PROPAQ®
100-Series EL Monitors
Technical Reference Guide

GSA Listing # V797P-3409J
NSN Listings:
Model 102: 6515-01-3156196
Model 104: 6515-01-3156198
Model 106: 6515-01-3156197
Expansion Module with Printer: 6515-01-3159814

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Part Number: 810-0257-00 Rev A
First Printing: 2/92

Safety Summary

The general safety information in this summary is for both operating and servicing personnel. Specific warnings and cautions will be found throughout the Operator's Guide and other manuals where they apply. Such specific warnings and cautions may not appear here in this summary.

CAUTION statements in the documentation identify conditions or practices that could result in damage to the equipment or other property.

WARNING statements in the documentation identify conditions or practices that could result in personal injury.

DANGER: Risk of explosion when used in the presence of flammable anesthetics.

Type CF, Isolated patient connections comply with the allowable leakage current limits for direct cardiac application and are protected against the effects of defibrillation.

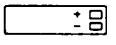
Type BF, Isolated accessible and applied parts comply with the allowable patient leakage current limits, protecting the patient and operator from risk of electric shock.

DC power input connector.

Caution: Refer to Operator's Manual.

Caution: Refer servicing to qualified service personnel. (For products certified by Underwriters Laboratories only.)

Battery



Positioning of battery cell.

Direct current.

Alternating current.

Inspect the power adapter cord periodically for fraying or other damage, and replace the adapter as needed. (The power adapter is not a serviceable part; however, the detachable power cord used with the table-top power adapter is separately serviceable). Do not operate the apparatus from mains power with a damaged power adapter cord or plug.

Frequent electrical and visual checks should be made on cables and electrode wires. Broken or frayed electrode wires, or loose snap-fittings may cause interference or loss of signal. Particular attention should be paid to the point at which the wire enters the terminals, since flexure will eventually cause breakage of strands at this point.

Avoid electrosurgery burns at monitoring sites by ensuring proper connection of the electrosurgery return circuit. If improperly connected, older electrosurgery units allow other return paths, even through fully isolated patient circuits. If necessary, operate the monitor on battery power only.

Do not operate this product in the presence of flammable anesthetics. Explosion can result. This product must only be operated in strict conformance with local fire prevention regulations.

NOTE

Within certain governmental jurisdictions, all interconnected accessory equipment must be labeled by an approved testing laboratory. After interconnection with accessory equipment, leakage current and grounding requirements must be maintained.

Component replacement and internal adjustments must be made by qualified service personnel only.

Place the product in a location where it cannot harm the patient should it fall from its shelf or other mount.

To ensure patient safety, use only accessories recommended or supplied by Protocol Systems, Inc. For a list of those accessories, see Accessories.

To ensure conformance to leakage current requirements when operating from an ac mains power source, use only a 503-0002 series power adapter.

Pour limiter le courant de fuite conformément aux exigences lorsque l'appareil est branché au secteur, utiliser seulement un bloc d'alimentation de la série 503-0002.

Do not autoclave this product.

Do not autoclave accessories unless the manufacturer's instructions clearly approve it. Many accessories can be severely damaged by autoclaving.

A product that has been dropped or severely abused should be checked by qualified service personnel to verify proper operation and acceptable leakage current values.

To assure operator safety during defibrillation, keep the discharge paddles away from ECG and other electrodes, as well as other conductive parts in contact with the patient. For additional safety precautions, refer to the defibrillator operator's manual.

To ensure patient safety, the conductive parts of the ECG electrodes (including associated connectors) and other patient-applied parts should not contact other conductive parts, including earth ground.

Only NELLCOR oxygen transducers, including OXISENSOR patient-dedicated adhesive sensors should be used with the Propaq pulse oximetry option.

Manual Revision History

The following table lists the revisions of this manual.

Issue/Revision	Date	Comment
Rev A 810-0257-00	1/92	Original Release

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Section 1

General Information

About This Manual

This Propaq *Technical Reference Guide* contains service information for the Propaq series of Protocol Systems' ultra-portable patient monitors and optional devices, including the SpO_2 and Propaq Printer options. This guide was written for the biomedical electronic technician (BMET or CBET). Only certified technicians should service the Propaq series monitors.

This manual contains information for the service technician to service Propaq monitors at the *replaceable module level.* Replaceable modules are items that can be easily replaced without desoldering circuit board components.

This manual does not include operating instructions or information. Refer to the appropriate user's guide.

The *Technical Reference Guide* contains six sections and four appendices. Here are brief descriptions of each.

- **Section 1 General Information**—This section contains information about this manual and about the Propaq series monitors and optional Expansion Module. Instructions on how to unpack and repack the monitor for shipping, a list of related documentation, the Protocol warranty policy, and important service recommendations, including service intervals, is also included.
- **Section 2 Calibration**—This section lists all tools and test equipment needed to perform a functional verification procedure and a complete adjustment procedure. The functional verification procedure allows you to check the operation of the Propaq without opening the case. A description of the Service Menu functions is provided. The adjustment procedure allows you to calibrate the Propaq to factory specifications.
- **Section 3 Replacement Procedures**—This section contains information and step-by-step instructions on making minor repairs to the Propaq, and shows you how to remove and replace serviceable modules.
- **Section 4 Theory of Operation**—This section describes the Propaq's circuitry at the system and functional block level. This section also contains detailed circuit descriptions of each of the monitor's circuit boards and major replaceable modules, including the Expansion Module With Printer (EMP).

  This section contains details on the pulse oximetry option (SpO_2) installed either in the EMP or in the optional module installed on the back of the monitor.

- **Section 5 Diagrams**—This section includes block diagrams, schematics, and mechanical drawings of the Propaq series monitors, the EMP and the pulse oximetry option.
- **Section 6 Replaceable Parts**—This section lists all mechanical and electrical parts for the Propaq series monitors, the EMP and the pulse oximetry option.
- **Appendix A Buildable Test Equipment**—This section provides descriptions and schematics for test equipment to build for servicing the Propaq.
- **Appendix B Dynatech/Nevada Patient Simulator Modification**—This section shows you how to modify Dynatech/Nevada models 213A, 215A, and 217A Patient Simulators for use with the Propaq series monitors. This section is especially important if you connect both the ECG and invasive blood pressure channels of this patient simulator to the Propaq.
- **Appendix C Software Revision History**—This section lists the revisions in software for the Propaq.

Product Description

The Propaq series is a product line of lightweight, ultra-portable patient monitors applicable to a wide variety of health care services. These monitors measure and display a patient's vital signs, including ECG, non-invasive blood pressure, invasive blood pressure, temperature, and oxygen saturation derived by pulse oximetry (SpO_2). Propaq configurations vary depending on the model. Table 1-1 lists the monitors and their configurations available at the printing of this manual.

All models of monitor may be ordered with the optional Hewlett-Packard patient connector side panel.

The Propaq Expansion Module allows SpO_2 monitoring to be added to any Propaq monitor. The Expansion Module with Printer (EMP) includes a high-resolution, dot-matrix printer for documenting patient vital signs. Additional features can be included as they become available from Protocol Systems, Inc.

Table 1-1. Propaq 100-Series EL Monitors Configurations

Model	ECG	Cuff	P1	P2	T1	T2	Analog Output	Optional SpO_2	Optional Printer
102	♥	♥			♥	♥	♥	♥	♥
104	♥	♥	♥		♥	♥	♥	♥	♥
106	♥	♥	♥	♥	♥		♥	♥	♥

Unpacking/ Repacking

Use the following guidelines when unpacking the monitor from its shipping carton.

1. Before unpacking the monitor, check the shipping carton for damage.
2. If damage is apparent, it is a good idea to stop unpacking the carton and contact the shipping company for further instructions. If the carton is intact, unpack the Propaq.
3. With the Propaq out of its carton, check to see that all the items listed on the Packing Slip (provided with shipment) are in the shipping carton.
4. If an item is missing, first recheck the carton, then check with your receiving department. If necessary, contact Protocol Systems, Inc. at the address and phone number shown in **Repair and Upgrade Support**.

   The shipping carton and packing material should be saved for repacking the monitor in case it needs to be sent to a repair center or back to Protocol Systems for service.

Related Documentation

This *Technical Reference Guide* is part of a manual package. The following documents are also available from Protocol.

Propaq User's Guide	*810-0035-XX*
Propaq Quick Reference Guide	*810-0139-XX*
Nellcor Sensors Quick Reference Guide	*810-0138-XX*

Limited Warranty

This product is sold by Protocol Systems, Inc. under the warranties set forth in the following paragraphs. Such warranties are extended only with respect to the purchase of this product directly from Protocol or Protocol's Authorized Distributors as new merchandise and are extended to the first buyer thereof, other than for resale.

Propaq Monitors and Accessories

For a period of twelve (12) months from the date of original delivery to Buyer (end user), the Propaq monitor is warranted to be free from functional defects in materials and workmanship and to conform to the description of the product contained in the User's Guide and accompanying labels and/or inserts, provided that the same is properly operated under conditions of normal use in accordance with applicable safety and regulatory requirements, and that replacements and repairs are made in accordance with the instructions provided by Protocol.

This same warranty is made for a period of ninety (90) days with respect to accessories provided by Protocol as a part of the original purchase of the Propaq monitor, including but not limited to: AC power adapter, blood pressure cuff, and ECG cable. Warranty of accessories purchased separately from listed suppliers will be the responsibility of such listed suppliers.

Acuity Monitoring System and Accessories

For a period of twelve (12) months from the date of original delivery to Buyer (end user), the Acuity monitoring system is warranted to be free from functional defects in materials and workmanship and to conform to the description of the product contained in the User's Guide and accompanying labels and/or inserts, provided that the same is properly operated under conditions of normal use in accordance with applicable safety and regulatory requirements, that replacements and repairs are made in accordance with the instructions provided by Protocol and that only the Acuity system or other software authorized by Protocol Systems is utilized on the workstation. The warranty is valid only if (a) the central station processing unit and monitor and the terminal servers are utilized with an approved uninterruptible power supply and (b) all networks equipment and cabling are approved for use with the Acuity system by Protocol Systems.

The foregoing warranties shall not apply if the product has been configured, modified, adjusted, or repaired other than by Protocol or by persons expressly authorized by Protocol, or not in accordance with written instructions provided by Protocol, or if the product has been subject to misuse, negligence or accident.

Protocol's sole and exclusive obligation and Buyer's sole and exclusive remedy under the above warranties, is limited to repairing or replacing, free of charge, a product which is telephonically reported to Protocol, has a Returned Material Authorization number assigned and which is returned, not later than seven (7) days after the expiration of the warranty, to:

Protocol Systems, Inc.
8500 Creekside Place
Beaverton, OR 97005-7107
Telephone: (503) 526-8500
Facsimile: (503) 526-4200

during normal business hours, transporting charges prepaid and which, upon Protocol's examination, is found to conform with the above warranties.

PROTOCOL SYSTEMS, INC. SHALL NOT BE OTHERWISE LIABLE FOR ANY DAMAGES INCLUDING, BUT NOT LIMITED TO, INCIDENTAL DAMAGES, CONSEQUENTIAL DAMAGES OR SPECIAL DAMAGES.

THERE ARE NO EXPRESS OR IMPLIED WARRANTIES WHICH EXTEND BEYOND WARRANTIES HEREINABOVE SET FORTH. PROTOCOL MAKES NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE PRODUCT OR PARTS THEREOF.

Repair and Upgrade Support

For repair and upgrade information, contact:

Technical Services Dept.
Protocol Systems, Inc.
8500 Creekside Place
Beaverton, OR 97005-7107 USA

or call Protocol Systems, Inc. in the USA at **(800) 289-2500.**

Technical Services toll-free number: **(800) 289-2501.**

For world-wide facsimile communications, call **(503) 526-4200.**

If calling from outside the United States, call **(503) 526-8500.**

When calling Protocol for service information or to order service parts, please have the following information ready:

- model number (102, 104, or 106 from front of monitor),
- serial number (from back of instrument),
- software version (from startup screen)
- attached options, if any (such as printer or SpO_2 option)
- a full description of the problem or service needed
- your complete return shipping address
- your purchase order number (for non-warranty repairs, all upgrades and parts orders).
- a contact name and phone number for any further questions

The model and serial numbers are printed on the label located on the rear of the monitor. The software version number is displayed each time the monitor is powered on.

If you are returning a Propaq for service:

- The Technical Service representative will give you a Return Material Authorization (RMA) number and tell you where and how to ship the monitor for service. Without the RMA number, Protocol cannot accept the monitor for service.
- Package the monitor in its original shipping carton using the original packing material. The material and carton were specifically designed for the monitor's safety during shipment.
- Clearly address the box and ship it to the address provided by Protocol's customer service representative. Be sure to write the RMA number on the outside of the shipping carton, and on any included correspondence.

For the location of your nearest Protocol Systems authorized repair center, or for information on all Protocol Systems products, contact Protocol Systems, Inc.

Obtaining Warranty Service

If during the warranty period, the Propaq requires service, DO NOT ATTEMPT TO SERVICE IT YOURSELF. For fast, convenient service from Protocol Systems, follow the procedure above.

Recommended Service

The *Technical Reference Guide* provides instructions and information for technicians to repair the Propaq at the replaceable module level. Replaceable modules include software, circuit boards, large hardware items, such as the air pump, check valve, chassis parts, and other parts easily replaced without desoldering of surface-mount components and other small hardware. Module-level repair allows monitor repair in minimal time and for a nominal price for the replaceable module. Some replaceable modules can be exchanged for a nominal fee to reduce the repair price. Protocol Systems maintains competitive exchange fees.

Because of the specialized equipment and knowledge required to manufacture and repair the Propaq, Protocol Systems, Inc. recommends that only Protocol's authorized repair facilities provide component-level repair. If repair by other than Protocol's authorized repair facilities is required, such a facility must have the necessary equipment to service and repair surface mount technology (SMT) electronics as well as the specialized equipment to service Propaq monitors. Contact Protocol Systems, Inc. for more information.

Service Intervals

Tables 1-2 and 1-3 list recommended service items that should be considered in order to keep the monitor in good operating condition.

Table 1-2. Recommended Service Procedures

Symptom or Problem	Perform
Monitor is dropped, an accident, suspected rough handling.	Complete Functional Verification (Section 2).
Suspected malfunction with all or part of functions.	Functional Verification (Section 2) of suspected function(s).
Monitor fails Functional Verification.	Complete Adjustment followed by Functional Verification (Section 2).
Module has been replaced and monitor fails Functional Verification.	Complete Adjustment followed by Functional Verification (Section 2).

Table 1-3. Recommended Service Intervals

Recommended Interval	Service Action
Semi-annually	Complete Functional Verification and Safety Check
Minimum every three years	Replace lithium battery. Replace battery pack. Replace air filter

Section 2
Calibration

Introduction

This section consists of two subparts: Functional Verification Procedures and Adjustment Procedures. These calibration procedures should be performed by qualified service personnel only.

These procedures should be performed whenever necessary as indicated in Table 2-1.

Table 2-1. Recommended Calibration Intervals

Interval/Condition	Perform
Semi-annually	Complete Functional Verification and Safety Check
Monitor is dropped, an accident, suspected rough handling.	Complete Functional Verification.
Suspected malfunction with all or part of functions.	Functional Verification for suspected function(s).
Monitor fails Functional Verification.	Complete Adjustment followed by Functional Verification.
Module has been replaced and monitor fails Functional Verification.	Complete Adjustment followed by Functional Verification.

Equipment Required

Table 2-2 lists all the equipment needed to perform a functional verification, and an adjustment procedure. Some equipment can be manufactured. See Appendix A for information on manufacturable test equipment.

Table 2-2. Equipment Required for Calibration

Description	Functional Verification	Adjustments
DMM, 4 1/2 Digit, Fluke 8050A or equivalent		X
Mercury-column Manometer with Bulb (300 mmHg), Baumanometer 0661-0320 Desk Manometer or equivalent	X	X
50 MHz Triggered Sweep Oscilloscope, Tektronix 2225 or equivalent	X	X
Frequency Counter, Beckman UC-10 or equivalent		X
Variable DC Power Supply, 0-36 V, 3A, VIZ WP-715A or equivalent	X	X
Patient Simulator[a], Dynatech/Nevada 213A, 215A, or 217A with Temperature and ECG Cable/Leads	X	X
Electromedics 37° C Temperature Sensor Simulator (See Appendix A)	X	X
IBP Simulator, 5 μV/mmHg/volt, Fogg Systems BP48C, BP28, or MDE Datasim 6000 with IBP cables	X	X
Battery Substitution Plugs (See Appendix A)		X
Battery Temperature Sensor Substitution Plug (See Appendix A)		X
Adult Cuff Kit, Protocol PN 008-0006-XX	X	X
Protocol Cuff Calibration Kit, Protocol PN 008-0012-XX	X	X
Protocol Analog Output Cable, Protocol PN 008-0017-XX	X	
Power Supply Adapter Cables (See Appendix A)	X	X
Propaq AC Power Adapter North American, 120 V, 60 Hz, Protocol PN 503-0002-00 International, 220-240 V, 50-60 Hz, Protocol PN 503-0002-20 Japanese, 100 V, 50-60 Hz, Protocol PN 503-0002-30	X	
Safety Analyzer, Neurodyne-Dempsey, 431F-1D or equivalent	X	
Non-Conductive Screwdriver		X
Nellcor Test Fixture, PT-2500	X	
Nellcor Patient Module Cable	X	
RS-423 Loopback Test Fixture (See Appendix A)		X
Extension Cable, Display, Protocol PN 850-0187-XX		X

[a]Do not simultaneously monitor ECG and IBP. See Appendix B.

The Service Menus

For added convenience while performing functional verification and adjustment procedures, Propaq monitors provide easy-to-use Service Menus (Figure 2-1). Service Menu selections activate software-controlled tests and functions. Using these functions and the instructions in this manual, a complete calibration of the monitor can be accomplished in little time. The Service Menu is accessed through the Propaq menu system.

The Service Menus (Figure 2-1) contain several functions for testing and verifying the Cuff channel, display, invasive pressure channel (models 104 and 106 only), and printer. During the procedures in this manual, the Service Menu functions will be accessed to perform necessary tests.

Button Presses

Button presses to access any function in the Propaq are shown in this manual with the > character separating the names of the buttons to be pressed. For example, SENSORS > ECG > LEAD means starting from the Main Menu, press the SENSORS button, then the ECG button, and finally the LEAD button.

The Service Menu is activated by pressing (from the Main Menu) SYSTEM > MORE > SERVICE.

