted or there is a circuit problem.	Unplug probe, power cycle. If problem persists, replace main board.
IBP PROBE2 CIRCUIT FAILURE	An unsupported probe was inserted or there is a circuit problem.	Unplug probe, power cycle. If problem persists, replace main board.
IBP PROBE3 CIRCUIT FAILURE	An unsupported probe was inserted or there is a circuit problem.	Unplug probe, power cycle. If problem persists, replace main board.
SPO2 DEVICE FAILURE	Communication failure or device malfunction.	Check SpO ₂ communication cables. If problem persists, replace the SpO ₂ module.
NIBP MONITORING FAILURE	One of the following issues occurred: <ul style="list-style-type: none"> A failure was reported by the NIBP module. The two transducers are not aligned. They are either not calibrated, there is a transducer failure, or there is a kinked tube. A calibration problem was reported by the NIBP module. 	If problem persists, replace the NIBP module.

Error Message	Explanation	Technical Action
NIBP COMMUNICATION FAILURE	There is a communication problem with the NIBP module.	Ensure that the J32 connection is secure. If error persists, replace the NIBP module.
NIBP CALIBRATION CHECK DUE	Annual calibration check is due.	Perform the NIBP Calibration Check procedure in <i>Chapter 1, "Calibration and Calibration Checks"</i> .
NIBP KINKED HOSE	The cuff inflation was too rapid. There may be kinked tubing or another air obstruction.	Check the external NIBP hose for kinks. If problem persists, check the routing of the NIBP tubing inside the device.
NIBP MAX PRESSURE EXCEEDED	Pressure limit exceeded.	<p>If problem persists, do the following:</p> <ul style="list-style-type: none"> • Check the calibration via the NIBP Calibration Check procedure in <i>Chapter 1, "Calibration and Calibration Checks"</i>. • Check the routing of the NIBP tubing inside the device for kinks or obstructions. <p>If the NIBP module is out of calibration, replace the NIBP module.</p>

Error Message	Explanation	Technical Action
NIBP AIR LEAK	Major air leak or could not reach target pressure.	<p>Attempt to identify problems with the hose and/or cuff by doing the following:</p> <ul style="list-style-type: none"> • Check the hose connection to the device. Make sure that the hose is tightly screwed onto the NIBP connector. • Ensure that the cuff is appropriately wrapped and is not too loose. • Inspect the cuff and hose for leaks. Inspect the O-ring on the NIBP hose connector. Consider replacing the cuff and/or hose. <p>If the problem persists, perform one of the following procedures in <i>Chapter 1, "NIBP Valve, Pump, and Tubing Integrity Tests"</i>:</p> <ul style="list-style-type: none"> • NIBP Leak Test • NIBP Inflation Test <p>Inspect internal NIBP tubing for leaks.</p>
NIBP EQUIPMENT CHECK	Device is unable to obtain a reading.	<p>Check the hose and cuff connections. If problem persists, perform one or more of the following procedures outlined in <i>Chapter 1, "NIBP Valve, Pump, and Tubing Integrity Tests"</i>:</p> <ul style="list-style-type: none"> • NIBP Leak Test • NIBP Deflation Test • NIBP Inflation Test
NIBP WEAK PULSE	Too few pulses are detected during the reading attempt.	Tighten the cuff and ensure appropriate placement.
NIBP TEMP OUT OF RANGE	Module temperature is out of its specified operating range.	Move the device to a cooler or warmer environment.
NIBP ARTIFACT	Unable to determine blood pressure. Check connections; restrict patient movement.	Attempt to identify and eliminate the source of artifact. If problem persists, replace the NIBP module.

Error Message	Explanation	Technical Action
NIBP NEONATAL DETECTED	Device thinks a neonate cuff is connected. If no neonate cuff is connected, tubing may be damaged or kinked.	Verify that neonate cuff is not connected. If problem persists, check the routing of the NIBP tubing inside the device.
NIBP LOW VOLTAGE	Insufficient voltage is supplied to the NIBP module.	Check the module voltage in the NIBP Test screen. Inspect the unit or water ingress. If evidence of water ingress is found, allow the water to evaporate while periodically checking the module voltage. If problem persists, replace the NIBP module.
SPO2 COM ERROR CODE	Communication error.	Check communication cables. If problem persists, replace the SpO ₂ module.
SPO2 SENSOR FAILURE	Defective sensor or sensor error.	Replace the SpO ₂ sensor.
SPO2 UNKNOWN RECOVERY NUM	Recovery error.	Replace the SpO ₂ sensor.
CO2 DEVICE FAILURE	Malfunction or device failure.	Replace the CO ₂ module.
CO2 COM ERROR CODE	Communication failure.	Check communication cables. If problem persists, replace the CO ₂ module.
CO2 BAROMETRIC OUT OF RANGE	Altitude is too high for module.	Bring device into specified altitude range. If problem persists, replace the CO ₂ module.
CO2 CAL REMINDER	Calibration reminder.	Calibrate the CO ₂ module soon.
CO2 CAL REQUIRED	Calibration due.	Calibrate the CO ₂ module.
CO2 CHECK FLOW	Exhaust port blocked.	Check for exhaust port occlusion. If problem persists, replace the CO ₂ module.

Error Message	Explanation	Technical Action
CO2 GAS INPUT OCCLUSION	CO ₂ inlet blocked.	Replace FilterLine®. If problem persists, check for CO ₂ inlet occlusion. If still persists, replace the CO ₂ module.
CO2 MAINTENANCE REMINDER	Periodic maintenance reminder.	Replace CO ₂ module soon.
CO2 MAINTENANCE REQUIRED	Periodic Maintenance due.	Replace CO ₂ module.
CO2 NO FILTERLINE	No filterline is detected.	If FilterLine is connected and problem persists, replace FilterLine. If still persists, replace the CO ₂ module.
CO2 CAL FAILURE	Calibration failed.	Retry calibration or continue with old calibration. Replace the CO ₂ module.
DEFIB PACER DEVICE FAILURE	One of the following issues occurred: <ul style="list-style-type: none"> Error was detected on the defib/pacer board. Interface self-test communication failed. Pacer interface self-test failed. Communication with pacer hardware failed after startup. 	Check communication cables. If problem persists, replace the defib board module.
DEFIB DEVICE FAILURE	One of the following issues occurred: <ul style="list-style-type: none"> Device could not charge up the self-test energy. Discharge circuit failed to discharge voltage within specified time duration. Device failed to deliver correct self-test energy. 	Check communication cables. If problem persists, replace defib board module.
FP DEFIB FIRE SHORT	Front panel button is stuck.	Replace the front panel.
PS DEFIB CHARGE SHORT	Paddle set fire button is stuck or paddle set energy up select button is stuck.	Replace the paddles.