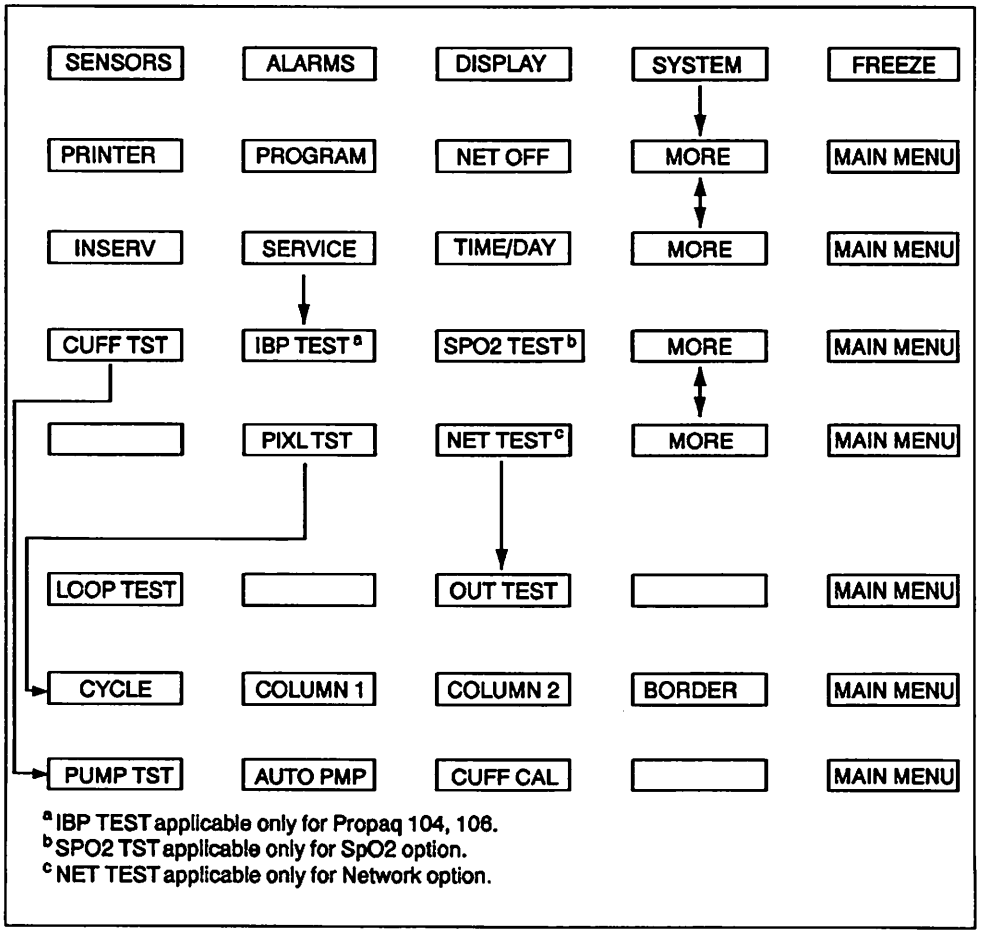

Fig. 2-1. The Service Menus

Functional Verification

Introduction

The functional verification procedures verify proper operation of the monitor and printer hardware. This procedure should be performed at intervals listed in Table 2-1.

Self Test

Many functions, such as alarms, wave form and scale sizing, and printer control, are software operations. Since system software is automatically checked during the monitor's power-up self-test, all software functions work normally if no error messages appear during the power-up sequence. (Some error messages indicate hardware failures.)

Functional Verification Checks

The functional verification checks the following:

- battery charger activation
- nominal current draw
- operation of pushbuttons
- display operation
- tone level control
- ECG channel operation
- correct alarm indicator response
- invasive pressure channel operation
- analog output operation
- CUFF channel operation
- temperature channel operation
- correct date and time
- correct monitor preset programming
- SpO_2 channel operation
- leakage current
- printer functions

Preparation

NOTE

If the monitor has been stored for longer than one month without the monitor connected to the ac adapter (for recharging), the battery voltage should be checked. The battery may need to be replaced if it cannot hold a charge.

The functional verification is a "covers on" process; the monitor is not disassembled. Minimal test equipment, listed in Table 2-2, is needed. Most items not commercially available can be made according to the information in Appendix A.

NOTE

If you plan to use a Dynatech/Nevada model 213A, 215A, or 217A Patient Simulator to simultaneously simulate ECG and invasive blood pressure, see Appendix B for important information.

If you need to do a routine monitor calibration, see the Adjustment Procedure in this section.

If you have replaced a module and the monitor does not pass the functional verification, perform a module calibration (see Adjustment Procedure subsection).

Procedures

NOTE

Before starting the verification procedures, charge the battery for at least 8 hours with the monitor turned off. (Charge for 12 hours if a Printer or SpO_2 module is attached.)

Power System

The following steps check the integrity of the power system.

1. If the ac power adapter is not plugged in, plug it into an ac socket with the correct voltage and connect it to the monitor's right side panel dc power connector.
2. Check that the green **BATTERY CHARGING** indicator lights.
3. Disconnect the power adapter from the monitor. Check that the **BATTERY CHARGING** indicator turns off.

CAUTION

In the next steps, carefully check for the proper polarity of the connection between the power supply and the monitor. Refer to the diagram on the monitor's right side panel for proper polarity.

4. Turn on the dc power supply and set it for 15 V ±0.5 V.
5. Using the Protocol Power Supply adapter, connect the power supply to the monitor's dc input connector on the right side panel.

6. Check that the **BATTERY CHARGING** LED indicator lights.
7. Check that the current draw from the supply is less than 650 mA.

NOTE

Initial charge current can be as high as 880 mA. However, as the battery charges, the current will decrease. A fully charged battery draws less than 100 mA. You should notice the current draw slowly drop the longer the dc supply is connected to the monitor.

8. Turn off the power supply.
9. Disconnect the supply from the monitor.

Button Tests The following steps check the operation of the buttons.

1. Turn on the monitor.
2. Make sure that no error messages appear and the monitor correctly powers up.
3. With the Main Menu displayed
   a. press one of the buttons
   b. check that the menu changed
   c. press the MAIN MENU button
   d. repeat steps 3a through 3c until all buttons have been checked.
4. Make sure that the Main Menu is displayed when you are done.

Display The following steps check the display.

1. Press MAIN MENU.
2. Press SYSTEM > MORE > SERVICE > MORE > PIXL TEST > CYCLE to start the display tests.
3. Check that all pixels in the activated columns are turned on.
4. Press the left button to advance to the next test.
5. Check that all pixels in the activated columns are turned on.
6. Press the left button to advance to the next test.
7. Check that all pixels around the perimeter of the display are turned off.
8. Press any but the left button to stop the tests.
9. Press MAIN MENU.
10. Press SYSTEM > TIME/DAY and check that the displayed time of day and date are correct. If they are not, correct them using the

NEXT and UP or DOWN buttons and set them with the ENTER button.

The clock should be accurate to ±2 seconds per day or ±1 minute per month. If the clock does not meet these specifications, complete the calibration of the Clock/Calendar listed later in this section.

ECG Channel & Alarm Indicators

The following steps check the ECG channel's input circuitry and the alarm indicator drivers.

1. Connect the ECG channel to the patient simulator.
2. Set the simulator as follows:

   normal sinus rhythm
   80 beats per minute (bpm)
   1 mV amplitude

3. Set the monitor as follows (from the Main Menu, press the keys indicated in parantheses):

   Lead II (SENSORS > ECG > LEAD)
   1 mV ECG size (SENSORS > ECG > SIZE)
   25 mm/Sec sweep speed (SENSORS > ECG > mm/SEC)
   ALL ALARMS OFF (ALARMS > ALL ALRM)
   ♥Tone to LOW (DISPLAY > MORE > ♥TONE)

4. Check that a normal sinus rhythm ECG waveform is displayed with a peak-to-peak height equal to that of the reference pulse at the left side of the display (18 ±2 pixels high). There should be a soft beep tone with each QRS event.

   NOTE

   The patient simulator recommended in Table 2-2 provides a 1mV output at Lead II. Other simulators may provide 1 mV at different leads. If you use a simulator other than the one recommended, check the simulator's specifications.

5. From the Main Menu, press DISPLAY > MORE > ♥TONE.
6. Check that the tone turned off.
7. Press ♥TONE twice more and check for high and medium tones.

   This affects only the heart beat tone. Alarm tones are not affected. Turn the tone off for the remainder of the functional verification.

8. Press MAIN MENU.
9. Check that the monitor's heart rate display is 80 ±4 bpm.
10. Remove one ECG lead wire.
11. Check that an equipment alarm occurs. The LEAD FAIL message should accurately indicate the removed lead.
12. Disconnect one of the two remaining leads.

13. Check that an equipment alarm occurs with a LEAD FAIL MULTIPLE message.
14. Reconnect all leads.
15. Press MAIN MENU.
16. Check that the **ALARM(S) OFF** light is on.
17. Press ALARMS >STAT SET to automatically set heart rate alarm limits.
18. Set the simulator heart rate outside a heart rate alarm limit.
19. Check that an alarm violation occurs with the tone and **ALARM** light on.

NOTE

The alarm tone may be set to high, med or low through DISPLAY > MORE > TONE.

20. Press ALL ALRM to turn off alarms.
21. Check that the tone turns off.
22. Press MAIN MENU.
23. Adjust the simulator heart rate to 80 bpm.
24. Set the simulator for PACED RHYTHMS, NON-FUNCTION.
25. If pacer indicator is not on, press SENSORS > ECG > MORE > PACER to turn on the pacer indicator.

    A dashed line between the heart rate numeric and waveform windows indicates the pacer is on.

26. Check that a dashed vertical line is displayed on the ECG waveform each time a pacer occurs.
27. Check that the heart rate numeric is displayed as three horizontal dashed lines.
28. Press MAIN MENU.

P1, P2 The following steps verify the operation of one invasive pressure channel (P1). Repeat the steps for checking P2 of a Propaq 106. If you are verifying a Propaq 102, skip this part of the procedure.

NOTE

Check that the P1 and P2 waveforms are turned on in the wave select window.

CAUTION

Many blood pressure simulators are not intended to be used as a calibration standard. The simulator you use should have an accuracy of at least 1%. Check your simulator's specifications.

NOTE

If you are using the Dynatech/Nevada model 213A, 215A, or 217A patient simulator, do not simultaneously monitor ECG and invasive blood pressure (IBP) unless the modification to the simulator is performed as described in Appendix B. If you do not wish to modify your simulator, use ECG and IBP independently.

1. Disconnect the ECG cable from the monitor.

   (Disconnecting an active channel initiates an equipment alarm.)

2. Press the DISABLE button to remove the alarm screen.
3. Plug the pressure simulator into the monitor's P1 connector (use the P2 connector if verifying P2).
4. Set the simulator to 0 mmHg.
5. Check that P1 NOT ZEROED (or P2 NOT ZEROED) is displayed in the blood pressure numerics window.

   (The pressure scale does not appear until the pressure channel has been zeroed.)

6. Zero the pressure channel by pressing SENSORS > INV PRS > MORE > ZERO P1 (P2).
7. Check that P1 ZEROED (or P2 ZEROED) is displayed.
8. Check that the mean pressure numeric is 0 mmHg ±2 mmHg.
9. Set the pressure simulator to 200 mmHg.
10. Check that the mean pressure numeric is 200 mmHg ±2 mmHg.
11. Set the pressure simulator to 0 mmHg.
12. Press MORE > RESCALE.
13. Check that the displayed pressure wave form is no larger than 6 pixels p-p.
14. Press MAIN MENU.

Analog Output

1. Connect the Propaq Analog Output Cable to the monitor's delayed analog output connector on the right side panel.
2. Set the pressure simulator to 200 mmHg.
3. For Propaq 104/106 monitors, check the P1 output pin for 2.0 ±0.2 mV. For Propaq 102 monitors, check the P1 output pin for 1.25 V ±120 mV. Disconnect the IBP input.
4. Connect the ECG simulator to the monitor.
5. Set the simulator for a normal sinus rhythm at 80 bpm with 1 mV amplitude.
6. Using the oscilloscope, check the SYNC output pin for a 0 to 5 V, 11.0 to 16.5 msec pulse occurring at the ECG rate (refer to Figure 2-2). (Software versions 6.12 and later have a duration of 100 ±5.5 ms.)
7. With the ECG channel set to lead II and 1mV size, check the ECG output pin for a 1 V ±100 mV ECG signal.
8. Turn off the ECG simulator and disconnect it from the monitor.
9. Disconnect the invasive pressure simulator and analog output cable from the monitor.

CUFF Channel

NOTE

In the following steps, the monitor's displayed pressure must be checked against a calibrated mercury-column manometer.

1. Connect the cuff, manometer with bulb, and the monitor together with the Cuff Calibration Kit. See Figure 2-3.
2. Wrap the adult cuff around a cylindrical object about the size of an adult's arm.
3. Press SYSTEM > MORE > SERVICE > CUFF TST > (allow the channel to zero before pressing the next button) CUFF CAL.

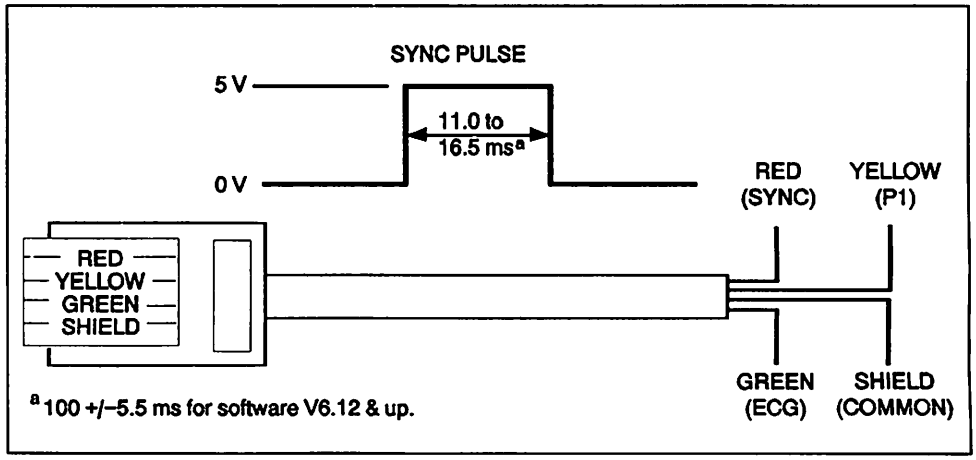

Fig. 2-2. Analog Output Cable Test Points

A ten-minute timer starts in the monitor. If steps 4 through 9 take longer than ten minutes, simply press CUFF CAL again.

4. Close the valve on the bulb and squeeze the bulb to inflate the cuff to 250 mmHg as shown on the mercury-column manometer.
5. Check that the reading on the monitor's display is 250±4 mmHg.
6. Reduce the pressure to 100 mmHg and check that the displayed pressure is 100±2 mmHg.
7. Reduce the pressure to 0 mmHg and check that the displayed pressure is 0±2 mmHg. Close the bulb valve.
8. Press PUMP TST.
9. Check that the pump inflates the cuff to approximately 229 mmHg within 10 seconds.
10. With the bulb valve closed, while observing the manometer, inflate the cuff until the monitor automatically vents the pressure.
11. Check that the manometer reading is approximately 260 mmHg when the pressure is vented.
12. Observe the leak rate display on the monitor screen. Check that the leak rate is less than 10 mmHg/min by the end of the one minute test.
13. Press MAIN MENU.
14. Disconnect the cuff and Cuff Calibration Kit.
15. Disable the equipment alarm by pressing DISABLE.

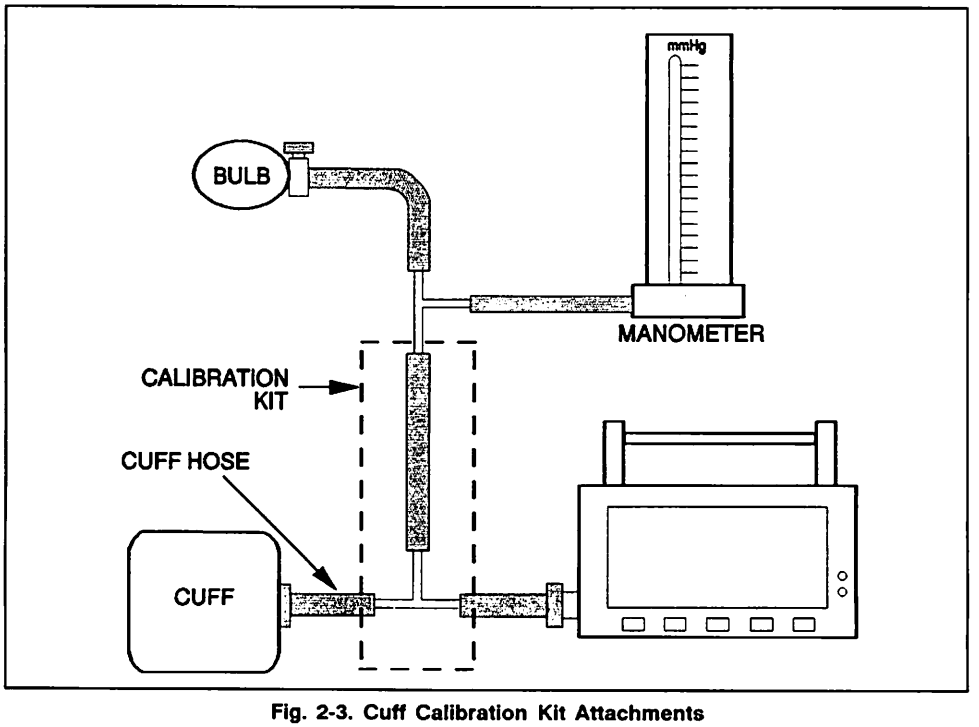

Fig. 2-3. Cuff Calibration Kit Attachments

Temperature

NOTE

The Propaq 106 does not support Electromedics temperature probes. Steps 5 and 6 below do not apply.

1. Insert a YSI 400 Series calibrated temperature probe simulator into the T1 jack.
2. Check that T1 temperature is ±0.2°F (±0.1°C) of the calibration temperature.
3. Replace the YSI 400 simulator with a YSI 700 Series probe simulator.
4. Check that T1 temperature is ±0.2°F (±0.1°C) of the calibration temperature.
5. Insert an Electromedics 2100 Series calibrated temperature probe simulator into the T2 jack.
6. Check that the displayed temperature (T2) is ±0.2°F (±0.1°C) of the calibration temperature.

Battery Capacity Test

This procedure checks the capacity of the battery to ensure that it is capable of holding a charge.

NOTE

A new battery should pass the following test. The run time of older batteries will decrease proportionally with age. Replacement is recommended when the run time becomes insufficient for the monitor's application.