Error Message	Explanation	Technical Action
PS DEFIB ENERGY DOWN SHORT	Paddle set energy down select button is stuck.	Replace the paddles.
PS DEFIB RECORDER SHORT	Paddle set recorder button is stuck.	Replace the paddles.
DEFIB CAP LEAKAGE	Capacitor bank cannot hold a charge.	Replace the capbank module.
DEFIB USING DEFAULT CALIBRATION	Calibration data lost.	Replace the defib board module.
DEFIB FATAL CHARGE ERROR	Charging error.	Replace the defib board module.
DEFIB CHARGE ERROR	Over voltage was detected.	If problem persists, replace the defib board module.
DEFIB LOW BATTERY	Battery is too low to charge defibrillator.	Charge the battery. Check battery contacts and clean if necessary.
DEFIB CHARGE TIMEOUT FAIL	The battery did not produce enough current to charge capacitor.	Charge the battery. If voltages are okay (from battery and aux), replace the defib board module.
DEFIB DISCHARGE TEMP	Device is in a hot environment or the discharge circuit is always on.	Move device to cooler area. If problem persists, replace the defib board module.
DEFIB FIRE FAILURE	High impedance or low impedance (short).	Replace pads. If problem persists, check internal connections. If still persists, replace the defib board module.
DEFIB PHASE FAILURE	Phase I or phase II waveform dropout.	Replace the defib board module.
DEFIB NO ENERGY DELIVERED	High impedance. No defib energy was delivered.	Replace pads. If problem persists, check internal connections. If still persists, replace the defib board module.
PACER DEVICE FAILURE	Generation of pacer pulse failed.	Replace the defib board module.
PACER CURRENT FAULT	Lack of pacer current.	Replace the defib board module.

Chapter 3

Disassembly Procedures

Overview

This chapter provides instructions on how to disassemble and reassemble the Propaq MD unit, and includes the following sections:

- Required Equipment
- Safety Precautions
- Modules
- Handle Disassembly
- Printer Disassembly
- Main Unit Disassembly
- Front Enclosure Disassembly
- Display Disassembly
- NIBP and EtCO₂ Disassembly
- Monitor Board and SpO₂ Disassembly
- Defibrillator Board and Capacitor Bank Disassembly

Required Equipment

- No. 1 Phillips screwdriver with torque capability
- No. 2 Phillips screwdriver with torque capability
- Exacto-knife
- Orange wooden stick. (Available from H.A. Stiles: 1-800-447-8537)
- 90° dental pick
- Needle nose pliers
- 6 mm socket wrench
- 26 mm socket wrench

- Kapton tape
- 3M copper adhesive tape, or equivalent
- 1/2" nut driver
- Large diagonal cutters
- Strong glue, such as Loctite 420 or equivalent
- Loctite needle tip dispenser

Safety Precautions

WARNING!

SHOCK HAZARD!



Caution

TAKE THE NECESSARY PRECAUTIONS TO GUARD AGAINST SHOCK OR INJURY BEFORE YOU CONDUCT DEFIBRILLATOR TESTS OR REPAIRS.

- Only properly trained technicians should service the unit.
- The unit can contain deadly voltages even if the unit is turned off.
- Make sure to discharge the unit before working with it.
- Make sure you take the necessary precautions when working with static sensitive units. For example, you must wear a conductive wrist strap (which touches your skin) connected to a grounding mat and to the earth ground. You must remove the wrist strap when you discharge high voltage or when you are working on energized equipment.

Modules

The Propaq MD unit contains the following nine (9) modules or assemblies:

- Printer
- Front Enclosure
- Display
- NIBP
- EtCO₂ (Oridion[®])
- Monitor Board
- Capacitor Bank
- Defibrillator Board
- SpO₂

These modules can be purchased as replacement parts from the ZOLL Technical Support Department. See Chapter 5, "Replacement Parts" for information on ordering replacement parts.

Removing the Handle

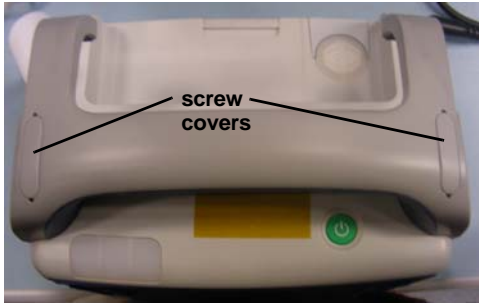
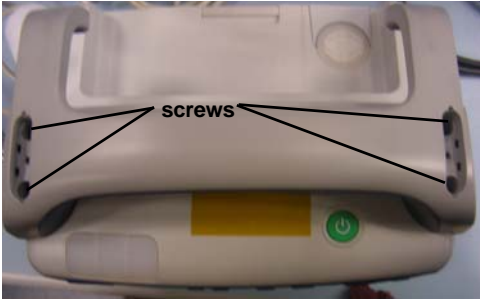
Tools Required

- #1 Phillips screwdriver with torque capability
- Orange (wooden) stick

Setup

- This procedure should be conducted on a static mat.
- Wear a wrist strap to ground during the procedure.

To reinstall the handle assembly, reverse the steps.

Handle Disassembly		
1	Using an orange stick, lift the screw covers off the handle in two locations.	
2	Remove four (4) screws (2 on each handle) and remove the handle. Note: During reassembly, torque screws to 8 in-lbs.	

Removing the Printer Module


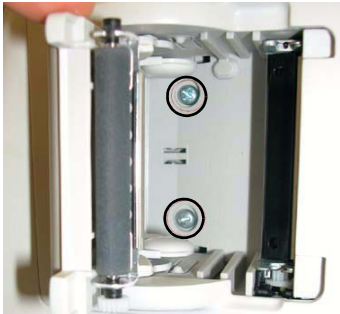

Tools Required

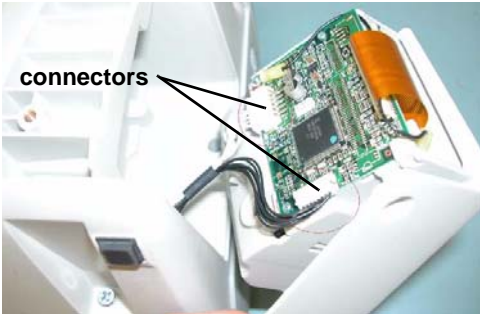
- #1 Phillips screwdriver with torque capability
- Orange (wooden) stick

Setup

- This procedure should be conducted on a static mat.
- Wear a wrist strap to ground during the procedure.

To reinstall the printer module, reverse the steps.

Printer Disassembly		
1	Place the unit screen down on the mat in a horizontal position.	
2	Open the printer housing and remove the printer paper.	
3	Remove the two (2) screws inside the printer module in the illustrated areas. Note: During reassembly, torque screws to 6 in-lbs.	
4	Remove the two (2) screws on the outside of the printer. Note: During reassembly, torque screws to 6 in-lbs.	
5	Slowly remove the printer from the unit, being careful not to strain the cables.	