1. Use the ac power adapter and charge the monitor for at least 8 hours with the monitor turned off (12 hours if a printer or pulse oximeter is attached).
2. Disconnect the power adapter.
3. Set the monitor as follows: CUFF in manual mode.
4. Run the monitor for 8 hours.
5. Check that the monitor did not automatically turn off.
6. Use the ac power adapter and charge the monitor for at least 8 hours with the monitor turned off. (Charge at least 12 hours if an EMP or pulse oximeter is attached.)

SpO_2 Checks

The following steps check the operation of the pulse oximetry option (SpO_2).

NOTE

The Propaq pulse oximeter option (for Propaq or Expansion With Printer) may have one or two input connectors on the left side connector panel. The large "D"-type connector which accepts the SpO_2 sensor directly is standard to all pulse oximeter options. The smaller, round connector which accepts the patient module cable was removed from all oximeter options beginning approximately with SNs SP01300 (in Expansion Module With Printer) and TD02670 (SpO_2 for Propaq only). Steps 2-10 below check the "D" connector and steps 14-18 check the patient module connector. Perform the applicable steps as required for your configuration.

1. Disconnect all test cables from the monitor's patient channel connectors. (It is not necessary to disconnect the cuff hose.)
2. Connect the Nellcor SpO_2 test fixture to the Propaq's D-type connector.

   The test fixture has no on/off switch. It automatically turns on with the monitor power.
3. Turn off all alarms by pressing ALARMS > ALL ALRM from the Main Menu.
4. Press MAIN MENU.
5. Turn on the SpO_2 waveform in the wave select window (DISPLAY > MORE > WAVE SEL).
6. Check that the SpO_2 numeric is 81 ±2.
7. Check that the pulse rate is 40 ±3.
8. Check that the waveform shape is similar to Figure 2-4.
9. Check that the speaker is sounding with every pulse indicated on the display.

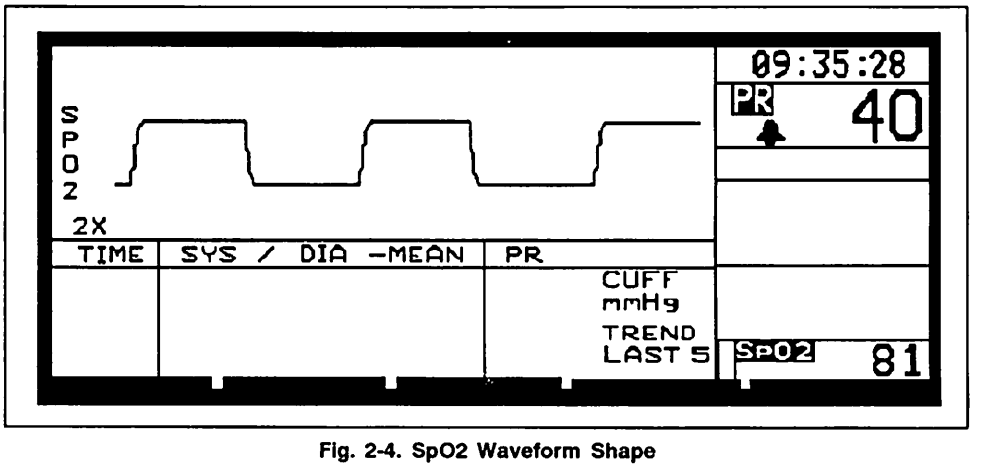

Fig. 2-4. SpO2 Waveform Shape

10. Check that the speaker volume changes according to the ♥TONE setting (DISPLAY > MORE > ♥TONE).
11. Disconnect the SpO_2 test fixture from the Propaq.
12. Check that an equipment alarm occurs.
13. Press SUSPEND.
14. Connect the SpO_2 test fixture to the Nellcor Patient Module Cable.
15. Connect the Patient Module Cable to the round connector on the SpO_2 side panel.
16. After the SpO_2 numerics and pulse rate are displayed, check that the pulse rate is 40 ±3.
17. Check that the SpO_2 numeric is 81 ±2.
18. Check that the waveform shape is similar to Figure 2-4.

NOTE

The following steps require a suitable ECG/SpO_2 simulator to provide a synchronized ECG and SpO_2 signal. Instead of a simulator, you can connect ECG electrodes to yourself and use a NELLCOR sensor on your finger.

19. Provide synchronized ECG and SpO_2 signals to the Propaq.
20. Press SENSORS > SpO_2 > MORE > C-LOCK until C-LOCK is turned ON.
21. Check that the SpO_2 signal and ECG signals appear normal and "normal" readings appear on the monitor.
22. Unplug the ECG connector from the Propaq.
23. Check that the NO C-LOCK message alternates with the time of day.
24. Disconnect all cables from the Propaq.

Leakage Current

Check leakage currents using a Neurodyne-Dempsey 431F-1D Safety Analyzer or its equivalent. The source current should not exceed 10 μA rms. The sink current should not exceed 20 μA rms. See the analyzer's operator's manual for the proper safety check procedure. Table 2-3 lists the proper electrode wire connections between the monitor and the analyzer.

NOTE

All safety checks are done with the ac power adapter plugged into the monitor and the safety analyzer.

Since the monitor case is manufactured from double-insulated plastic, case-to-ground leakage test (Neurodyne-Dempsey TEST 1) is not done.

Table 2-3. Lead Connections for Safety Check

Monitor Cable	Safety Analyzer
RA	RA
LA	LA
LL	RL

Printer Tests

The following steps check the functionality of the printer.

NOTE

Before performing the printer tests, the monitor should first be verified that it properly functions.

1. Turn on the monitor and check that the green LED on the printer's front panel lights after 2 to 3 seconds.
2. Connect the patient simulator to the monitor.
3. Set the patient simulator for ECG, normal sinus rhythm.
4. Check that the monitor displays a normal ECG signal.
5. Press and hold in the printer's PAPER FEED button.

   Paper should feed out the side of the printer as long as the button is held in.
6. Release the PAPER FEED button.
7. Press the printer's SNAPSHOT button.

   The printer should print an eight-inch strip of a normal ECG wave form. The paper should stop only after the entire wave form has been fed out of the printer.
8. Press the printer's START/STOP button.

   The printer should begin printing a normal ECG wave form without stopping.

9. Press the START/STOP button to stop printing.
10. Press the START/STOP button to start printing.
11. Lay the Propaq on its back while the printer is printing.
12. Completely open the paper door on the bottom of the Expansion Module.
13. Check that the printer stops printing, that the green LED is not lit, and that an equipment alarm and CHECK DOOR message appear on the monitor screen.
14. Cut the printer paper from the roll, leaving a strip of paper in the printer mechanism.
15. Close the paper door and set the monitor upright.
16. Press the START/STOP button.
17. After the printer runs out of paper, check that the green LED is not lit and that an equipment alarm and PAPER OUT message appear on the monitor screen.
18. Open the printer door and replace the end of the paper roll in the printer.
19. Close the paper door and set the monitor upright.
20. Check that the green LED lights.
21. Press and hold in the printer's PAPER FEED button and then press the START/STOP button.
22. Check that a test printout similar to Figure 2-5 is printed.
23. Turn off the monitor and simulator, and disconnect the simulator from the monitor.

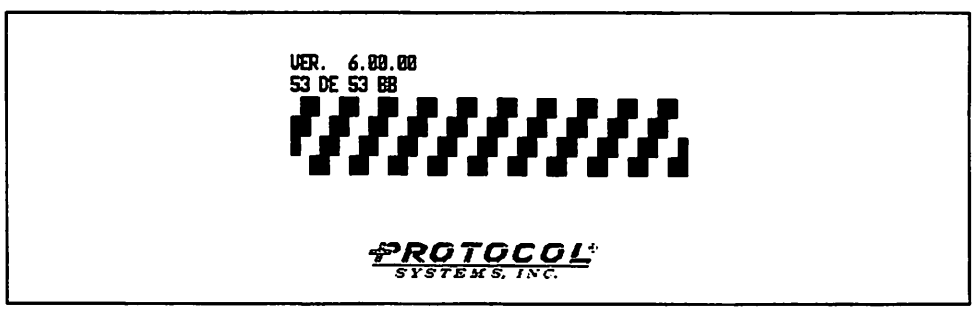

Fig. 2-5. Printer Test Printout

Adjustments

Introduction

The following calibration procedure is provided to ensure that the monitor performs according to Protocol's specifications. After you complete this calibration procedure, you must also perform the verification procedures listed at the start of this section.

The following calibration procedure includes checks and adjustments of the recharger and power supply, invasive pressure channel, non-invasive blood pressure channel (cuff), and the time of day clock. Verification of proper circuit and channel operation of other channels is performed according to the Functional Verification procedures listed at the start of this section.

See Table 2-1 for information on service intervals.

See Table 2-2 for a list of the required test equipment for calibration. Some of the test fixtures listed can be manufactured. See Appendix A.

Procedures

Instructions for opening and closing the monitor's case are provided in Section 3.

NOTE

Before performing this calibration procedure, charge the monitor for at least 8 hours with the monitor turned off.

CAUTION

Make sure calibration is performed at a static-protected work station. Static discharge can damage components in the Propaq monitor.

Setup

1. Make sure the battery pack is fully charged.
2. If an EMP or pulse oximetry option is attached to the monitor, remove it prior to calibration (see Section 3)—these options are tested in the **Functional Verification** section. The following procedures are for the Propaq monitor only.
3. Disconnect the ac power adapter from the monitor's side panel connector.

CAUTION

As you open the monitor in the next step, be sure to disconnect the tubing from the pressure transducer to prevent the tubing from tearing. See Section 3.

4. Open the monitor case as described in Section 3.
5. Disconnect P6 display interconnect cable and and install the extension cable (850-0187-xx).

NOTE

In all the following procedures, the alarms should first be disabled by pressing ALARMS > ALL ALRM. This prevents alarms from being activated as you make adjustments.

Recharger Board

WARNING

High Voltages (approx. ±200 V dc) are present on the recharger board when the monitor power is turned on. These voltages could present a shock hazard if contacted during calibration.

1. Refer to Figure 2-6 and disconnect the battery connector from P4 on the Recharger Board.
2. Connect the 91Ω Battery Substitution Plug (see Table 2-2) to P4.
3. Refer to Figure 2-6 and disconnect the temperature sensor connector from P1 on the Recharger Board.
4. Connect the temperature sensor simulator to P1 (see Table 2-2).
5. Turn on and set the variable dc power supply to 17.0 ±0.1 V.

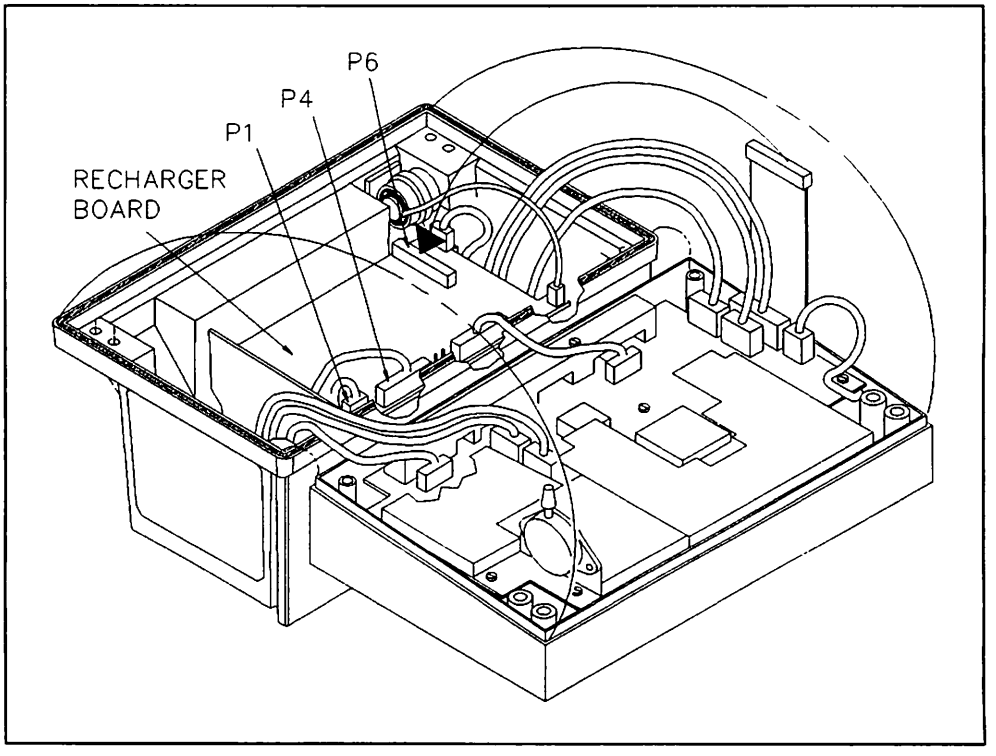

Fig. 2-6. Locations of P1, P4 and P6, Recharger Board

NOTE

Adjustment of PT3 in step 14 below sets an overvoltage limit which, if misadjusted, can cause fuse F1 to open. If PT3 adjustment has been tampered with, adjust fully clockwise before connecting power to the dc input jack on the Propaq. Proceed with the following calibration, including step 14 which properly sets the overvoltage limit.

6. Using the power supply adapter cable (see Table 2-2), connect the variable dc power supply to the monitor's dc input connector.
7. Check that the **BATTERY CHARGING** indicator LED lights.
8. Check that the current draw from the variable dc power supply is not more than 130 mA.
9. Set the DMM for a voltage measurement of up to 10 V dc.
10. Connect the DMM's positive lead to TP1 (Figure 2-7).
11. Connect the DMM's reference lead to ground at TP2 (Figure 2-7).
12. Adjust PT2 (Figure 2-7) for a DMM reading of 9.40 V ±10 mV.
13. Refer to Figure 2-7 and move the DMM's positive lead to U4-8 (the test pad located near pins 4 and 5).
14. Adjust PT3 (Figure 2-7) for a DMM reading of 2.393 V ±10 mV. Use care not to adjust this control beyond the specified voltage; fuse F1 may open.

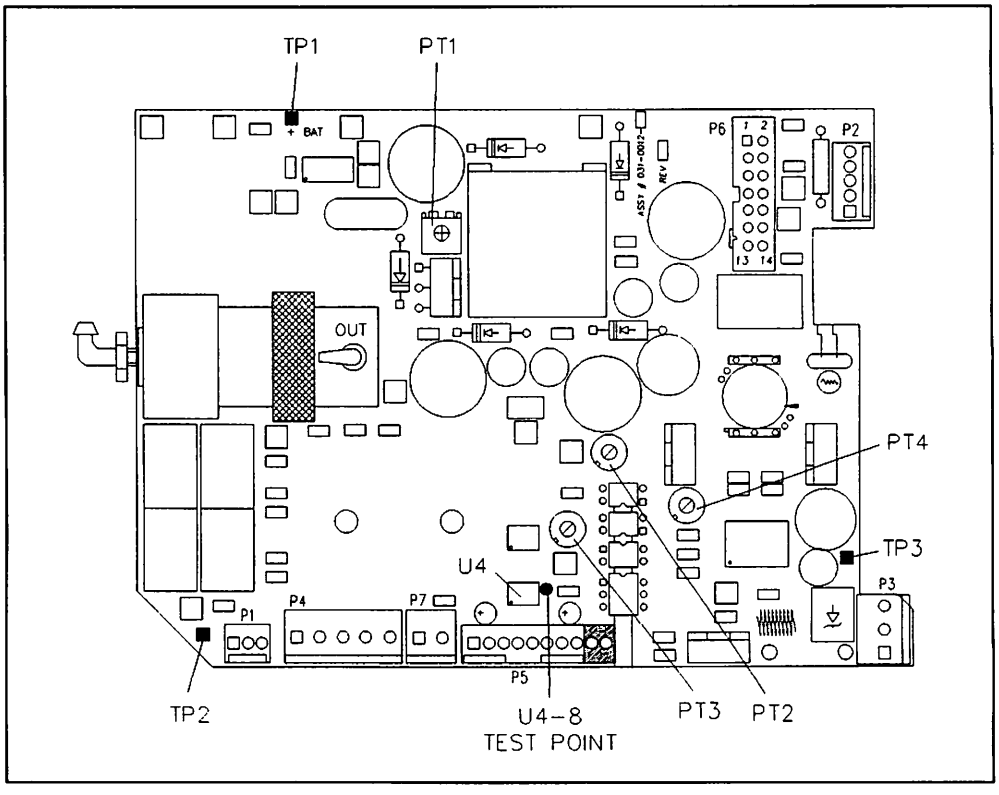

Fig. 2-7. Recharger Board Test Points and Adjustments

15. Disconnect the DC input from the monitor's right side panel.
16. Replace the 91Ω battery substitution plug with the 11Ω plug.
17. Reconnect the 17.0 V supply to the monitor.
18. Adjust PT4 (Figure 2-7) for a DMM reading of 9.35 V ±10 mV.
19. Disconnect the DMM leads from monitor.
20. Slowly raise the variable dc power supply voltage to 32 V while checking that the **BATTERY CHARGING** LED indicator remains on.
21. Slowly reduce the variable dc power supply voltage to 10.3 V while checking that the **BATTERY CHARGING** LED indicator remains on.
22. Slowly reduce the variable dc power supply voltage until the **BATTERY CHARGING** LED indicator turns off.
23. Check that the variable dc power supply voltage is between 8.0 V and 10.3 V.
24. Disconnect the variable dc power supply from the monitor.
25. Disconnect the substitution plugs from P1 and P4.
26. Reconnect the temperature sensor cable to P1.
27. Using the DMM, measure the battery voltage between pins 1 and 2 of the battery cable previously connected to P4 (see Figure 2-6).

    The battery voltage should be 7.0 to 9.4 V.

    CAUTION

    When reconnecting the battery cable in the next step, make sure the plug is properly oriented and aligned onto connector P4. Improper orientation and alignment can cause immediate damage to the Recharger Board.

28. Carefully reconnect the battery cable to P4.
29. Adjust the variable dc power supply to 17.0 ±0.1 V.
30. Using the power supply adapter cable, connect variable dc power supply to the dc input connector on the monitor's side panel.
31. Connect the DMM's reference lead to P4 pin 2 or 4 (Ground), or connect it to the tab of U602 on the Main Board (see Figure 2-8).
32. Connect the DMM's positive lead to P4 pin 1 or 5.
33. Check that the current drawn from the variable dc power supply is less than 650 mA.
34. As the current draw to the charged battery decreases, note the DMM reading after the current draw drops below 400 mA.

    The voltage should be approximately 9.4 V.
35. Disconnect the DMM leads.

36. Connect the scope reference to pin 2 or pin 4 of P4, or connect it to the tab of U602 on the Main Board (see Figure 2-8).
37. Connect the scope probe to P4 pin 1 or 5.
38. Set the scope for a 300 mV ac bandwidth limited measurement.
39. Check that the recharger ripple is less than 300 mV p-p.

This concludes the Recharger Board calibration. For a full monitor calibration, continue to the Main Board calibration procedure below.

Main Board Setup

Set up for Main Board calibration as follows. If you are continuing from the Recharger Board calibration, skip steps 1 through 3.

1. Make sure the batteries are fully charged.
2. Disconnect the ac power adapter from the monitor's side panel connector.

CAUTION

As you open the monitor in the next step, be sure to disconnect the tubing from the pressure transducer to prevent the tubing from tearing. See Section 3.

3. If necessary, open the monitor casing as described in Section 3.
4. Refer to Figure 2-6 and disconnect the battery connector from P4 on the Recharger Board.
5. Connect the power supply adapter cable (see Table 2-2) to the dc power supply (red wire to +; black wire to -).
6. Turn on the variable dc power supply and adjust for 9.0 V output.
7. Connect the power supply adapter cable to P4.

Power Supplies

1. Turn on the monitor.

NOTE

The ability to accurately measure the value in the next step depends on the dc power supply's current meter. Some digital meters cannot accurately average currents from switching power supplies.

2. Check that the current drawn from the dc supply averages ≈190 mA, fluctuating up to ≤450 mA.

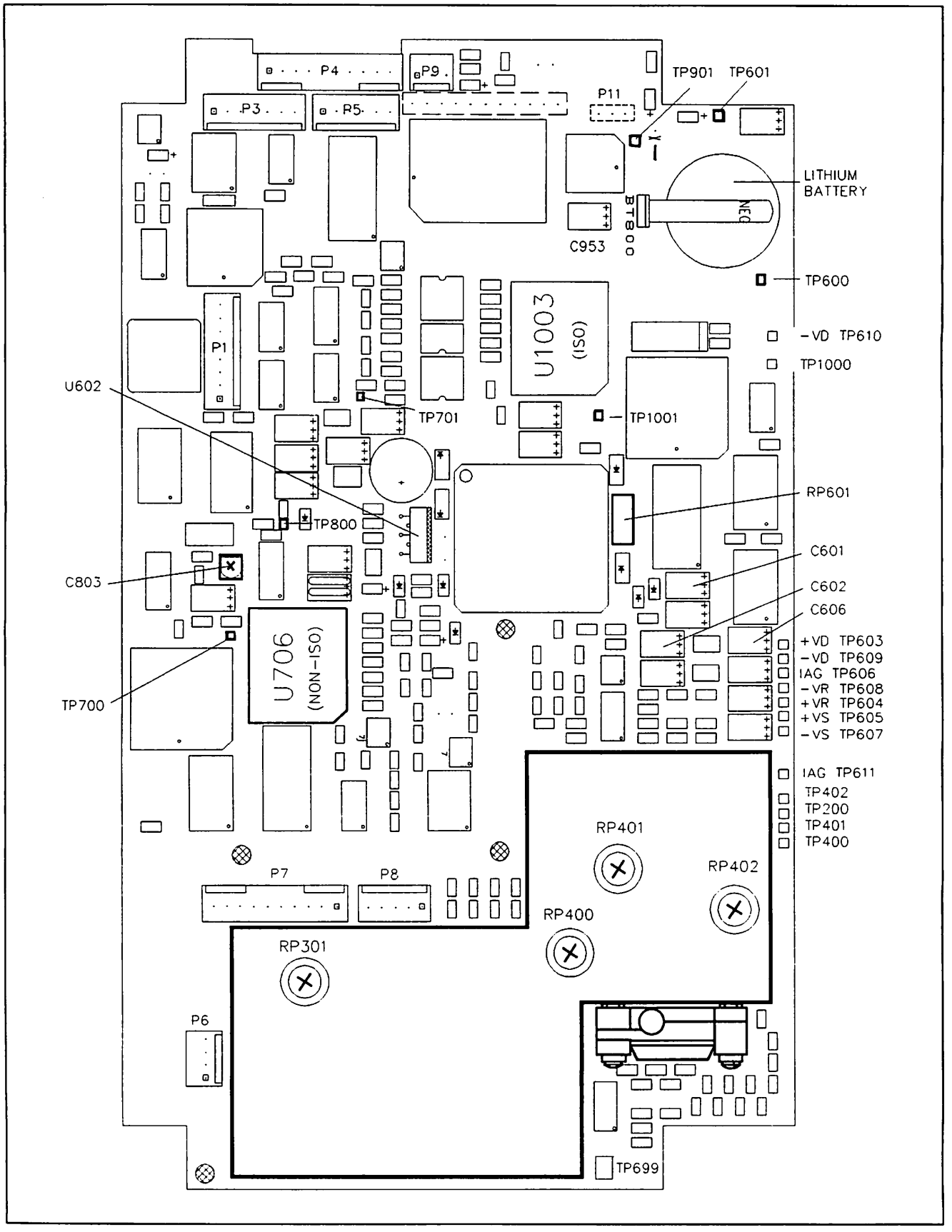

Fig. 2-8. Main Board Test Points and Adjustments

3. Turn off the monitor.
4. Disconnect the display interconnect extension cable from P6.
5. Turn on the monitor.
6. Check that the current drawn from the dc supply is 85 ±15 mA.
7. Turn off the monitor.
8. Reconnect the display interconnect extension cable to P6.
9. Turn on the monitor.
10. Connect the DMM reference probe to TP606 (IAG). See Figure 2-8.
11. Refer to Table 2-4 and Figure 2-8 and check the isolated dc supply voltages at listed positive test points. Change the DMM reference probe as indicated, starting with the +VD supply.

Table 2-4. Isolated Power Supply Voltage Checks

Supply	DMM Reference Test Point	DMM Positive Test Point	Voltage Limits
+VR	TP606 (IAG)	TP604	+2.425 to 2.540 V
–VR	TP606 (IAG)	TP608	–VR = –| +VR ±0.025| V
+VS	TP606 (IAG)	TP605	+5.50 to +5.90 V
–VS	TP606 (IAG)	TP607	–5.50 to –5.90 V
+VB	TP606 (IAG)	C602 +	+3.10 to +3.50 V
–VB	TP606 (IAG)	C601 –	–3.10 to –3.50 V
+VD	TP604 (+VR)	TP603	0.200 to 0.230 V
–VD	TP609 (-VD)	TP608	0.200 to 0.230 V

12. Connect the DMM reference probe to TP601 (non-isolated ground). See Figure 2-8.
13. Refer to Table 2-5 and Figure 2-8 and check the non-isolated dc supply voltages at listed positive test points.

NOTE

V4.0 measurements must be made while the monitor is in the CUFF CAL Mode). This is done by pressing SYSTEM > MORE> SERVICE > CUFF TEST> CUFF CAL.

14. Disconnect DMM leads.
15. Disconnect P5 from the Main Board.

Table 2-5. Non-Isolated Power Supply Voltage Checks

Supply	DMM Reference Test Point	DMM Positive Test Point	Voltage Limits
Vcc	TP601 (Non-Isolated)	TP600	4.90 to 5.10 V
V–15	TP601 (Non-Isolated)	TP602	–14.70 to –15.30 V
V+15	TP601 (Non-Isolated)	C953 +	–14.70 to –15.80 V
V4.0	TP601 (Non-Isolated)	C614 +	+3.80 to +4.20 V
–5.0 V	TP601 (Non-Isolated)	C1101 –	–4.80 to –3.50 V
–2.5 V	TP601 (Non-Isolated)	TP901	–2.470 to –2.520 V

16. Connect a jumper between test points TP701 and TP601 and another jumper between TP1001 and TP610. See Figure 2-8. This will hold both CPUs in reset to allow power supply ripple checks to be made.
17. Reconnect P5.
18. Connect the bandwidth-limited oscilloscope ground lead to the isolated ground test point TP606 (IAG). See Figure 2-8.
19. Refer to Table 2-6 and Figure 2-8 and check that the isolated power supply ripple is within the limits shown at the listed test points.
20. Connect the bandwidth-limited oscilloscope ground lead to the non-isolated test point TP601 (IAG). See Figure 2-8.

Table 2-6. Isolated Power Supply Ripple Checks

Supply	Oscillscope Reference Test Point	Oscillscope Signal Test Point	Ripple Limits (Peak-to-Peak)
+VR	TP606 (IAG)	TP604	≤5 mV
–VR	TP606 (IAG)	TP608	≤5 mV
+VS	TP606 (IAG)	TP605	≤15 mV
–VS	TP606 (IAG)	TP607	≤15 mV
+VB	TP606 (IAG)	C602 +	≤50 mV
–VB	TP606 (IAG)	C601 –	≤50 mV
+VD	TP606 (IAG)	TP603	≤50 mV
–VD	TP606 (IAG)	TP608	≤50 mV

21. Refer to Table 2-7 and Figure 2-8 and check that the isolated power supply ripple is within the limits shown at the listed test points.
22. Disconnect oscilloscope.

Table 2-7. Isolated Power Supply Ripple Checks

Supply	DMM Reference Test Point	DMM Positive Test Point	Voltage Limits
Vcc	TP601 (Non-Isolated)	TP600	≤50 mV
V–15	TP601 (Non-Isolated)	TP602	≤50 mV
V+15	TP601 (Non-Isolated)	C953 +	≤50 mV
–5.0 V	TP601 (Non-Isolated)	C1101 –	≤50 mV
–2.5 V	TP601 (Non-Isolated)	TP901	≤20 mV

23. Set up frequency counter to measure time period with attenuator in 0.1 position and gate at 0.01 sec.
24. Connect counter negative lead to TP601 (non-isolated ground point). Connect positive lead to TP800.
25. Adjust C803 for a period of 1 second, ±20 μs.
26. Remove frequency counter leads, turn off monitor, and remove jumpers from TP701, TP610, TP601 and TP1001.
27. Turn on the monitor. Position the display for easy viewing.
28. Adjust PT1 (Figure 2-7) clockwise until the display background illuminates.
29. Find the brightest background area on the display and view this area through a paper tube to shield view from external light.
30. Adjust PT1 counter-clockwise until the brightest background area, as viewed through the tube, fades to black.
31. Position the tube to view the brightest area (now dim) and simultaneously a lighted area (pixels on). Adjust PT1 clockwise until the background area is just beginning to illuminate.
32. Check that the dc power supply voltage is 9.00 V ±0.05.
33. Check that the battery voltage displayed in the Propaq status window is 9.0 ±0.2 V.
34. Press MAIN MENU.
35. Turn the monitor power switch off.
36. Adjust variable dc power supply for 6.5 V.
37. Turn the monitor on and check that the monitor automatically turns off after performing its self test.
38. Turn off the monitor.
39. Measure the voltage across R818 to be 3.5 mV ±1.5 mV.

40. Adjust the dc power supply to 9.0 V.
41. Turn monitor power on.
42. Disconnect any test equipment leads still remaining connected to the monitor.
43. Using the oscilloscope with a 1X probe, measure the test pad TP699. Adjust RP601 with a non-conductive screwdriver for minimum high frequency signal. (The oscilloscope ground clip is not used for this step.)

P1, P2

The following steps allow calibrating one invasive pressure channel (P1). Repeat the steps for checking P2 of a Propaq 106. If you are calibrating a 102, skip this part of the procedure.

CAUTION

Many blood pressure simulators are not intended to be used as a calibration standard. The simulator you use should meet the specifications of Table 2-2. Check your simulator's specifications.

1. Plug the invasive pressure simulator into the pressure jack.
2. Set the simulator to 0 mmHg.
3. Press SYSTEM > MORE > SERVICE > IBP TEST.
4. Record the A/D count on the display (512 ±10).
5. Set the simulator to 200 mmHg.
6. Check that the A/D count is 200 ±2 counts over the value recorded in step 4.
7. If necessary, adjust RP301 (Figure 2-8) with a non-conductive screwdriver to set the count difference to 200.

NOTE

Because RP301 affects the counts at 0 mmHg and 200 mmHg, repeat steps 2 through 7 until the difference is 200.

8. Set the pressure simulator to 0 mmHg.
9. Press MAIN MENU.
10. Press SENSORS > INV PRS > RESCALE.
11. Check that the displayed pressure waveform, i.e., channel noise, is no larger than 6 pixels p-p.
12. Press MAIN MENU.

CUFF Channel

NOTE

In the following steps, the monitor's displayed pressure must be checked against a calibrated mercury-column manometer.

1. Connect the cuff, manometer with bulb, and the monitor together with the Cuff Calibration Kit. See Figure 2-3.
2. Connect the extender tubing supplied with the Cuff Calibration Kit between the transducer mounted on the Main Board and the tubing that was previously disconnected from it.
3. Wrap the adult cuff around a cylindrical object about the size of an adult's arm.
4. Press SYSTEM > MORE > SERVICE > CUFF TST > CUFF CAL.

   A ten-minute timer starts in the monitor. If the following steps take longer than ten minutes, simply press CUFF CAL again.
5. Set the DMM for a 1 V measurement.
6. Connect the DMM reference lead to TP606 (Figure 2-8).
7. Connect the DMM positive lead to TP400 (Figure 2-8).
8. Adjust RP402 (Figure 2-8) for a DMM reading of -0.625 ±0.075 V.
9. Disconnect the DMM positive lead from TP400.
10. Connect the scope reference lead to TP606.
11. Connect the oscilloscope to TP400, and activate the bandwidth limiting function.
12. Check for a noise level of no greater than 60 mV.
13. Disconnect the oscilloscope from TP400.
14. Press CUFF CAL and listen for a mild "click" sound from the cuff valve.

NOTE

In the following step, if pumping the bulb does not inflate the cuff, press CUFF CAL again.

15. Close the valve on the bulb.
16. Inflate the cuff to 164 mmHg as shown on the mercury-column manometer.

NOTE

Adjustments in steps 17 and 19 are sensitive.

17. Adjust RP401 (Figure 2-8) for an A/D count of 512 ±3.
18. Deflate the cuff to 50 mmHg as shown on the mercury-column manometer.
19. Adjust RP400 (Figure 2-8) for an A/D count of 170 ±3.

NOTE

Recheck the A/D count at 164 mmHg. Adjustments of RP401 and RP400 are interactive. Repeat steps 14 to 19 until the values are as specified.

20. Connect the oscilloscope to TP401.
21. Check for a noise level no greater than 5 mV.
22. Disconnect the oscilloscope.
23. Inflate cuff to over 250 mmHg as shown on the mercury-column manometer.
24. Begin to slowly bleed the cuff at a constant rate until the mercury-column manometer reads 250 mmHg.
25. Check the monitor display for 250 ±3 mmHg.
26. Continue to bleed the cuff to each of the following manometer pressure readings and check that the monitor displays the cuff pressure within the following limits: ±3 mmHg at 250 and 200, ±2 mmHg at 100, 20 and 50.
27. Bleed cuff to 0 mmHg and check that the monitor displays 16 ±5 counts.
28. Disconnect the Cuff Calibration Kit from the monitor.
29. Disconnect the extender tube from the transducer and tubing.

    If an equipment alarm sounds, press DISABLE.
30. Press MAIN MENU.

Temperature

NOTE

The Propaq 106 does not support Electromedics temperature probes. Steps 5 and 6 below do not apply.

1. Insert a YSI 400 Series calibrated temperature probe simulator into the T1 jack.
2. Check that T1 temperature is ±0.2°F (±0.1°C) of the calibration temperature.
3. Replace the YSI 400 simulator with a YSI 700 Series probe simulator.
4. Check that T1 temperature is ±0.2°F (±0.1°C) of the calibration temperature.
5. Insert an Electromedics 2100 Series calibrated temperature probe simulator (see Table 2-2) into the T2 jack.
6. Check that the T2 temperature is ±0.2°F (±0.1°C) of the calibration temperature.
7. Disconnect all simulators from the monitor.

Functional Verification

1. Turn off the monitor and all test equipment.
2. Disconnect all cables from the monitor.
3. Close the monitor casing as described in Section 3.
4. Perform the Functional Verification procedure as described at the start of this section.

Section 3

Replacement Procedures

Introduction

This section provides instructions for removing and replacing serviceable modules in the Propaq monitor, EMP, and SpO_2 option. Instructions for the monitor are followed by instructions for the EMP and then the SpO_2 option installed either in the SpO_2 module on the rear of the monitor or in the EMP chassis.

System Software

Protocol continually works to enhance the Propaq series monitors. Appendix C lists the software revisions made to the Propaq series monitors. Enhancements often require changing the system software in the monitor. See **Replacing System Software** later in this section for a description of how to change the system software.

STATIC DISCHARGE WARNING

Propaq monitors are manufactured with static-sensitive CMOS devices. All calibration, service, and repair must be done at a static-protected work station. Failure to protect against damage due to static discharge may reduce monitor operation life and increase repairs. Any time the monitor's casing is opened, the monitor should be placed on a static protected work area.

Opening the Monitor

Follow these steps when opening the monitor case to gain access to monitor circuitry.

WARNING

High current capability of the monitor battery pack can cause personal injury and monitor damage. Remove the battery pack before opening monitor case and replacing components. See instructions in this section for replacing the battery pack.

1. Set the monitor on a static-protected work area.
2. Using a Phillips screwdriver, carefully remove the six screws securing the handle and monitor casing (refer to Figure 3-1).

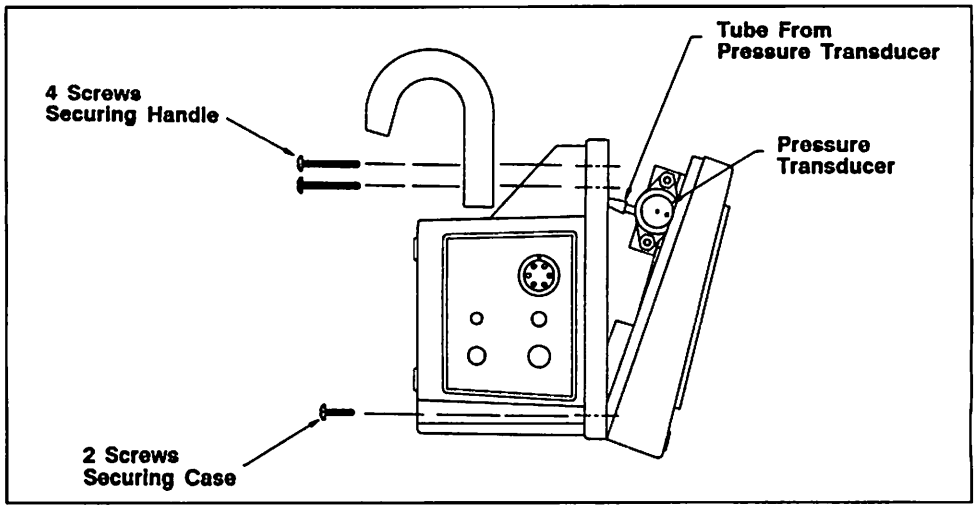

Fig. 3-1. Opening the Propaq: Screws and Transducer Tubing

CAUTION

Before opening the casing more than one inch in the next step, disconnect the tube from the pressure transducer shown in Figure 3-1. Failure to disconnect the tubing at this point may cause damage to the tubing.