6	Disconnect the two (2) cable connectors from the printer module.	
----------	--	--

Disassembling the Main Unit


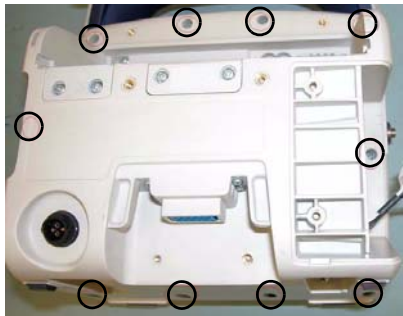
Tool Required

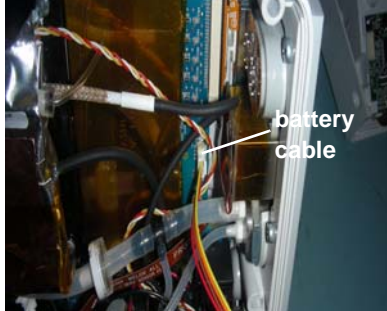

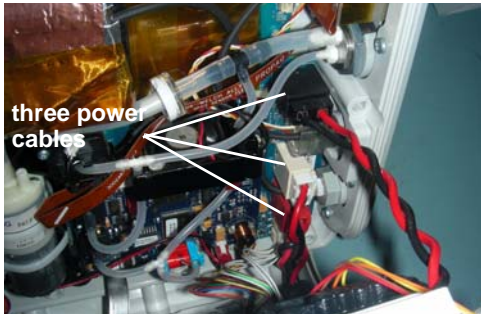
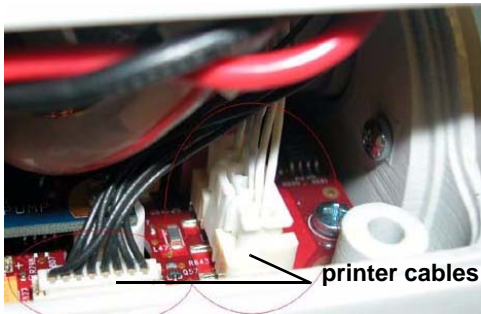
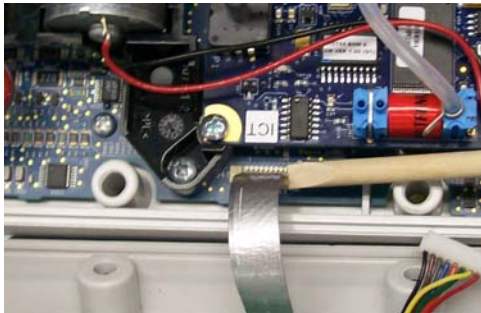
- # 1 Phillips screwdriver with torque capability
- orange (wooden) stick

Setup

- This procedure should be conducted on a static mat.
- Wear a wrist strap to ground during the procedure.
- Complete these procedures in the following order before performing this procedure:
 1. “Removing the Handle” on page 49
 2. “Removing the Printer Module” on page 50

To reassemble the main unit, reverse the steps.

Main Unit Disassembly		
1	Place tape on the top of the unit (near the front of the display) in the illustrated area.	
2	Gently place unit screen so the display screen is facing down.	
3	Remove ten (10) screws: four (4) on the top, four (4) on the bottom, and two (2) in the middle in the illustrated areas. Take care to keep the two parts of the unit together. Note: During reassembly, torque screws to 6 in-lbs.	
4	While holding the two parts of the unit together, place the unit vertically on the mat (feet down).	
5	Separate the top part of the unit by creating a small gap, and remove any screws that are in the way.	

6	Disconnect the battery communication cable (yellow, orange, brown, red) connector from the monitor board.	 A close-up photograph showing a multi-colored cable (yellow, orange, brown, red) being disconnected from a circuit board. A white arrow points to the cable, labeled "battery cable".
7	Disconnect the monitor/defibrillator flex cable from the monitor board. Note: Be careful to pull the connector straight out. Rocking the connector or disconnecting it at an angle may result in bent pins.	 A close-up photograph showing a wide, flat flex cable being pulled away from a circuit board. A white arrow points to the cable, labeled "flex cable".
8	Disconnect the three power cable connectors (battery (black), AUX (white), and defibrillator (red)).	 A close-up photograph showing three power cables (black, white, and red) being disconnected from a circuit board. A white arrow points to the cables, labeled "three power cables".
9	Press the tabs on either side of the two printer cables to disconnect them.	 A close-up photograph showing two printer cables being disconnected from a circuit board. A white arrow points to the cables, labeled "printer cables".
10	Use an orange stick to release the tabs on either side of silver ZIF connector between the dock connector and the monitor board. Note: Release one side at a time.	 A close-up photograph showing a silver ZIF connector being released from a circuit board. A white arrow points to the connector, labeled "ZIF connector".

11	Separate the two parts of the unit.	
----	-------------------------------------	--

Removing the Front Enclosure Module



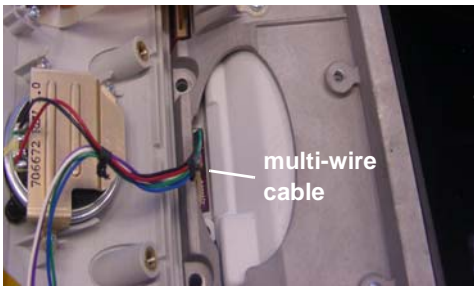
Tools Required

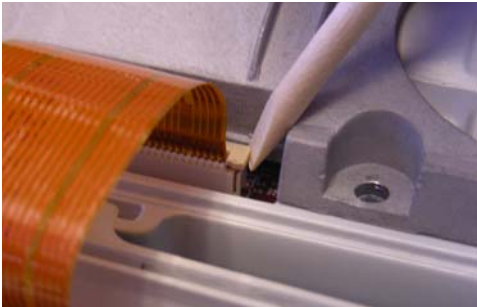
- #2 Phillips screwdriver with torque capability
- Orange (wooden) stick

Setup

- This procedure should be conducted on a static mat.
- Wear a wrist strap to ground during the procedure.
- Complete these procedures in the following order before performing this procedure:
 1. “Removing the Handle” on page 49
 2. “Disassembling the Main Unit” on page 52

To reinstall the front enclosure module, reverse the steps.

Front Enclosure Disassembly		
1	Remove tape from the top of the unit.	
2	Separate monitor front enclosure.	
3	Pivot top up with cables still connected.	
4	Remove grounding screw as shown in the illustration. Note: During reassembly, torque screw to 6 in-lbs.	
5	Disconnect the front panel multi-wire cable in the area illustrated.	

6	Remove the ZIF (Zero Insertion Force) flex cable using an orange stick.	
----------	---	--

Removing the Display Module

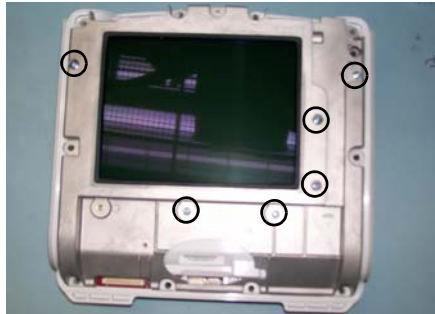
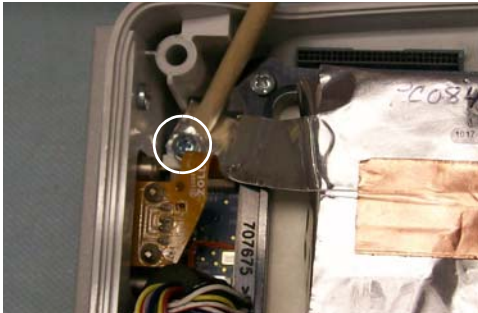

Tools Required



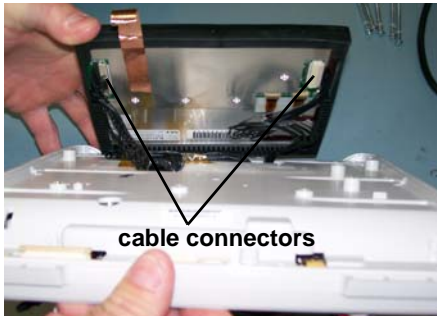
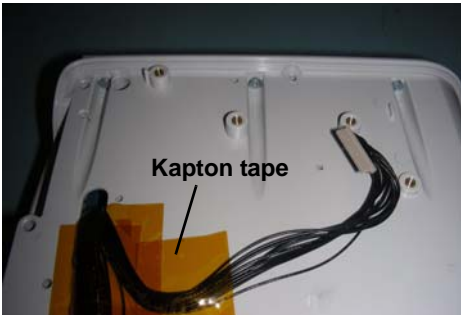
- #1 Phillips screwdriver with torque capability
- 3M copper adhesive tape
- 6mm socket wrench

Setup

- This procedure should be conducted on a static mat.
- Wear a wrist strap to ground during the procedure.
- Complete these procedures in the following order before performing this procedure:
 1. “Disassembling the Main Unit” on page 52
 2. “Removing the Front Enclosure Module” on page 55

To reinstall the display module, reverse the steps.