3. Carefully separate the casing by spreading the two halves from the top.

NOTE

Note the dressing of cables and tubing. The Recharger Board lays in the rear chassis of the monitor with the air pump secured to it. The Main Board lays in the front chassis.

4. Disconnect the pressure transducer tube.
5. Lay the two halves apart.

   If you disconnect any cables or unplug any air hoses, note their proper locations and connection points for referral when reassembling the monitor casing.

Closing the Monitor

1. Reconnect all disconnected cables and unplugged hoses according to Figure 5-1. Refer to Table 5-1 for cable connections.
2. While closing the monitor casing, check that hoses and cables are not pinched, and reconnect the pressure transducer tube before completely closing the monitor casing.
3. Install the two bottom screws.
4. Assemble the handle to the monitor top and install the handle and the four top screws.

5. Make sure all screws are snug.
6. After reassembly, perform the verification procedures in Section 2.

Replacing the Single Battery Pack

The battery pack should be replaced when it can no longer hold a charge as described in the **Battery Capacity Test** in Section 2. For dual battery pack service, see **Replacing the Dual Battery Pack** below.

WARNING

Handle the lead-acid battery pack with extreme caution. The battery can deliver very high currents, which can cause damage and burns should it be improperly handled or connected.

1. Using a slotted screwdriver, unscrew the four screws securing the battery pack cover (Figure 3-2).
2. Disconnect the battery pack cable from the battery pack.
3. Remove the battery pack from the monitor.
4. Carefully connect the battery pack cable to the new battery pack, noting the proper polarity of the connection.

CAUTION

Use care not to pinch the battery cables when inserting the battery pack into the monitor.

5. Place the new battery pack into the monitor as shown in Figure 3-2.
6. Replace the cover and secure the screws.

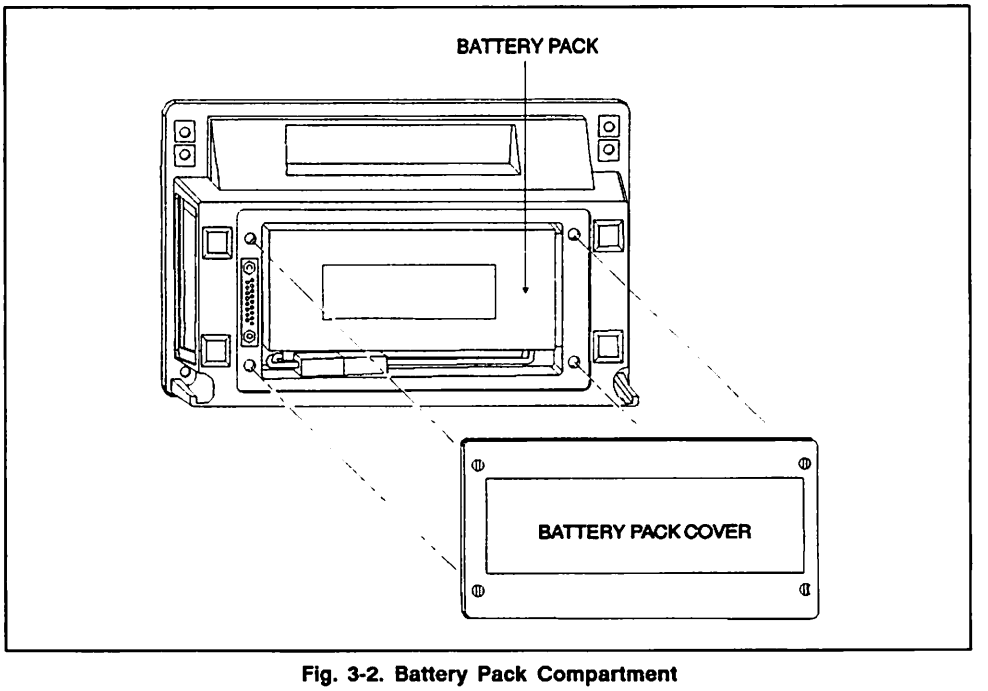

Fig. 3-2. Battery Pack Compartment

Replacing the Dual Battery Pack

The dual battery pack should be replaced when it can no longer hold a charge as described in the **Battery Capacity Test** in Section 2. For single battery pack service, see **Replacing the Single Battery Pack** above.

The dual battery pack is used in both the EMP and the monitor with SpO_2 module. Replacement for both installations is similar. The following instructions refer to illustrations later in this section.

Dual Battery in EMP

NOTE

Besides the four screws securing the EMP to the monitor, four additional screws secure the rear panel of the EMP to the EMP chassis. Do not remove these screws.

1. Using a Phillips screwdriver, remove four screws (identified as A in Figure 3-13 later) from the EMP rear panel.

WARNING

The Propaq sealed lead-acid battery pack is capable of quickly delivering dangerously high currents if improperly handled, misused, or abused. These current levels may burn skin or damage the Propaq. Use extreme caution when handling the battery pack in the next steps.

2. Slide the monitor forward until you can disconnect the battery pack cable from the monitor's power cable (Figure 3-14 later).
3. Slide the monitor forward until it can be completely separated from the EMP.
4. Slide the dual battery pack forward out of the EMP until the battery connector can be reached (Figure 3-15 later).
5. Disconnect the battery connector from the EMP.
6. Remove the dual battery pack from the EMP.

CAUTION

Use care not to pinch the battery cables when inserting the dual battery pack into the EMP.

7. Place the new dual battery pack into the EMP.
8. Connect the battery connector to the EMP.
9. Slide the dual battery pack into the EMP.
10. Slide the monitor onto the EMP as shown in Figure 3-14 later in this section.
11. With the monitor and EMP slightly separated, connect the battery cable to the monitor power cable (Figure 3-14 later).
12. Slide the monitor completely onto the EMP and secure with the four screws removed earlier.

Dual Battery in SpO_2 Module

1. Using a Phillips screwdriver, remove four screws from the SpO_2 module rear panel (see drawing #824-0106-XX, Sheet 2, in Section 5, *Diagrams*).

WARNING

The Propaq sealed lead-acid battery pack is capable of quickly delivering dangerously high currents if improperly handled, misused, or abused. These current levels may burn skin or damage the Propaq. Use extreme caution when handling the battery pack in the next steps.

2. Slide the monitor forward until you can disconnect the battery pack cable from the monitor's power cable (drawing #824-0106-XX, Sheet 2).
3. Slide the monitor forward until it can be completely separated from the SpO_2 module.
4. Remove the dual battery pack.
5. Place the new dual battery pack into the SpO_2 module.
6. Slide the dual battery pack into the SpO_2 module.
7. Slide the monitor onto the SpO_2 module as shown on drawing #824-0106-XX, Sheet 2, in Section 5, *Diagrams.*
8. With the monitor and SpO_2 module slightly separated, connect the battery cable to the monitor power cable (drawing #824-0106-XX, Sheet 2).
9. Slide the monitor completely onto the SpO_2 module and secure with the four screws removed earlier.

Replacing the Lithium Battery

The lithium battery maintains programmed defaults and time of day. Without the Lithium battery, the values for these items return to the factory settings. If the power up error messsage "INVALID DEFAULT DATA: TIME/DATE SETTINGS LOST" is displayed, check the lithium battery.

WARNING

The lithium battery used in this monitor may present a fire or chemical burn hazard if mistreated. Do not recharge, disassemble, heat above 100°C (212°F) or incinerate. Replace the battery with Duracell Inc., Cat. No. DL2032 or Matsushita Electric, Cat. No. BR-2032 only. Use of another battery may present a risk of fire or explosion.

1. Open the monitor casing as described earlier.
2. Refer to Figure 3-5 for the location of the lithium battery.

NOTE

When removing the battery, do not bend the spring clip on the battery socket.

3. Remove the battery.
4. Measure the battery voltage.

   The battery should be replaced if it measures less than 2.9 V.

   Replace the battery only with either Duracell, Inc., Cat. No. DL2032, or Matsushita Electric, Cat. No. BR-2032. See Section 6 for replacement part numbers.

WARNING

Dispose of used battery promptly. Keep away from children. Do not disassemble and do not dispose of in fire.

5. Close monitor casing as described earlier.
6. Reprogram the monitor's defaults and set the time of day using the System Menu.

   See the *Propaq User's Guide* for more information.

Replacing Fuses

There are two fuses located on the Recharger Board. Fuse locations are shown in Figure 3-3. Fuse F1 protects the recharger input at the ac power adapter connector. Fuse F2 protects the Main Board power supply input at the battery line to the Main Board. If the monitor does not turn on but the **BATTERY CHARGING** indicator lights when the ac power adapter is connected, check fuse F2 (3 Amp).

If the monitor will not accept a charge from the ac power adapter but you believe the power adapter is functional and you notice that the green **BATTERY CHARGING** indicator is off, check fuse F1 (3 Amp).

CAUTION

Fuses are heat sensitive and must be soldered with heat sinks in place between the fuse body and the solder joint.

See Section 6 for replacement part numbers.

Replacing the Air Filter

The air filter keeps the air to the cuff relatively clean. If the filter becomes clogged with accumulated dust, smoke, or other debris, the air pump will not be able to inflate the cuff.

The filter is located inside the back half of the monitor casing (Figure 3-4). It is tucked into the back half next to the pump, but can easily be replaced after the casing has been separated.

1. Open the monitor as described earlier.

2. Reach into the cavity where the filter is located and slide out the filter.
3. Remove the tubings from the filter and attach a new filter.
4. Carefully tuck the filter and tubing back in place.
5. Close the monitor as described earlier.

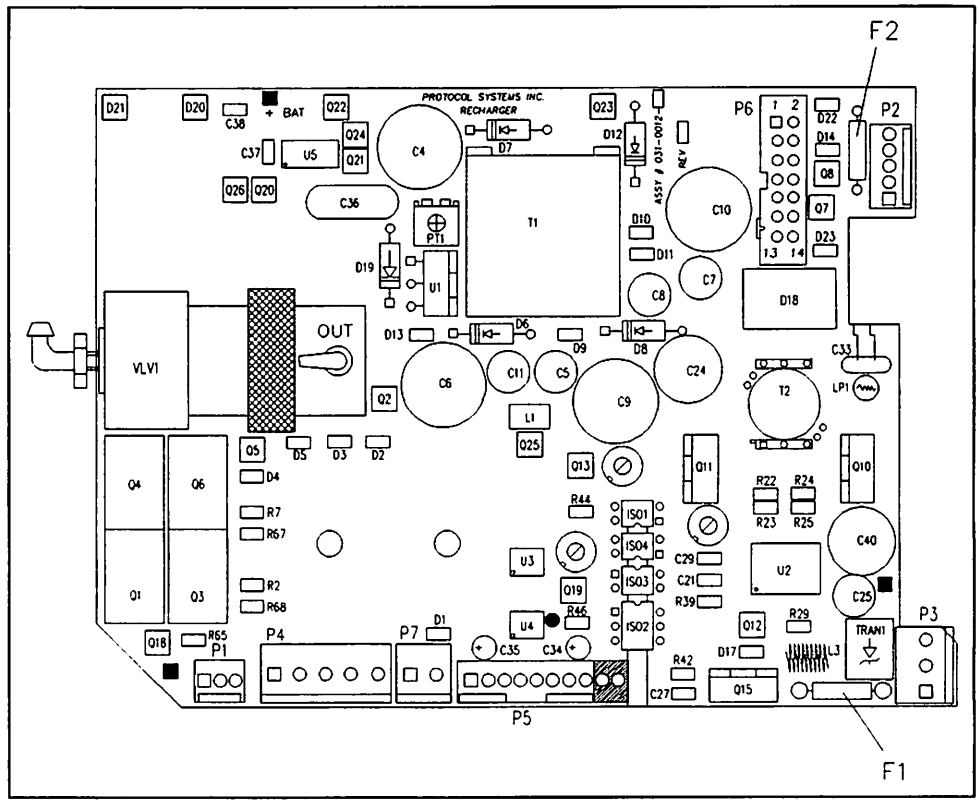

Fig. 3-3. Fuse Locations

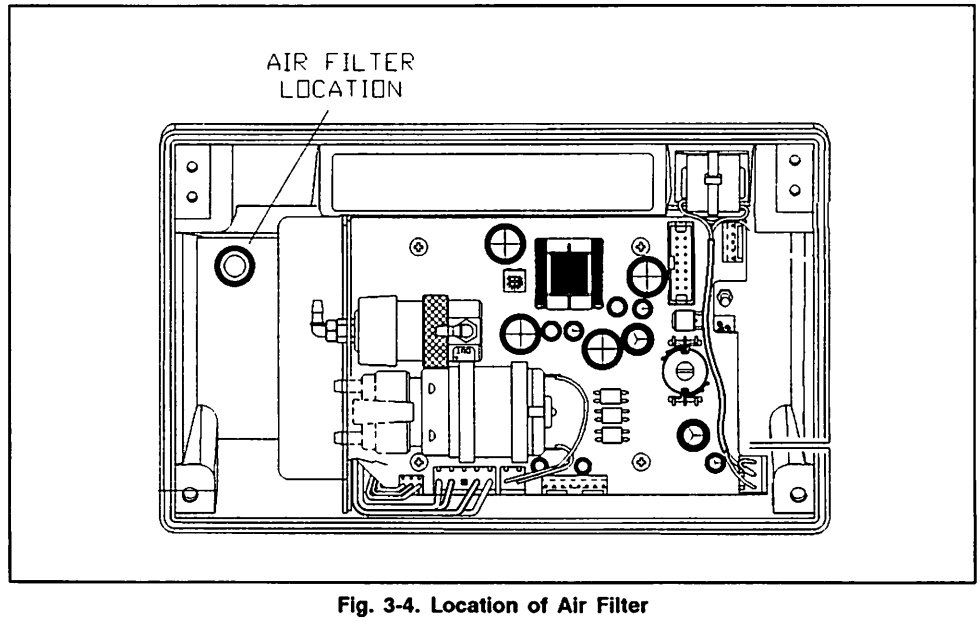

Fig. 3-4. Location of Air Filter

Replacing Air Tubing

Refer to Section 5 for plumbing layouts and lengths of tubing. If plumbing must be replaced, see Section 6 for part numbers.

Air problems can be due to restricted air flow or air leaks. Restricted air flow can be due to blocked tubing, a clogged air filter, or more likely, pinched tubing. Air leaks can be due to tubing and fittings, cuff overpressure valve, check valve, 0-rings in the cuff hose fittings, or the bleed valve.

If the monitor displays **KINKED HOSE** or **BLOCKED VENT** messages, check the following in order:

- an obstruction of the cuff vent on the side panel
- pinched or kinked tubing
- torn tubing
- the condition of the filter (see **Replacing The Air Filter** earlier)

Firmly pull on the air tubing to disconnect it from its respective fitting. Replace it with the identical length and type of tubing. Section 5 contains plumbing diagrams. See Section 6 for the tubing part number.

Replacing Cables

Figure 5-1 and Table 5-1 identify the locations of cables and their connections. Refer to this figure and table when disconnecting and reconnecting cables.

If you suspect a cable to be faulty, check its continuity on all pins. If you need to replace a cable, see Section 6 or contact Protocol Systems for part numbers.

Replacing System Software

The system software is contained in pre-programmed PROMs on the Main Board. As upgrades to the system software are made available, these PROMs should only be exchanged with new PROMs.

NOTE

The PROMs should only be removed by a special tool available from Protocol Systems (PROM Removal Tool—PN 850-0053-XX). The following instructions describe how to replace the system software.

CAUTION

The PROMs and other components in the Propaq monitor can be damaged by static discharge. Work only at a static-protected work station.

1. Open the monitor casing as described earlier.

   The system software is contained in two PROMs located on the Main Board (Figure 3-5).

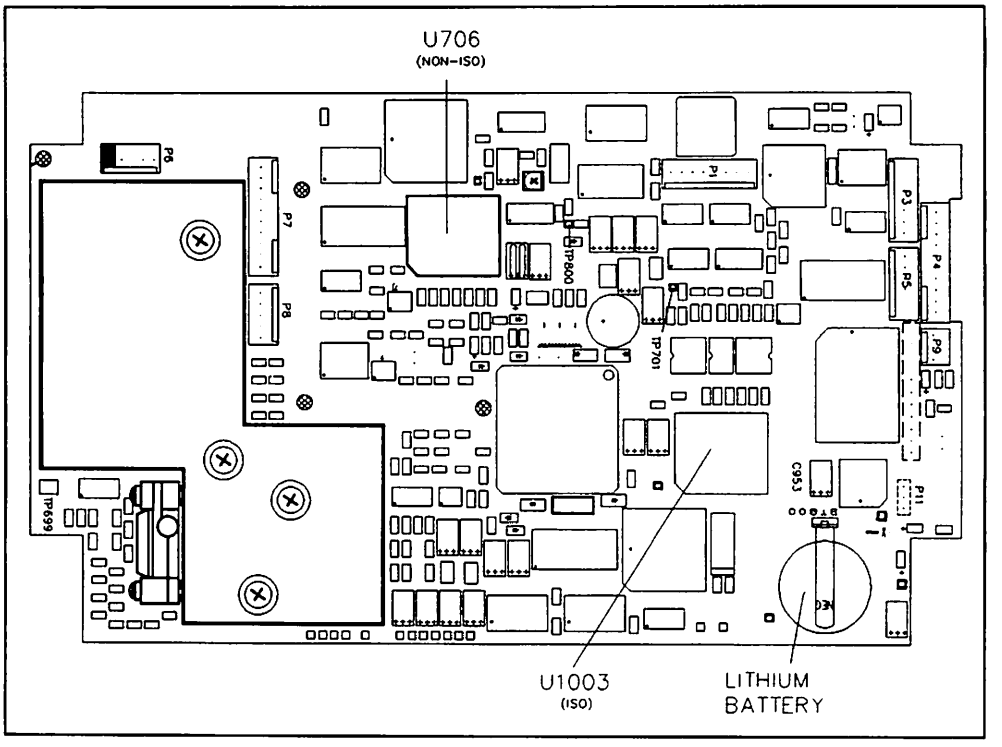

Fig. 3-5. Location of System Software PROMS and Lithium Battery

2. Insert the PROM Removal Tool over one of the PROMs as shown in Figure 3-6.

3. Applying a slight downward force, squeeze together the handles until the PROM lifts out.

NOTE

Be sure to put the PROMs in their proper locations according to the information supplied with the PROMs.

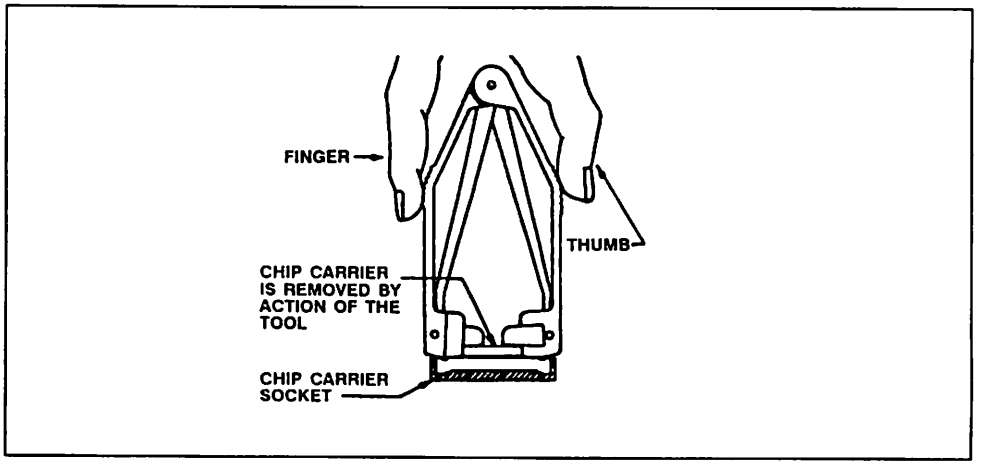

Fig. 3-6. Using the PROM Removal Tool

4. Orient the new PROM to properly fit into the socket.

   Both the socket and PROM are keyed for proper orientation. In addition, the dot on the top of the PROM should be matched with the arrow in the bottom of the socket for proper orientation.

   CAUTION

   Do not force the PROM in place, especially if it is improperly oriented. Damage to the PROM and socket can result.

5. Carefully and with even pressure press the new PROM into place, taking care not to press it in tilted.
6. Repeat steps 2 through 5 for the second PROM.
7. Close the monitor.

Servicing Cuff Fittings

Air system integrity in the CUFF channel is essential to accurate measurements. Leaky cuff fittings or air bladder can cause cuff error messages and erroneous cuff measurements. A leak rate test described in the CUFF Channel Functional Verification procedure, Section 2, can help identify air leaks.

WARNING

Use of Cuff channel with leaking cuff hose fittings may result in inaccurate non-invasive blood pressure measurements.

Routine wear to the O-ring located within the threaded fitting on the cuff hose requires occasional replacement of the O-ring to ensure system air-seal integrity. Replace O-ring according to the following instructions.

1. Disconnect the cuff hose from the monitor's cuff connector.
2. Using pliers, pull off the metal fitting from the cuff hose as shown in Figure 3-7.
3. Using cutters, cut approximately 1/2" off the cuff hose.
4. Using a small screwdriver, remove the C-clip from the fitting as shown in Figure 3-8.
5. Remove the knurled nut from the fitting.

   The O-ring is now accessible.

6. Remove the O-ring and replace it with one from the kit.

   Take care while installing a new O-ring not to "nick" or otherwise damage the new O-ring.

7. Reassemble the fitting with the knurled nut and C-clip.
8. Press the fitting back onto the cuff hose.

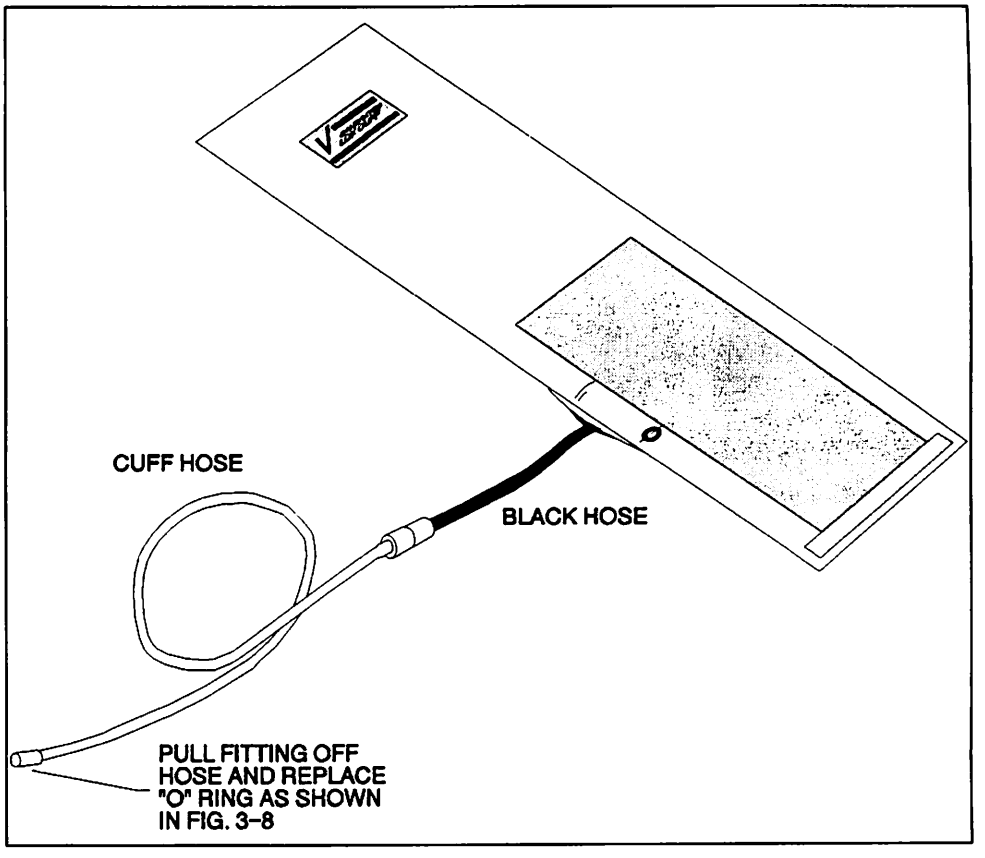

Fig. 3-7. Replacing Cuff Hose Fittings

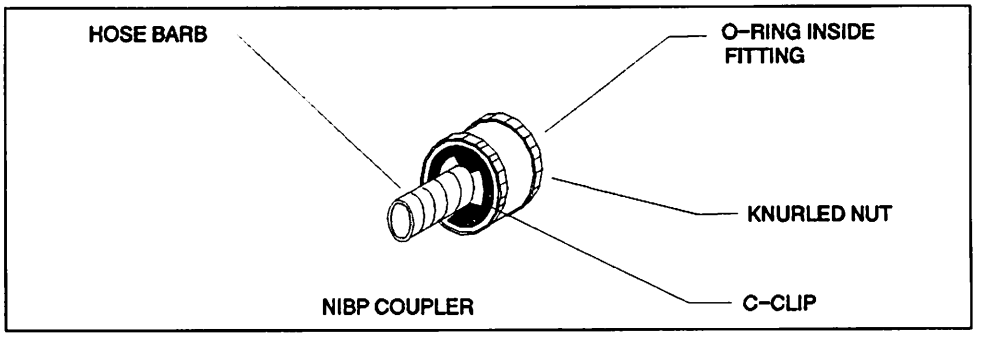

Fig. 3-8. Disassembling the Metal Cuff Fitting

Replacing the Main Board

This section provides instructions on removing and installing a Main Board.

CAUTION

Work only at a static-protected work station while disassembling the Propaq.

The Main Board is secured to the Propaq front chassis by five screws. When removing the Main Board, note the location of cables and screws and screw lengths. Handle the protective insulating paper carefully to avoid damaging it.

Removing Main Board

1. If an EMP is attached to the monitor, separate the two according to the procedures in **Separating EMP from Monitor** later in this section.
2. Open the monitor as described in **Opening the Monitor** in this section.

   Be sure to disconnect the pressure transducer tubing before opening the monitor more than two inches.
3. Disconnect all cables from the Main Board (Figure 3-9).
4. Remove the five screws securing the Main Board to the front chassis. Note that the two longer screws hold the plastic support spacer.

   Do not attempt to remove the Main Board yet. Although the Main Board is not secured to the front chassis, it is still connected to the Main Interconnect board by two flexible cables on the back side of the board.
5. Lift the Main Board about two inches.

   CAUTION

   The flexible cables to be removed in the next step have pin connectors that can become bent if the cables are improperly removed.
6. Reach under the Main Board and carefully disconnect the flexible cable by using tweezers or needle-nose pliers to pull the cables straight down away from the Main Board.

   Take care not to bend the pins on the ends of the cables.
7. Carefully lift out the Main Board.

   Key contact areas are located on the opposite side of the Main Board. Flexible key contacts from the front panel buttons often "stick" to the Main Board as it is removed. These flexible contacts should be removed from the board and set aside.

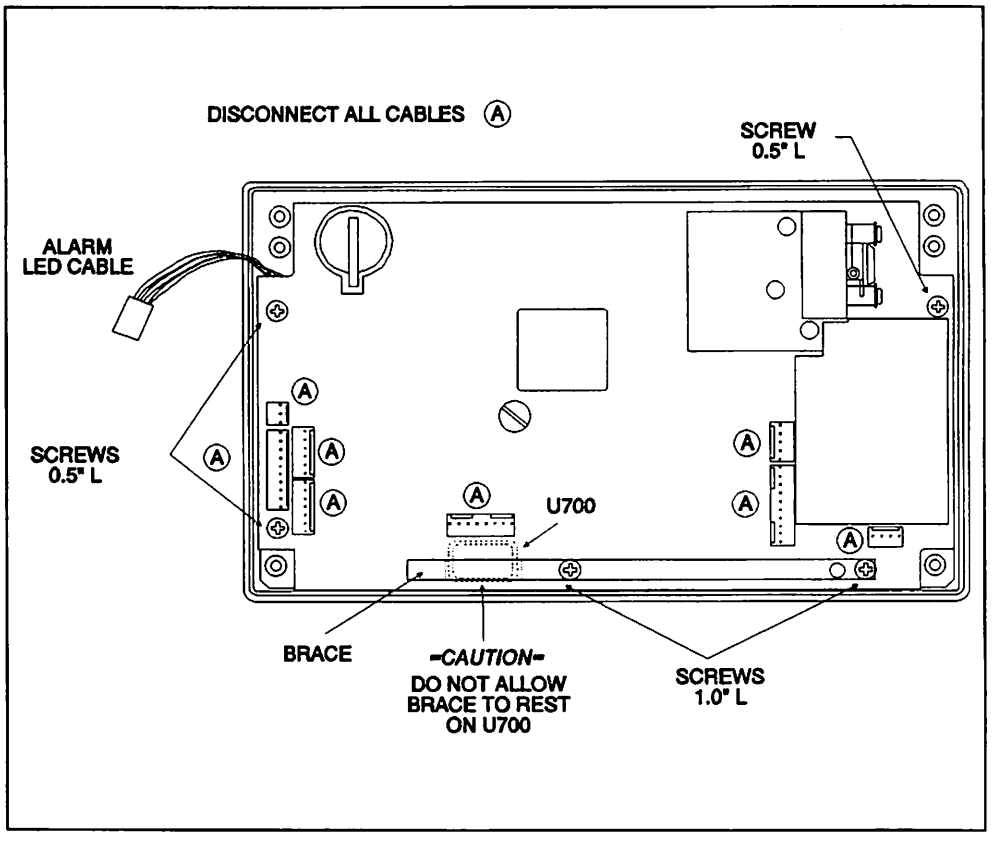

Fig. 3-9. Main Board Screws, Connectors and Cables

Installing Main Board

CAUTION

When handling the Main Board, do not touch the button contact surfaces. These surfaces should remain clean and oil-free. If you do touch them, clean them with a cotton swab dipped in isopropyl alcohol or freon.

1. Check that the protective insulating paper is in place and properly fastened to the Main Interconnect Board with the two plastic fasteners.
2. Set the five flexible key contacts in the opening to the pushbutton housings.

   The contacts should be centered on the button with the protrusion entering the button cavity.
3. Carefully connect the flexible cables to the Main Board.
4. Check the routing of the alarm LED cable as shown in Figure 3-9.

   The routings of these cables are critical to prevent pinching of the cables when the Main Board is secured to the front chassis.

5. Set the Main Board in place, watching the alignment of the flexible key contacts and Main Board.

NOTE

Using tweezers in the next steps to place the screws can make screw placement easy.

CAUTION

Use caution when positioning the plastic brace and tightening the screws, as described in the next three steps, to avoid damaging the U700 oscillator located under the brace (see Figure 3-9).

6. Place the screws in the Main Board, beginning with the two one-inch screws that go through the plastic brace.
7. Before tightening the screws, check that the brace is in place (not caught on the lip of U700) and check the routing of the alarm LED cable.
8. Tighten (7 in-lbs) the screws securing the Main Board.
9. Set the Propaq rear chassis next to the front chassis and reconnect all cables to the Main Board.
10. Close the monitor as described in **Closing the Monitor** in this section.
11. If an EMP was attached, re-attach the EMP as described in **Attaching the EMP** in this section.

Replacing EL Front Panel Components

The EL Front Panel components discussed here include the Main Interconnect board, the EL Display Subassembly, the Display Window and associated parts referenced on drawing #824-0149-XX in Section 5, *Diagrams.*

CAUTION

The Main Interconnect Board and the EL Display Subassembly cannot be removed without the possibility of causing damage to the electronically-conductive silicone gasket between the EL Display Subassembly and the Display Window.

If you find it necessary to disassemble the front panel, first contact Protocol Systems, Inc., Service Support Group, for advice.

Replacing the Recharger Board

CAUTION

Work only at a static-protected work station while disassembling the Propaq. The Recharger Board is secured to the Propaq rear chassis by four screws. When removing the Recharger Board, note the location of cables, plumbing, and screws and screw lengths.

Removing Recharger Board

1. If an EMP is attached to the monitor, separate the two as described in **Separating EMP From Monitor** in this section.
2. Open the monitor as described in **Opening the Monitor** in this section.

   Be sure to disconnect the pressure transducer tubing before opening the monitor more than one inch.
3. Disconnect all cables from the Main Board (Figure 3-9).

   The Propaq front and rear chassis should now be separated. Place the front chassis off to the side.
4. Disconnect the air tubing attached to the valve and pump (Figure 3-10).
5. Disconnect all cables from the Recharger Board as shown in Figure 3-10.
6. Move cables out of the way.

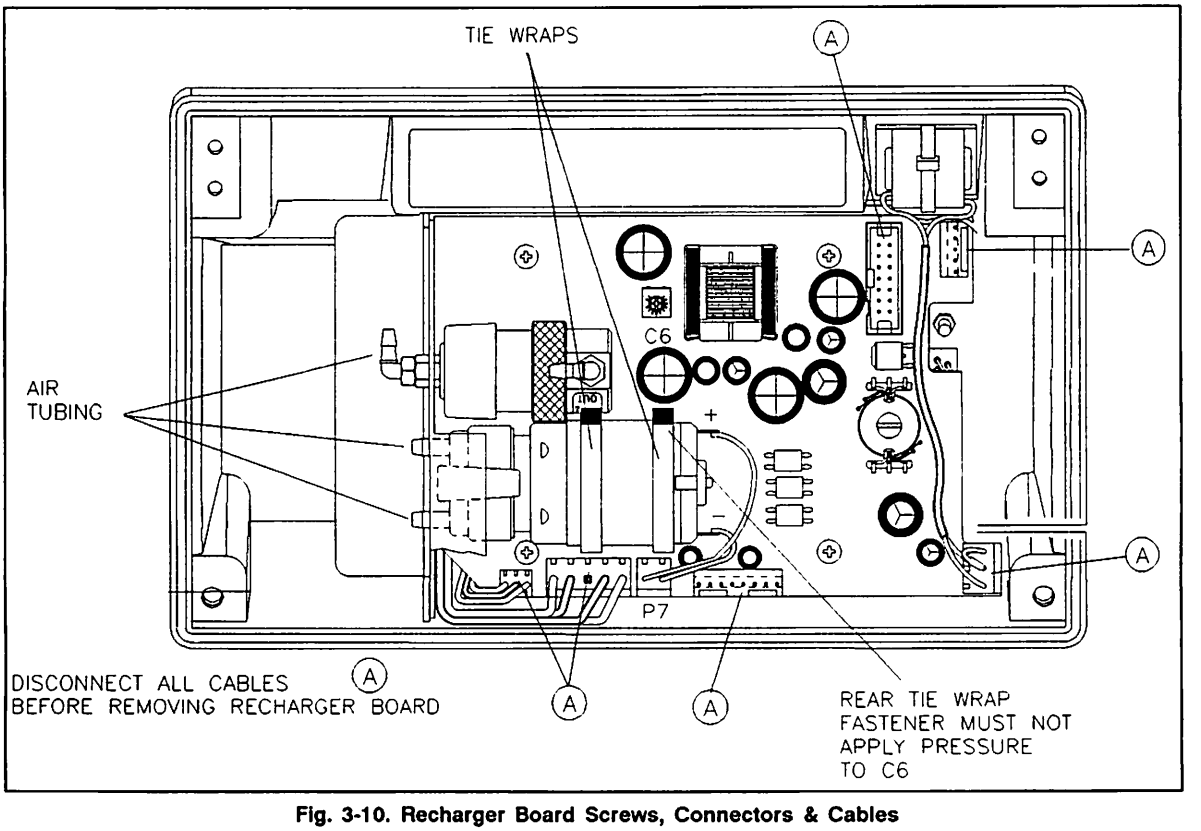

Fig. 3-10. Recharger Board Screws, Connectors & Cables

7 Remove the four screws securing the Recharger Board to the rear chassis.

8. Carefully lift out the Recharger Board.

9. Remove the protective insulating paper from the board.

   The protective paper should be saved for installing the new Recharger Board.

NOTE

If the pump needs to be replaced, see replacement instructions elsewhere in this section. Return to ***Installing Recharger Board*** *below when replacement has been done.*

Installing Recharger Board

1. Place the protective insulating paper on the Recharger Board.

2. Move all cables out of the way.

CAUTION

As you set the board in place in the next step, take care around the power switch. If the Recharger Board binds against the switch solder points, the solder points can become damaged if force is applied to the board.

3. Set the Recharger Board in place, carefully routing the cables.

4. Set the screws in place.

5. Align the board and protective insulating paper, and recheck the routing of all cables.

6. Tighten all screws.

7. Reconnect all cabling and plumbing.

8. Reconnect all cables between the Recharger and Main Boards.

9. Close the monitor as described in **Closing the Monitor** in this section.

10. If an EMP was attached, re-attach the EMP as described in **Attaching the EMP** in this section.

Replacing the Pump

CAUTION

Work only at a static-protected work station while disassembling the Propaq.

Removing Pump

1. Remove the Recharger Board as described in **Removing Recharger Board** in this section.
2. With the Recharger Board out of the rear chassis, unplug the pump cable from the Recharger Board.