Display Disassembly		
1	Place the back of the unit down on the mat so that the display screen is facing up.	
2	Remove the six (6) screws from the front of the casting in the areas illustrated. Note: During reassembly, torque screws to 6 in-lbs.	
3	Flip the unit over and remove the screw in the area illustrated.	
4	Remove the hex standoff located underneath the screw you just removed. Note: During reassembly, torque to 6 in-lbs.	

5	Flip the unit back over so the display screen is facing up.	
6	Lift the casting up while pushing down on the rubber boot that runs around the edge of the LCD screen.	
7	Remove the copper tape from the casting. Note: During reassembly, apply new copper tape for grounding.	
8	Disconnect the LCD display cable connectors from the back of the LCD screen to release it.	
9	Remove the Kapton tape from the display cable.	

Removing the EtCO₂ and NIBP Modules

Tool Required



- # 1 Phillips screwdriver with torque capability
- orange (wooden) stick

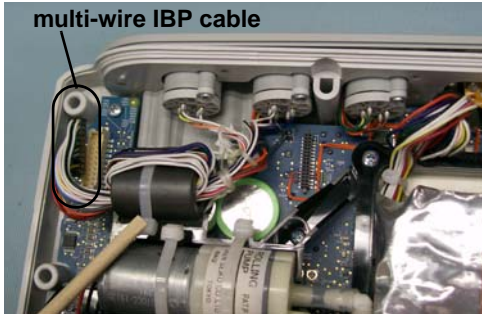

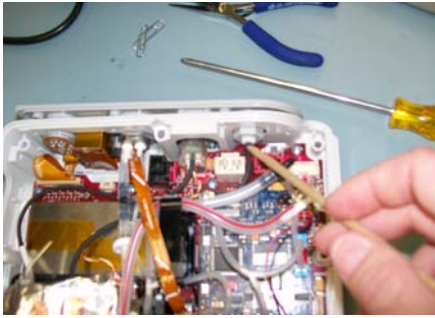
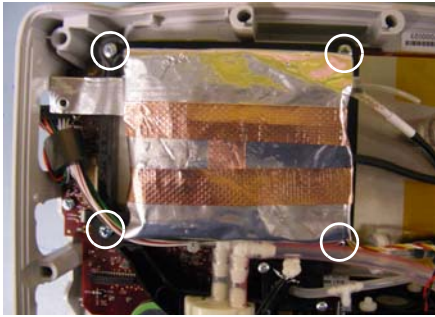
Setup

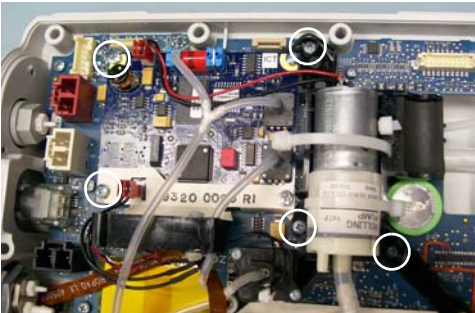
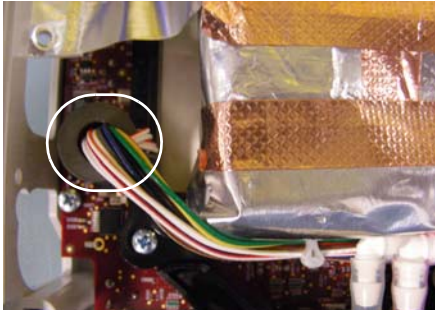


- This procedure should be conducted on a static mat.
- Wear a wrist strap to ground during the procedure.
- Complete these procedures in the following order before performing this procedure:
 1. “Removing the Handle” on page 49
 2. “Removing the Printer Module” on page 50
 3. “Disassembling the Main Unit” on page 52
 4. “Removing the Front Enclosure Module” on page 55
 5. “Removing the Monitor Board and SpO₂ Modules” on page 63

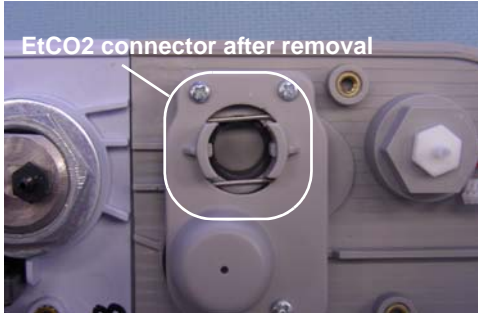
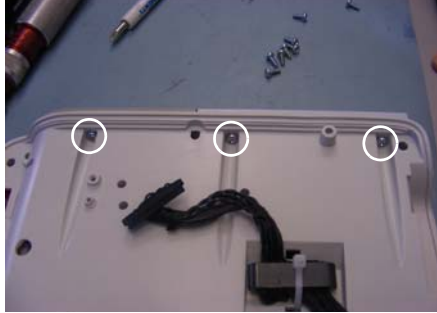

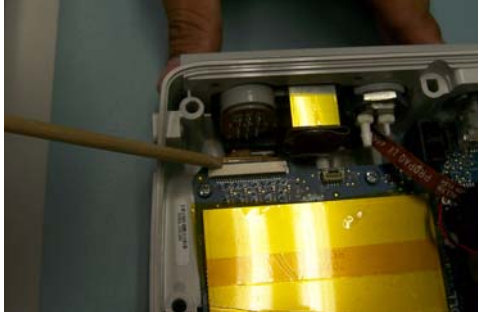
Note: After replacing the EtCO₂ and/or NIBP modules, see Chapter 4, "Resetting Life Cycle Counters" to reset the life cycle counters for the module(s) that you have replaced.

To assemble the EtCO₂ and/or NIBP modules, reverse the steps.

EtCO ₂ and/or NIBP Disassembly		
1	<p>Remove the right side panel (containing temperature, IBP, and USB connectors) by removing four (4) screws from inside the unit.</p> <p>Note: During reassembly, torque screws to 6 in-lbs.</p>	
2	<p>Remove three (3) screws from underneath and outside the unit.</p> <p>Note: During reassembly, torque screws to 6 in-lbs.</p>	

3	Disconnect multi-wire IBP cable with ferrite in the area illustrated.	
4	Cut the tie wrap to the IBP cable in the area shown with the orange stick. Note: During reassembly, secure a new tie wrap to the IBP cable.	
5	Disconnect the USB flex cable from ZIF connector in the area illustrated.	
6	Lay front end of separated unit down with opened side facing up.	
7	Disconnect the black EtCO ₂ tube connector from the air vent.	
8	Remove four (4) screws in the areas illustrated to release the silver EtCO ₂ module. Note: During reassembly, torque screws to 6 in-lbs.	