   New wires and connector are provided with the replacement pump kit.
3. Cut the tie wraps securing the pump to the Recharger Board.
4. Lift pump from board, and remove old tie wraps from support brackets.

Installing Pump

Refer to assembly drawing 824-0170-XX in Section 5 for greater detail.

1. Slide new tie wraps into support brackets (install wraps from the right).
2. Set the pump onto the Recharger Board, oriented so that ports are down (nearest board and support brackets; see Figure 3-11).
3. Secure the pump to the Recharger Board with tie wraps, aligning the fastener ends and cutting excess ends from tie wraps as shown in Figure 3-11. Position the rear fastener so as to avoid putting pressure on capacitor C6 (shown in Figure 3-10).
   (The tie wrap fasteners must be placed as shown in the figures to allow the monitor to properly close.)

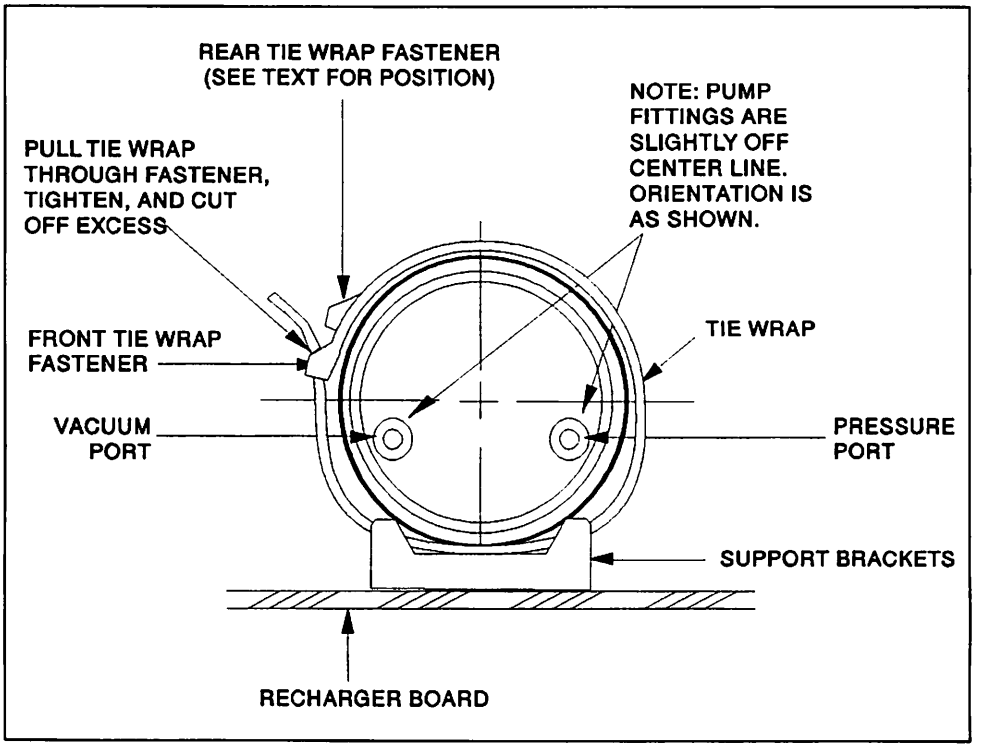

Fig. 3-11. Proper Pump Orientation

4. Plug in the pump cable to connector P7 on the Recharger Board (see Figure 3-10).
5. Install the Recharger Board as described in **Installing Recharger Board** in this section.
6. If an EMP was attached, re-attach the EMP as described in **Attaching the EMP** in this section.

Replacing the Side Panels

Propaq side panels are complete assemblies requiring only to be set in place, secured, and the cables or plumbing connected.

Side panels are sealed to the Propaq rear chassis with a gasket. A new gasket is provided with the new side panel kit. Refer to assembly drawing 824-0150-XX, Sheet 3, in Section 5 when removing or installing side panels.

Removing Side Panels

1. Open the monitor as described in **Opening the Monitor** in this section.
2. **To Remove Right Side Panel**—remove the Recharger Board as described in **Removing Recharger Board** in this section; cut and remove the tie wrap securing the coil connected to the side panel.

   Remove the two right side panel clamps. They can be removed by inserting the end of a needle-nosed pliers in the small hole in the end of the clamp and pulling outward.
3. **To Remove Left Side Panel**—disconnect the plumbing at the pump and valve; disconnect the cables between the side panel and the Main Board.

   Remove the U-shaped clamp that secures the left side panel assembly as shown in Figure 3-12. Place the end of a flat-bladed screwdriver between the metal clamp and the side panel assembly and rotate the screwdriver to loosen the clamp. Using a long-nosed pliers, slide the clamp free.
4. Carefully press the side panel out of the rear chassis. (There is an adhesive gasket around the side panel which requires considerable force to separate.)
5. If replacing the left side panel, disconnect all plumbing from the side panel.

   Save the plumbing for reconnection to the new side panel.

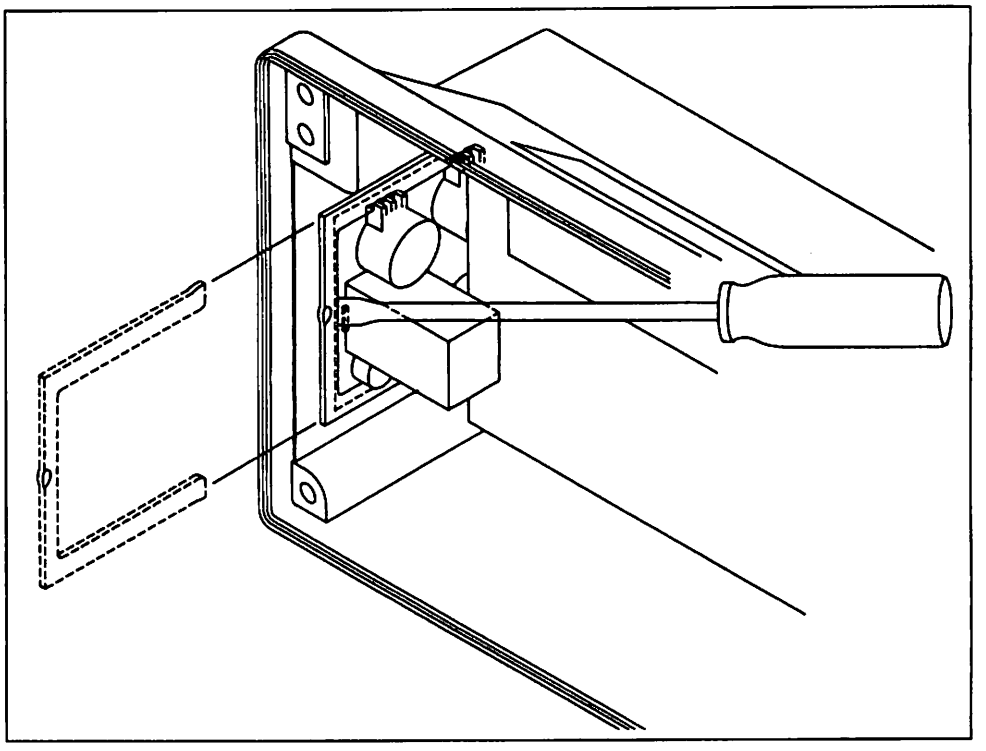

Fig. 3-12. Removing the Left Side Panel Clamp

Installing Side Panels

1. Clean all gasket material from the rear chassis where the side panel is to be installed.
2. On the new side panel, remove the protective paper from the gasket attached to the side panel.

   NOTE

   Uncovering the protective paper exposes the adhesive on the gasket. Do not touch or otherwise contaminate the adhesive, or the adhesive may not properly seal the side panel.

3. Set the side panel in place. Slightly bend up wires at the left side panel P1 and P2 pressure connector pins to allow proper fit.

   Make sure the side panel sets all the way in place (it should be flush with the exterior of the rear chassis). If not properly fitted, the clamp securing the side panel will not be allowed to seat.

4. Apply slight pressure to seal the side panel in the rear chassis.

   CAUTION

   Do not force the clamp in the next step. Forcing it may damage the side panel or rear chassis.

5. Carefully slide the clamp(s) in place.

   If the clamp requires excessive pressure to slide in place, remove the clamp and check the side panel to be sure it is completely seated.

6. Connect all plumbing and cables. Refer to Figure 5-1 and the NIBP AIRWAY FITTINGS drawing in Section 5 for proper connections.
7. If installing the right side panel, install a new tie wrap inside the rear chassis and secure the coil connected to the side panel; install the Recharger Board as described in **Installing Recharger Board** in this section.
8. Close the monitor as described in **Closing the Monitor** in this section.
9. If an EMP was attached, re-attach the EMP as described in **Attaching the EMP** in this section.

Separating EMP From Monitor

The Monitor is secured to the EMP with four screws as shown in Figure 3-13.

NOTE

Besides the four screws securing the monitor, four additional screws secure the rear panel of the EMP to the EMP chassis. Do not remove these screws.

1. Using a Phillips screwdriver, remove four screws (identified as A in Figure 3-13) from the EMP rear panel.

WARNING

The Propaq sealed lead-acid battery pack is capable of quickly delivering dangerously high currents if improperly handled, misused, or abused. These current levels may burn skin or damage the Propaq. Use extreme caution when handling the battery pack in the next steps.

2. Slide the monitor forward until you can disconnect the battery pack cable from the monitor's power cable (Figure 3-14).

   The battery pack should remain in the EMP chassis.

3. Slide the monitor forward until it can be completely separated from the EMP.

The EMP can now be disassembled according to the instructions in this section.

CAUTION

Further disassembly of the Propaq or EMP should be done at a static-protected work station. See the static discharge warning at the beginning of this section.

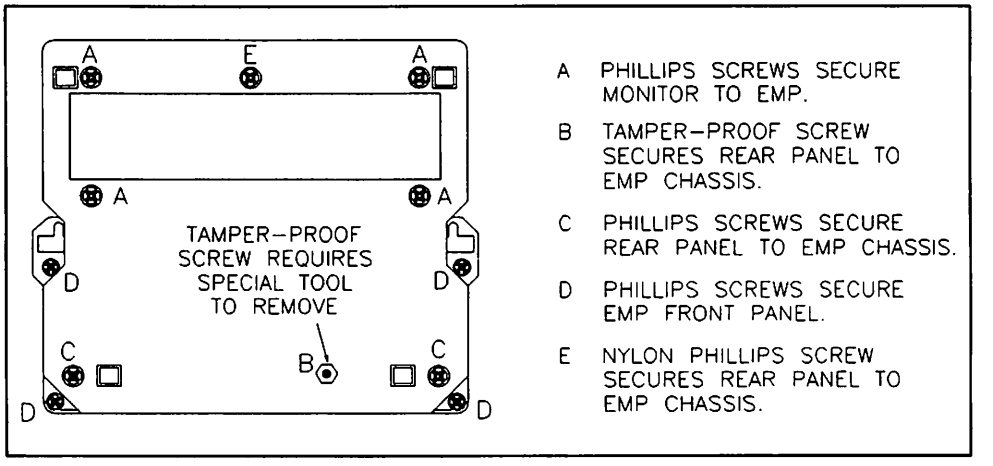

Fig. 3-13. EMP Securing Screws

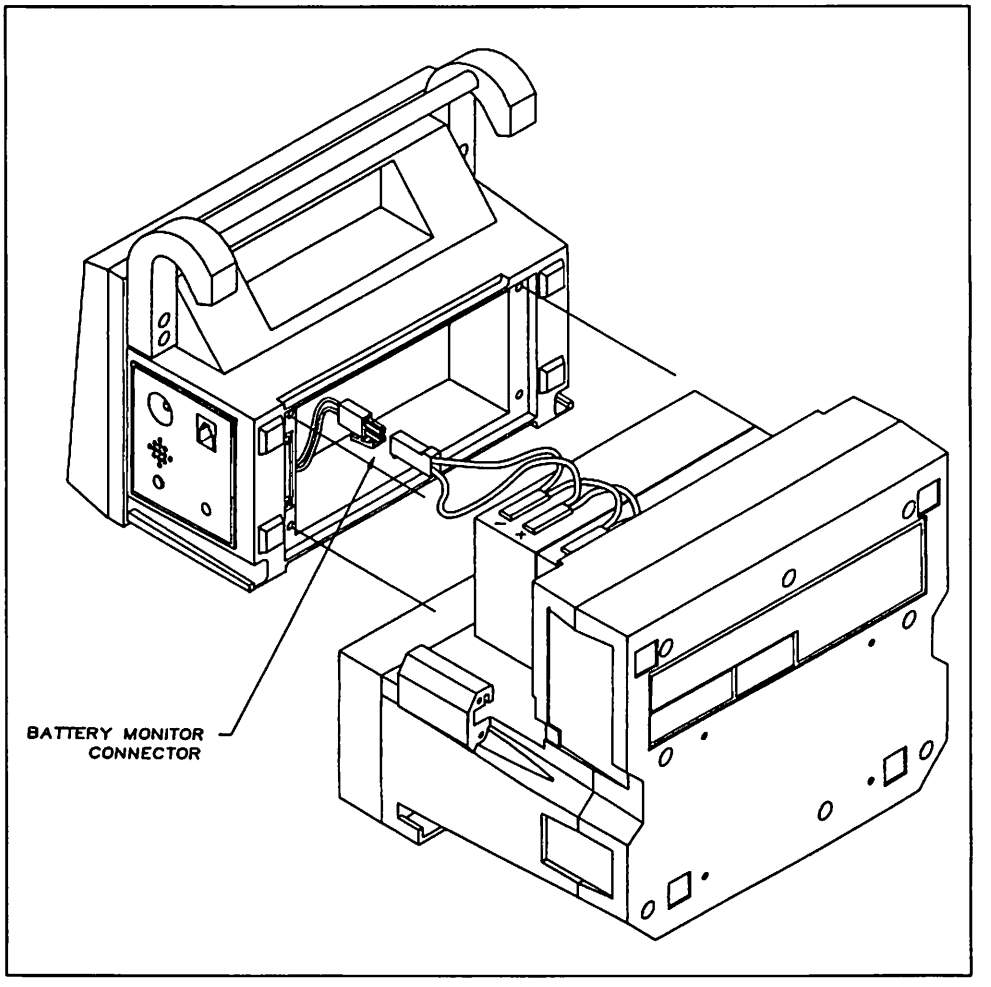

Fig. 3-14. Disconnecting Monitor from EMP/Battery Pack

Attaching the EMP

The following information describes how to attach an EMP to a Propaq monitor.

WARNING

The Propaq sealed lead-acid battery pack is capable of quickly delivering dangerously high currents if improperly handled, misused, or abused. These current levels may burn skin or damage the Propaq. Use extreme caution when handling the battery pack in the next steps.

1. Slide the assembled monitor onto the EMP as shown in Figure 3-14.
2. With the monitor and EMP separated a few inches, connect the battery cable to the monitor power cable as shown in Figure 3-14.
3. Slide the monitor completely onto the EMP.
4. Secure the monitor to the EMP with the four screws removed earlier.

Opening the EMP

NOTE

The EMP rear panel is secured to the EMP chassis by four screws (Figure 3-13). One of these screws is a tamper-proof screw (indicated as B in Figure 3-13) that requires a special tool to remove (tamper-proof screwdriver tip, Protocol PN 850-0065-XX).

1. Separate the EMP from the monitor as described in **Separating EMP From Monitor** in this section.

WARNING

The Propaq sealed lead-acid battery pack is capable of quickly delivering dangerously high currents if improperly handled, misused, or abused. These current levels may burn skin or damage the Propaq. Use extreme caution when handling the battery pack in the next steps.

2. Carefully slide out the battery pack from the EMP chassis.
3. Disconnect the EMP power cable from the battery pack (Figure 3-15).
4. Set the battery pack aside.
5. Using the special tamper-proof screwdriver, remove the tamper-proof screw from the EMP rear panel.
6. Remove the remaining three Phillips screws.

   Note the lengths and positions of the three screws.
7. Remove the EMP rear panel from the chassis.

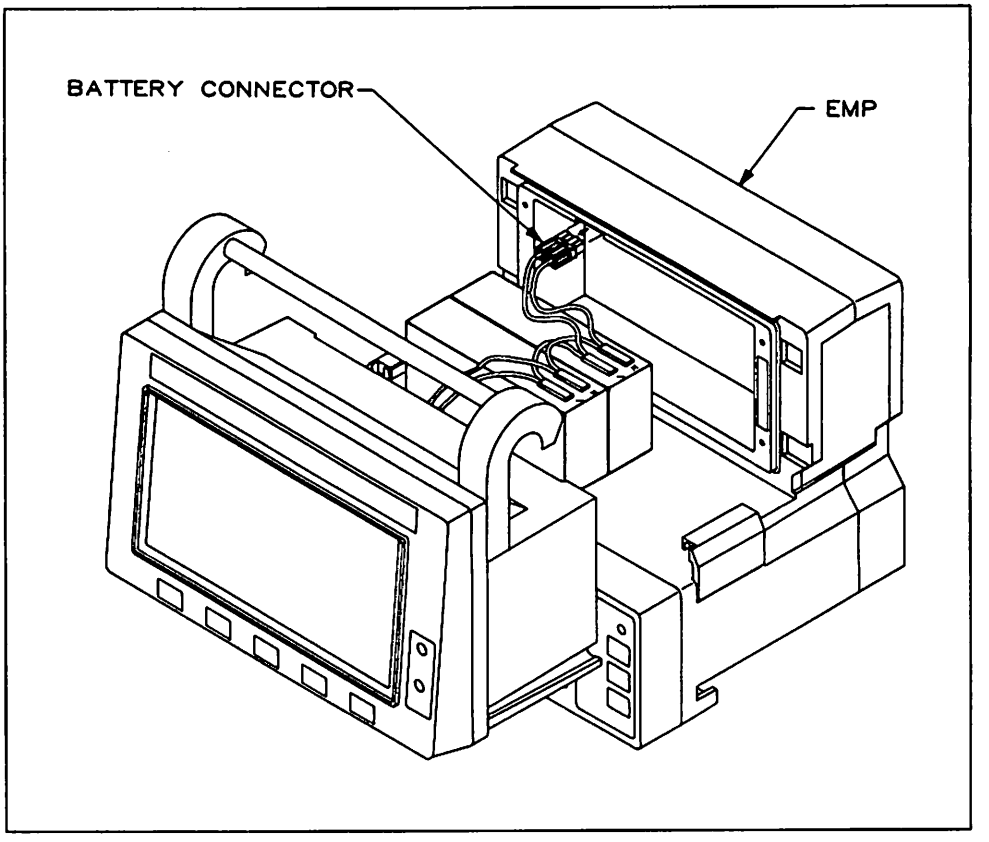

Fig. 3-15. Disconnecting Battery from EMP

NOTE

The rear panel is sealed to the chassis with rubber gaskets around the perimeter of the rear panel. These gaskets can be reused when reassembling the EMP. Save these gaskets.