<p>9</p>	<p>Remove five (5) screws and washers from the NIBP unit to release it.</p> <p>Note: During reassembly, torque screws to 6 in-lbs.</p>	
<p>10</p>	<p>Remove multi-wire EtCO₂ cable with ferrite.</p>	
<p>11</p>	<p>Disconnect the brown SpO₂ flex cable as shown.</p>	
<p>12</p>	<p>Disconnect the NIBP tubing from the side panel in the area illustrated.</p>	
<p>13</p>	<p>Remove the NIBP module from the unit.</p>	

14	Tilt side panel to access the EtCO ₂ connector and use an orange stick release the tabs and remove the EtCO ₂ connector.	
15	Remove the EtCO ₂ module from the unit.	
16	Remove three (3) screws from the outside of the left side panel in the areas illustrated. Note: During reassembly, torque screws to 6 in-lbs.	
17	Remove four (4) screws from the inside top of the left side panel in the areas illustrated and carefully pull out side panel. Note: During reassembly, torque screws to 6 in-lbs.	
18	Remove ECG ZIF connector in the area illustrated.	
19	Remove the left side panel from the unit.	

Removing the Monitor Board and SpO₂ Modules

Tool Required

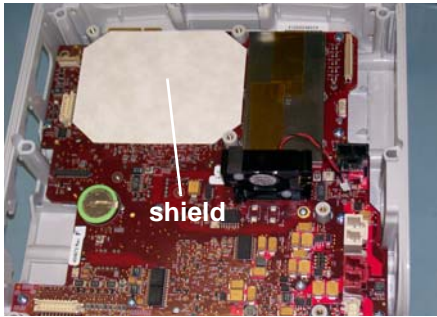
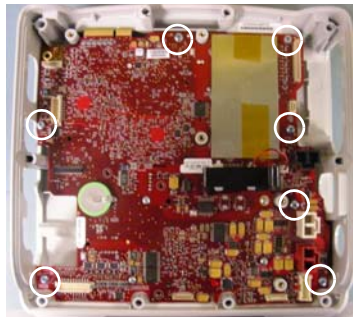
- # 1 Phillips screwdriver with torque capability

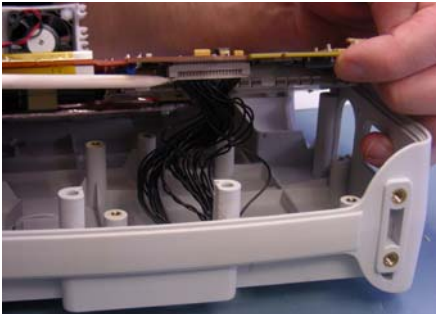
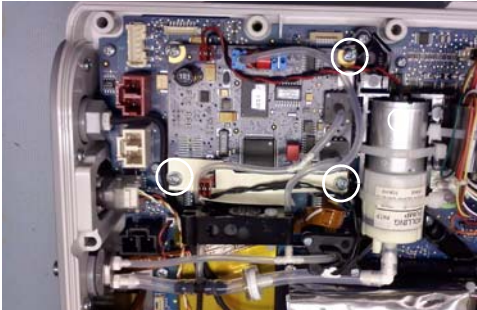
Setup

- This procedure should be conducted on a static mat.
- Wear a wrist strap to ground during the procedure.
- Complete these procedures in the following order before performing this procedure:
 1. "Removing the Handle" on page 49
 2. "Removing the Printer Module" on page 50
 3. "Disassembling the Main Unit" on page 52
 4. "Removing the Front Enclosure Module" on page 55
 5. "Removing the Display Module" on page 57

Note: After replacing the Monitor Board and/or SpO₂ modules, see Chapter 4, "Resetting Life Cycle Counters" to reset the life cycle counter for the module.

To reinstall the monitor board and/or SpO₂ modules, reverse the steps.

Monitor Board and/or SpO ₂ Disassembly		
1	Remove the EtCO ₂ anti-conductive shield that lies on top of the unit.	
2	Remove six (6) screws to release the monitor board in the areas illustrated. Note: During reassembly, torque screws to 6 in-lbs.	

3	<p>Lift the monitor board to expose the multi-wire LCD cable on the back side of monitor board and disconnect it.</p>	
4	<p>Remove three (3) screws and washers from the NIBP unit.</p> <p>Note: During reassembly, torque screws to 6 in-lbs.</p>	
5	<p>Lift the SpO2 unit straight up to disconnect it from the monitor board and remove it from the unit.</p>	
6	<p>Lift out the monitor board.</p>	

Removing the Defibrillator Board and Capacitor Bank Modules

Tools Required

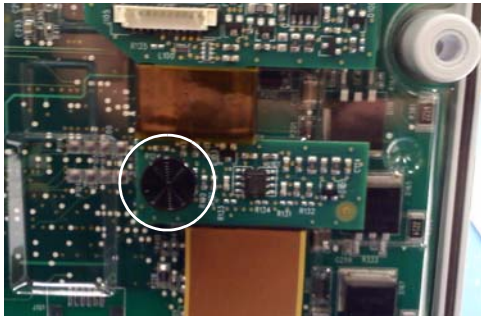
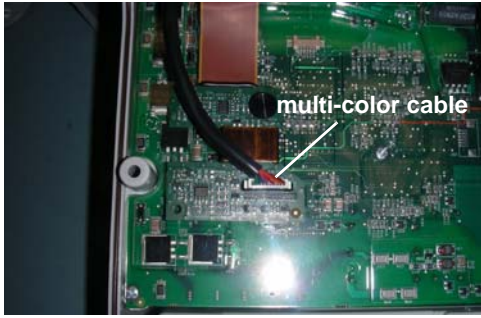
- #1 Phillips screwdriver with torque capability
- #2 Phillips screwdriver with torque capability
- 26 mm open end wrench



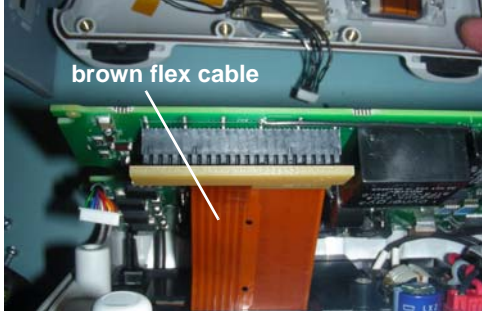

Setup


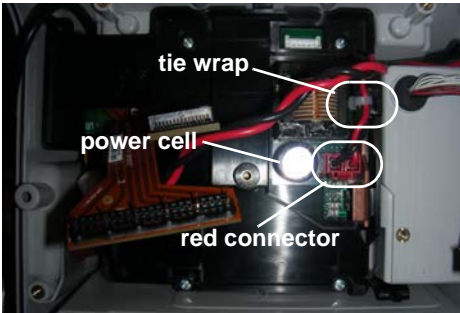
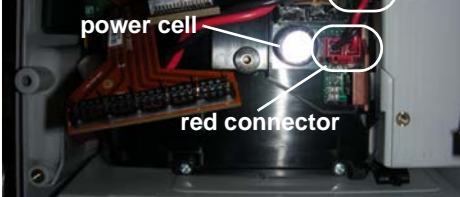



- This procedure should be conducted on a static mat.
- Wear a wrist strap to ground during the procedure.
- Complete these procedures in the following order before performing this procedure:
 1. "Removing the Handle" on page 49
 2. "Removing the Printer Module" on page 50
 3. "Disassembling the Main Unit" on page 52

Note: After replacing the Defibrillator Board and/or Capacitor Bank modules, see Chapter 4, "Resetting Life Cycle Counters" to reset the life cycle counter for the module.

To reinstall the defibrillator board and/or capacitor bank modules, reverse the steps.

Defibrillator Board and Capacitor Bank Disassembly		
1	Lay back end of separated unit down with opened side facing up.	
2	Remove interface board and disconnect the black cable by pulling the black snap rivet straight out.	
3	Remove the multi-color cable from the defibrillator board.	
4	Pull out small interconnect board.	

5	<p>Remove screw in the middle of the plastic isolator (located on top of the processor board) in the area illustrated.</p> <p>Note: During reassembly, torque screw to 6 in-lbs.</p>	
6	<p>Remove the plastic isolator shield.</p>	
7	<p>Remove the four (4) screws in the areas illustrated.</p> <p>Note: During reassembly, torque screws to 6 in-lbs.</p>	
8	<p>Lift up the processor board and remove the brown flex cable (there are two connections).</p>	
9	<p>Lift out the processor board.</p>	
10	<p>Remove the black cable from the capacitor in the area illustrated.</p>	

11	Locate the black ferrite. Using the orange stick, pull the ferrite cover apart and untwist the couple.	
12	Cut the tie wrap securing the black and red coupled wire (in illustrated area) to remove the power cell.	
13	Disconnect the black and red wire (via the red connector) in the area illustrated.	
14	Remove four (4) screws in the areas illustrated. Note: During reassembly, torque screws to 6 in-lbs.	
15	Remove red and white multi-function cable connector from the ECG board in the area illustrated.	
16	Remove two (2) screws in the areas illustrated to release the capacitor from the unit.	

Chapter 4

Life Cycle Counters

Overview

This chapter contains instructions for setting life cycle counters on the Propaq MD. The Propaq MD tracks various life cycle counters for specific modules installed in the device. When replacing modules in the unit, it is important to reset the life cycle counters. Once you have reset the appropriate life cycle counter(s), see “Functional Verification Tests” on page 1-21 to perform the functional verification tests to ensure that the functions of the Propaq MD unit work properly.

Note: Only reset the life cycle counters for the modules that you have replaced.

Resetting Life Cycle Counters

NIBP


On the Propaq MD, do the following:

1. Press the Setup quick access key ()
2. Use the navigation keys to select **Supervisor>Service>Diagnostic>NIBP>Cycle/Error Counts**.
3. Select **Reset Counters**. Select **Yes** when prompted to confirm the reset.

See “Functional Verification Tests” on page 1-21 to perform the functional verification tests.

CO2


On the Propaq MD, do the following:

1. Press the Setup quick access key ()
2. Use the navigation keys to select **Supervisor>Service>Diagnostic>CO2>Service Codes**.
3. Select **Reset CRC Counter**. Select **Yes** when prompted to confirm the reset.

See “Functional Verification Tests” on page 1-21 to perform the functional verification tests.

SpO2


On the Propaq MD, do the following:

1. Press the Setup quick access key ()
2. Use the navigation keys to select **Supervisor>Service>Diagnostic>SpO2>Error Counts**.
3. Select **Reset CRC Counter**. Select **Yes** when prompted to confirm the reset.

See “Functional Verification Tests” on page 1-21 to perform the functional verification tests.

Defibrillator/Pacer

On the Propaq MD, do the following:

1. Press the Setup quick access key ()
2. Use the navigation keys to select **Supervisor>Service>Diagnostic>Defib/Pacer>Error Counts**.
3. Select **Reset CRC Counter**. Select **Yes** when prompted to confirm the reset.

See “Functional Verification Tests” on page 1-21 to perform the functional verification tests.

Chapter 5

Replacement Parts

Overview

This section contains a listing of the replacement parts available for the ZOLL Propaq MD devices.

Replacement parts may be ordered through an authorized ZOLL distributor or directly from ZOLL Medical Corporation. The prices for parts are available from ZOLL Medical Corporation's Technical Service Department.

When ordering parts, please provide the following information:

- Propaq MD device model and serial number
- Field replaceable part number
- Description of the replacement assembly

To order by mail from ZOLL Medical Corporation, address your request to:

ZOLL Medical Corporation

269 Mill Road

Chelmsford, MA. 01824-4105

Attention: Technical Service Department

1-978-421-9655; 1-800-348-9011; Fax: 1-978-421-0010

Replacement Parts

PART NUMBER	QUANTITY	DESCRIPTION
705519	1	Handle Top
705517	1	Handle Bottom
705510	4	Screw
0162-0263	4	Screw Mount
705523	1	Left Cap, Handle
705524	1	Right Cap, Handle
1017-0005-01	1	Front Panel Assembly
403889	1	Panel I/O Left
402359	1	Panel I/O Right
705099-99	1	Back Housing
708494-99	1	Middle Housing
9301-0225	1	Dock Connector Assembly
402342	1	Cable Harness, Printer
9500-0650	1	Assy, Recerpt Defib Cable
403888	1	Power Assembly Cable
403871	1	Assy Battery Connection
704992	1	Cover, Filter Recess
708438	1	Catch, Battery, Rear Defib
1017-0160-01	1	Assy, Filter, NIBP

PART NUMBER	QUANTITY	DESCRIPTION
7772-0001-01	1	Printer Assembly
7772-0002-01	1	Front Enclosure Assembly
7772-0003-01	1	Display Assembly
7772-0004-01	1	NIBP Assembly
7772-0005-01	1	Oridion Assembly
7772-0006-01	1	Monitor Board Assembly
7772-0007-01	1	CapBank Assembly
7772-0008-01	1	Defib Board Assembly
7772-0009-01	1	SpO ₂ Assembly

Chapter 6

Functional Description

Overview

This chapter contains functional descriptions of the components contained in the Propaq MD and the Propaq MD options.

Circuit Distribution

The Defib/Monitor Propaq MD unit consists of two key PCB assemblies, the Monitor Board and the Defibrillator Board as well as a few modules and assemblies: the Front Panel Keypad assembly, Status LCD Board, Dock Connector Board, Display, and Printer. The NIBP, CO2, and SpO2 circuitry reside on modules that connect to the Monitor Board.

Monitor Board

The Monitor board integrates the analog circuitry and interface circuitry for patient parameters, a digital processing section as well as user interface controls, printer control, audio control, and power circuitry for the entire system and charging circuitry for the battery. The Propaq MD system relies on a centralized dual processor engine for its computing needs. The Main Processor (MP) serves as the primary user interface engine and provides connectivity needs, while the Patient Processor (PP) controls the patient monitoring and defibrillation-pacing functions. An additional power controller micro-controller (PC) controls the power sequencing, and battery/charger interface.

Main Processor (MP)

The MP section controls the user interface, connectivity needs, as well as data logging, printing, and general system control. It consists of the CPU, program memory Flash and SDRAM, Communication with modules/circuits: USB Client, USB Host, Debug Ports (JTAG, Serial), Storage memory for 24 hour disclosure data, Internal VGA display and interface circuit, LED indicators, Key Pad, and Audio circuit. The MP also controls the real-time clock and interface to the power controller processor, battery and charger.

Patient Processor (PP)

The Patient processor circuitry supports the data acquisition, signal processing and conditioning, analysis and control algorithms required for the physiological sensors. The PP also controls the defibrillation and pacing circuitry. It consists of the processor, program memory Flash and SDRAM as well as interface circuitry to physiological sensor modules/circuits.

Power Controller (PC)

The Power Controller (PC) micro-controller controls the power sequencing to turn the device on and off when the power switch is pressed. It also communicates to the battery charger and battery via a serial SPI bus. Additionally, the PC controls the Status LCD and communicates battery and charger status to the MP.

ECG 3/5 or 12 Lead Circuitry

Propaq MD supports 3/5 lead and 12 lead ECG acquisition. Analog circuitry provides signal conditioned data through an A/D converter to the PP. All of the signal processing, lead derivation, fault detection is performed by the PP. The ECG circuitry utilizes a CPLD for control of analog circuitry and transmission of data to the PP across an isolation barrier. A common connector is used to receive 3/5 Lead ECG cables with a 12 Lead ECG extension. The ECG acquisition inputs are CF defib-proof applied parts. The defib protection resistors reside in the patient cable. The ECG signals from the external connector on the left side panel are connected to the monitor board through a flex cable to J28.

Impedance Respiration

Propaq MD provides the circuitry for impedance respiration measurements in 3/5 and 12 lead configurations. This circuitry provides a low-current 72kHz AC signal across leads I and II of the ECG cable. The signal is passed through a synchronous demodulator and decoded by the PP through the ECG CPLD.

Blood Pressure NIBP

The Propaq MD NIBP circuitry resided on module that connects to the Monitor board through J32. The PP communicates to the NIBP module via a bi-directional, serial bus. The NIBP module supports both dual lumen and single lumen cuffs. The NIBP pump and valve hoses are connected to the cuff connector on the left side panel and to the filter on the rear enclosure. The pump and valve are connected to the NIBP module by short, 2-wire cables.

Invasive Blood Pressure (IBP)

Propaq MD supports up to 3 IBP measurement channels. The IBP circuitry supports AAMI BP-22 transducers (5uV/V/mmHg). The PP communicates directly to the IBP ADC over an

isolated serial bus through the FPGA. The IBP probes connect to the monitor board through the IBP/Temp wire harness which connects to J33 of the Monitor board.

SPO₂ Module

Propaq MD supports the Nellcor NELL-3 OEM Module that mounts to the Monitor board and communicates through J36 and J40. The SpO₂ module communicates across an isolation barrier using a UART on the PP. Signals from the probe are routed to the SpO₂ module through a flex cable that connects to J41 of the Monitor board.

End tidal CO₂ (CO₂)

Propaq MD supports an Oridion Microstream[®] CO₂ module. The CO₂ module mounts to the Monitor board and communicates to the board through a cable connected to J50. Serial communications from the monitor board is implemented via a UART on the PP. The CO₂ module obtains gas samples from the sampling lines through tubing and a 3-wire cable connected to the left side panel.

Thermometry

Propaq MD supports two simultaneous temperature measurements. YSI400/YSI700 series probes are used to make temperature measurements. Data is communicated to the PP from the Temperature ADC via an isolated SPI bus through the FPGA. The Temperature probes connect to the monitor board through the IBP/Temp wire harness which connects to J33 of the Monitor board.

Power Circuitry, Battery Charger, DC-DC converters

Power circuitry for all subsystems but the defibrillator-pacer module reside on the Monitor Board. Auxiliary Power and Battery Power are automatically switched to provide constant current, the unit draws current from auxiliary power when present. There is a smart battery charging circuit that will charge the battery when Auxiliary power is present. Switching mode DC-DC converters are utilized to make internal 6V, 5V, 3.3V, 1.8V and processor core voltages. Regulators are used to provide regulated supply voltages with low dropout for low current consumption circuits. Each of the isolated modules, Temp/IBP, ECG, SpO₂ have independent power supplies. Isolated power supplies are designed for isolating Patient Applied Parts. The MP via the FPGA GPIO has the ability to shut down voltage rails or power to individual patient parameters. Power from the battery connects to the Monitor board through J29. Auxiliary power connects to the Monitor board through J31.

USB Host Port

Propaq MD Monitor Board incorporates one USB Host ver 1.1 port. The port uses the USB controller built into the PXA270 Main processor. Full speed of 12 Mbps and Low speed 1.5Mbps are supported. The Host port supports a USB flash memory stick for data export. The USB host connector is in the right side panel and connects to the Monitor board through J44.

Defibrillator Pacer Module

The Defibrillator/Pacer Module consists of two PCB assemblies connected by a flex cable. This Defibrillator/Pacer module relies on proven core defibrillation/pacing technology for improved power conversion efficiency, reduced EMI, and improved stability in volume production. This

module contains power supplies, charging and discharge circuitry, pacing circuitry, and the Pads/Paddles ECG preamplifier and impedance circuitry. Communication with the Defibrillator/Pacer module is a function of the PP. The ECG-Charger board contains the charger circuit, ECG acquisition circuitry, and protection components. The Processor-Bridge-Pacer board contains the micro controller, CPLD, Pacer, and defibrillation shock delivery circuit.

Defib CPLD

The Defib CPLD provides I/O control for the Pacer circuitry, the defibrillator charging and fire control circuitry.

Pace/Defib (PD) Micro controller

The PD micro controller communicates with the PP processor on the monitor board to accept commands to control the defibrillator and pacer. The PD micro controller controls the pacer current and pulse timing and the defibrillation charging and waveform generation. Communication between the Monitor and Defibrillator/Pacer boards is routed through the flex cable connected to J106 of the defibrillator board and J38 on the Monitor board.

Charging Circuit

This is a high voltage step-up inverter that charges the Defib Capacitor. It provides electrical isolation between the defib output and the system. The charging circuit will charge the Defib Capacitor to up to 2775V. The Defib Capacitor is connected to the Defibrillator/Pacer board through the 2-wire cable connected to J119.

Fire and Relay Circuit

The fire circuit employs high voltage switching devices to deliver a biphasic waveform to the patient. Switching devices are utilized to produce a rectilinear biphasic waveform. In addition, relays are located between the fire circuit and the patient for electrical isolation. They are engaged only when a valid command is set from the Defib CPLD.

Pacer

Pacer circuit delivers pacing pulses under control of the PD micro controller over an isolation transformer. The pacer circuitry consists of an adjustable constant current power supply, pulse timing, and current monitoring circuits.

Pads/Paddles ECG Preamplifier

This is a single channel ECG preamplifier paddle pick up that monitors the patient ECG signal from the Defib paddles (or pads). It digitizes this signal and delivers it to the PP processor via the PP interface. This preamp is a simplified version of the 3/5/12 Lead ECG utilized on the Monitor Board.

Paddle Interface

Paddle interface circuitry detects analog voltage levels to decode switches and ID resistors of the standard ZOLL paddles and internal paddles. The paddle set interface is connected to J115 of the Processor-Bridge-Pace PCB.

Printer

Propaq MD uses an internal thermal printer of 50 mm paper size that is built into the Defib section of the enclosure. Communications with the printer is bi-directional, serial, (Main CPU to/from printer) and complies with the software/hardware interface of the internal printer. Communications are implemented using hardware Universal Asynchronous Receiver Transmitter (UART). The printer is controlled by the MP and is connected through a cable to J46 and J49 of the Monitor board.

Lithium Ion Battery

The portable Propaq MD device is powered by a removable Lithium Ion battery pack. This battery pack incorporates protection circuitry and "smart battery" circuitry. The battery power is routed from the 2-pin connector on the rear of the device to J29 of the Monitor board. The Power Controller communicates to the smart circuitry on the battery through the 4 spring contacts connected to J34 on the Monitor board.

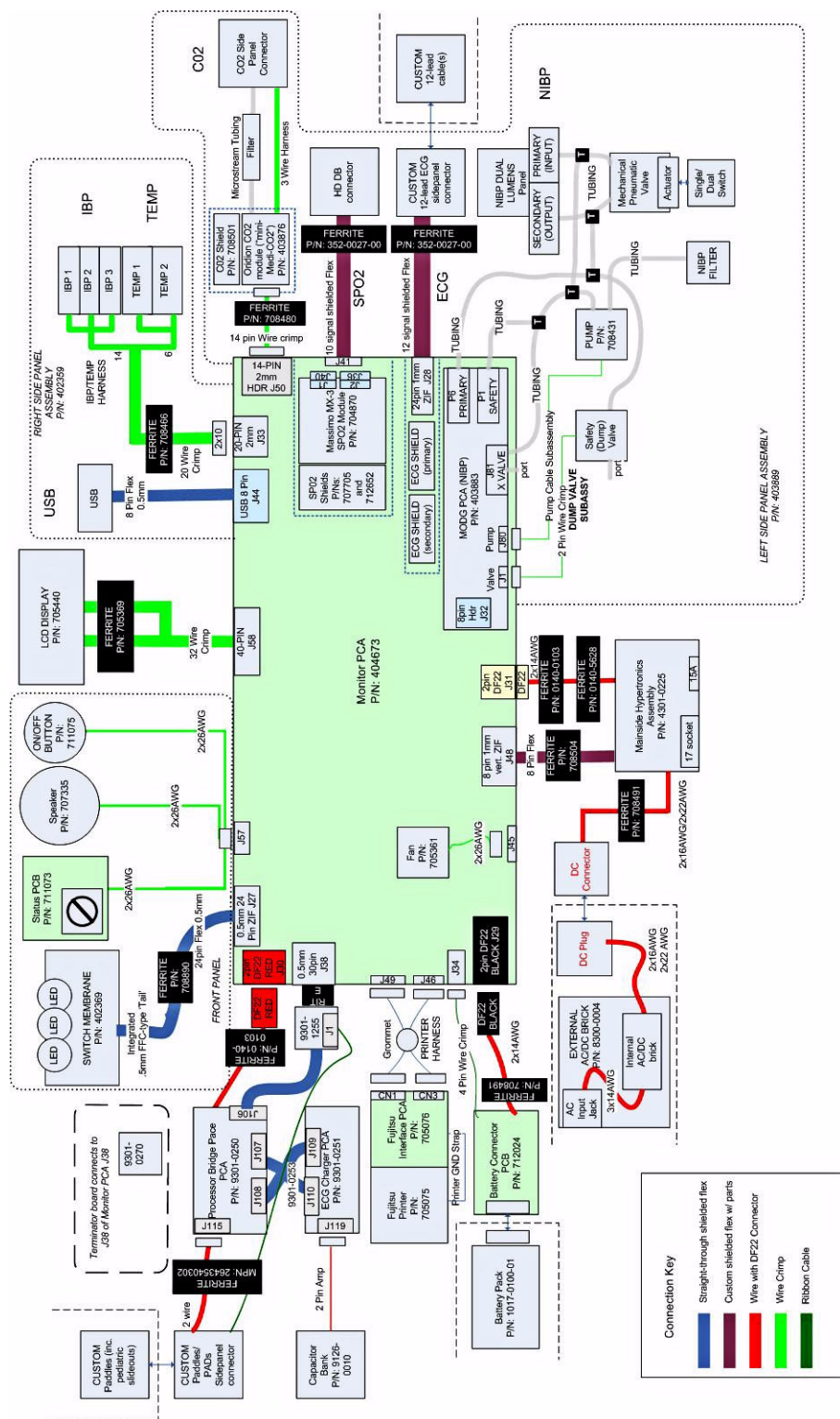
Appendix A

Overview

This appendix includes the following diagrams:

- Propaq MD Electrical Hardware Interconnect Diagram
- Propaq MD Signal and Power Interconnect Schematic

Propaq MD Electrical Hardware Interconnect Diagram





Appendix B

Overview

This appendix includes simulators and settings that may be used to assess the performance of the NIBP module. Readings should be obtained within +/- 10 mmHg of the expected measurement result. The following simulators are used in this chapter:

- Bio-Tek Instruments BP Pump
- Bio-Tek Instruments BP Pump2
- DNI Nevada CuffLink
- Clinical Dynamics Smart Arm

NIBP Simulator Performance

FastBP

A dual lumen hose is required for FastBP. When you use FastBP, the reading is obtained during cuff inflation.

StepBP

StepBP is compatible with both single and dual lumen hoses. When you use StepBP, the reading is obtained during step deflation.

Bio-Tek Instruments BP Pump

Adult/Pediatric Mode

	FastBP		StepBP	
Simulator Setting	Expected Systolic	Expected Diastolic	Expected Systolic	Expected Diastolic
200/150	198	151	200	149
120/80	120	83	116	84
80/50	83	54	77	53

Neonate Mode

	NeoBP	
Simulator Setting	Expected Systolic	Expected Diastolic
60/30	56	26
35/15	31	12

Bio-Tek Instruments BP Pump2

Adult/Pediatric Mode

	FastBP		StepBP	
Simulator Setting	Expected Systolic	Expected Diastolic	Expected Systolic	Expected Diastolic
200/150	202	157	201	146
120/80	118	80	116	82
80/50	86	51	77	55

Neonate Mode

	NeoBP	
Simulator Setting	Expected Systolic	Expected Diastolic
80/50	78	46
60/30	57	31
35/15	31	12

DNI Nevada CuffLink

Adult/Pediatric Mode

Simulator Setting	FastBP		StepBP	
	Expected Systolic	Expected Diastolic	Expected Systolic	Expected Diastolic
200/150	210	152	201	138
120/80	116	77	124	80
80/50	87	49	90	50

Clinical Dynamics Smart Arm

Adult/Pediatric Mode

Simulator Setting	FastBP		StepBP	
	Expected Systolic	Expected Diastolic	Expected Systolic	Expected Diastolic
200/150	192	152	194	136
120/80	124	79	122	80
80/50	85	42	80	49

Neonate Mode

Simulator Setting	NeoBP	
	Expected Systolic	Expected Diastolic
80/50	77	48
60/30	57	32
35/15	31	13