Further disassembly of the EMP can now be done according to the procedures in this section.

CAUTION

Work only at a static-protected work station while disassembling the EMP any further.

Closing the EMP

Make sure all cables are in place and the gaskets removed earlier are available.

CAUTION

Work only at a static-protected work station while handling the EMP.

1. Set the rubber gaskets in their proper places as shown in Figure 3-16.
2. Carefully set chassis onto rear panel, seeing that no gasket slips out of its channel and becomes pinched between rear panel and chassis.

CAUTION

To prevent damage to EMP chassis, make sure that the spacers are in place as shown in Figure 3-16. The chassis may crack if screws are tightened without the spacers in place. Note that the 5 upper spacers are not used when the SpO_2 module is present.

3. With the rear panel in place, insert the three Phillips screws and the tamper-proof screw (as shown in Figure 3-13) and tighten.
4. Set the battery pack on the rear chassis, leaving enough clearance to connect the EMP power cable to the battery pack (Figure 3-15).
5. Connect the EMP power cable to the battery pack.
6. Slide the battery pack into the EMP chassis.
7. Install the monitor as described in **Attaching the EMP** in this section.

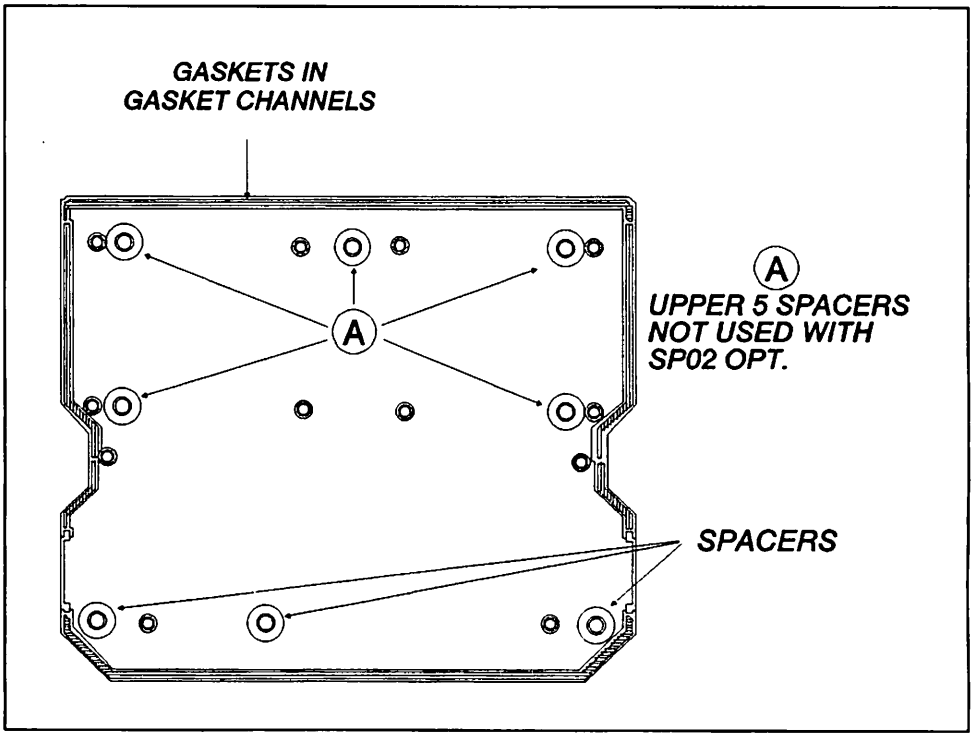

Fig. 3-16. EMP Rear Panel Gasket Channels and Gaskets

Replacing the Printer

This section provides instructions on removing and installing the printer mechanism and power supply board. These two components are provided as a replacement unit called the printer assembly.

Removing Printer

Remove the printer assembly according to the following instructions.

CAUTION

Work only at a static-protected work station while disassembling the EMP.

1. Separate the monitor and EMP as described in **Separating EMP From Monitor** in this section.
2. Open the EMP as described in **Opening the EMP** in this section.
3. Remove the EMP front panel as described in **Removing EMP Front Panel** in this section.
4. Disconnect the battery cable and expansion cable from the EMP power supply board as shown in Figure 3-17.
5. Completely open the paper door.
6. Remove the paper from the printer.
6. Carefully slide the printer assembly out the front of the chassis, noting the proper positioning of the paper door mechanism shown in Figure 3-18.

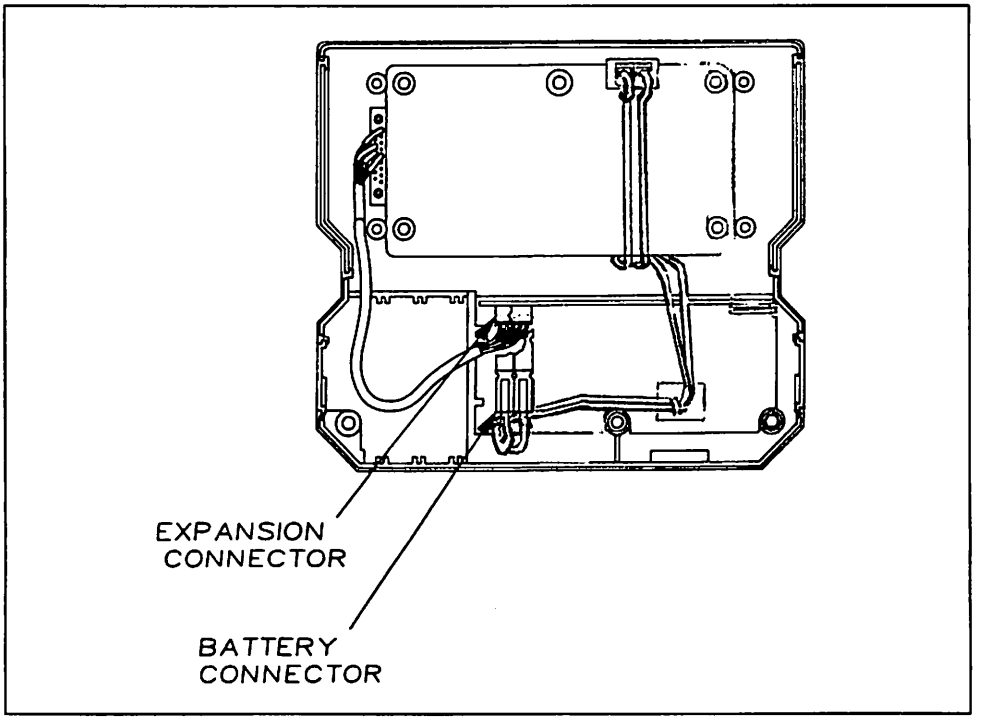

Fig. 3-17. Disconnecting Cables from Printer Main Board

Installing Printer

1. Completely open the paper door.
2. Turn the printer assembly so the printer mechanism is on the bottom and the power supply board is on top.
3. On the printer assembly, make sure the swivel bracket (labeled "Print Head Latch" in Figure 3-18) is down.
4. Carefully slide the printer assembly into the guides as shown in Figure 3-18, noting that the paper door pin slides into the print head latch on the printer mechanism.
5. Connect the battery cable and expansion connector cable to the power supply board (Figure 3-17). To properly dress the battery cable, refer to assembly drawing 824-0069-XX, sheet 3, in Section 5, *Diagrams.*
6. Replace the EMP front panel as described in **Installing EMP Front Panel** in this section.
7. Close the EMP as described in **Closing the EMP** in this section.
8. Attach the EMP to the monitor as described in **Attaching the EMP** in this section.

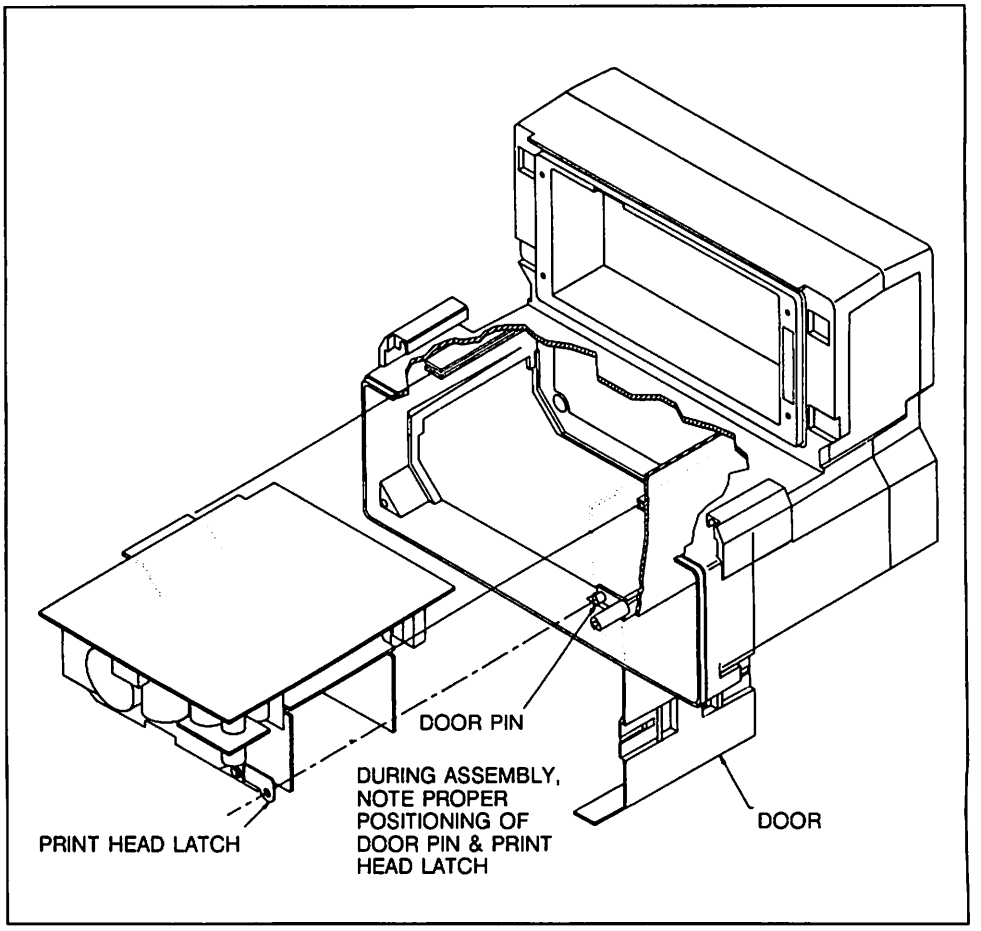

Fig. 3-18. Installing Printer Main Board into EMP

Replacing EMP Front Panel

The front panel contains the printer buttons and an area for an additional display screen for future options. Like the rear panel, the front is sealed to the chassis with a rubber gasket. This gasket can be re-used when replacing the front panel.

The EMP front panel is attached to the chassis with four screws. The EMP does not need to be separated from the monitor to replace the EMP front panel.

Removing EMP Front Panel

1. Remove the four screws (D) shown in Figure 3-13.
2. Separate the front panel from the chassis, disconnecting the front panel cable from the EMP button board.

   Note the rubber gasket that seals the front panel to the chassis. This gasket should be saved for re-installing on the front panel.

Installing EMP Front Panel

1. Replace the rubber gasket in the front panel channel.
2. Connect the front panel cable to the EMP button board.
3. Attach the front panel to the chassis making sure the gasket does not become pinched between the front panel and chassis.
4. Lay the EMP on the front panel to keep the front panel in place.
5. Insert four screws securing the front panel to the chassis.
6. Again check that the gasket is in place and not pinched.
7. Tighten the screws.

Replacing EMP Button Board and Buttons

The EMP button board has electrical contact areas that detect when an EMP button is pressed. The front panel buttons are identical to the monitor buttons with the plastic button and flexible contact that touches the contact area on the button board when a button is pressed. When replacing the buttons or button board, refer to assembly drawing 824-0177-XX, located in Section 5, *Diagrams*.

Removing Button Board and Buttons

1. Remove the EMP front panel as described in **Removing EMP Front Panel** in this section.
2. Remove the four screws securing the button board to the front panel.
3. To remove the button board, slide a screwdriver between the board and the EMP front panel near the **PRINTER READY** LED and lift to release the LED from its lens housing.

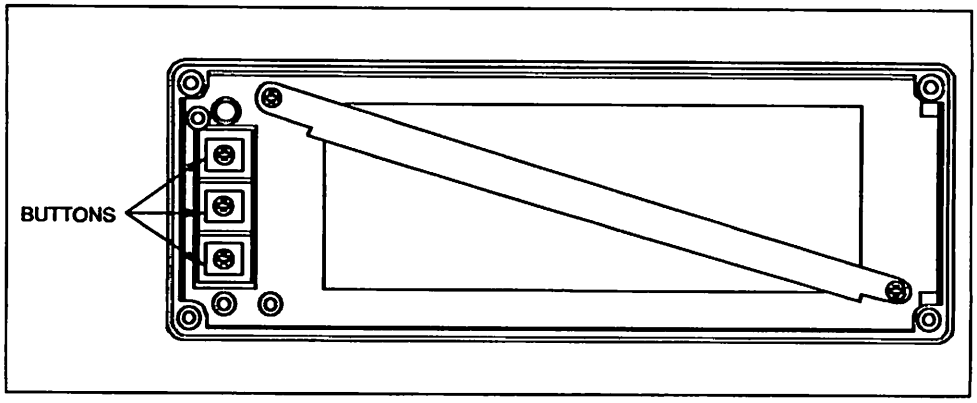

Fig. 3-19. EMP Front Panel (Rear View)

4. Remove the button board.

   The flexible contacts may attach themselves to the button board contact areas. The flexible contacts can simply be lifted from the board.

   NOTE

   Do not touch the contact areas on the button board or the contact inside the flexible contacts. Touching these areas may deposit oil on them, reducing the ability of the parts to make electrical contact. If you do touch these areas, clean them with isopropyl alcohol or freon.

5. Each button is held with a Phillips screw. Refer to assembly drawing 824-0177-XX if replacement is necessary.

Installing Button Board and Buttons

1. If buttons were removed, reinstall as shown in drawing 824-0177-XX.
2. Set the flexible contacts in place over buttons shown in Figure 3-19.
3. Set the button board in place over the buttons.
4. Secure the button board with the four screws.
5. Install the front panel as described in **Installing EMP Front Panel** in this section.

Separating SpO_2 Module From Monitor

The monitor is secured to the SpO_2 module with four screws as shown in drawing #824-0106-XX, Sheet 2, in Section 5, *Diagrams.*

1. Using a Phillips screwdriver, remove the four screws from the SpO2 module rear panel (824-0106-XX, Sheet 2).

WARNING

The Propaq sealed lead-acid battery pack is capable of quickly delivering dangerously high currents if improperly handled, misused, or abused. These current levels may burn skin or damage the Propaq. Use extreme caution when handling the battery pack in the next steps.

2. Slide the monitor forward until you can disconnect the battery pack cable from the monitor's power cable.
3. Disconnect the battery cable from the monitor power cable.
4. Slide the monitor forward until it can be completely separated from the SpO_2 module.

   The SpO_2 module can now be disassembled according to the instructions in this section.

CAUTION

Further disassembly of the Propaq should be done at a static-protected work station. See the static discharge warning at the beginning of this section.

Attaching the SpO_2 Module

The following information describes how to attach an SpO_2 module to a Propaq monitor.

WARNING

The Propaq sealed lead-acid battery pack is capable of quickly delivering dangerously high currents if improperly handled, misused, or abused. These current levels may burn skin or damage the Propaq. Use extreme caution when handling the battery pack in the next steps.

1. Slide the assembled monitor onto the SpO_2 module (battery pack installed) as shown in 824-0106-XX, Sheet 2, in Section 5, *Diagrams.*
2. With the monitor and SpO_2 module separated a few inches, connect the battery cable to the monitor power cable.
3. Slide the monitor completely onto the SpO_2 module.
4. Secure the monitor to the SpO_2 module with the four screws removed earlier.

Opening the SpO_2 Module

Two tabs secure the SpO_2 module rear panel to the SpO_2 module chassis (Figure 3-20).

1. Separate the SpO_2 module from the monitor as described in **Separating SpO_2 Module From Monitor** in this section.

WARNING

The Propaq sealed lead-acid battery pack is capable of quickly delivering dangerously high currents if improperly handled, misused, or abused. These current levels may burn skin or damage the Propaq. Use extreme caution when handling the battery pack in the next steps.

2. Carefully slide out the battery pack from the SpO_2 module.
3. Disconnect the battery cable from the SpO_2 module.
4. Set the battery pack aside.
5. Using a small screwdriver or your finger, press on each of the tabs inside the SpO_2 module chassis while applying pressure to separate the rear panel from the chassis. (When separating rear panel from chassis, make sure that side panels remain seated in rear panel.)
6. Once the tabs allow the rear panel to be removed, separate the rear panel from the chassis.

NOTE

The rear panel is sealed to the chassis with rubber gaskets (drawing #824-0106-XX, Sheet 1, in Section 5, Diagrams). These gaskets can be reused when re-assembling the SpO_2 module. Save these gaskets.

Further disassembly of the SpO_2 module can now be done according to the procedures in this section.

CAUTION

Work only at a static-protected work station while disassembling the EMP any further.

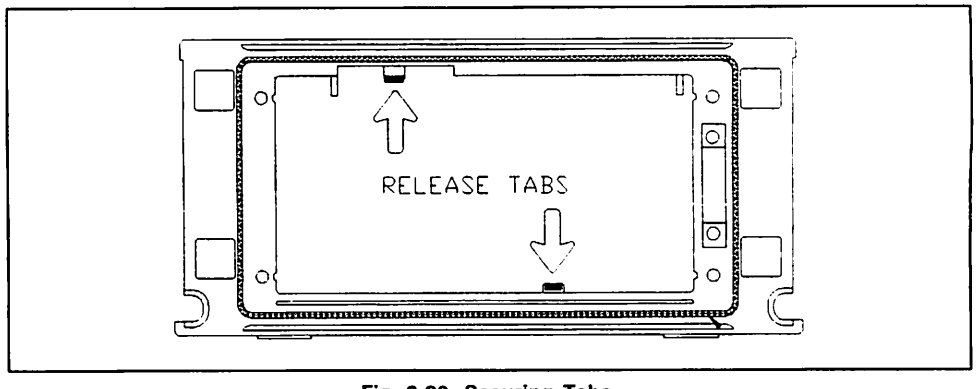

Fig. 3-20. Securing Tabs

Closing the SpO_2 Module

Make sure all cables are in place and the gaskets removed earlier are available or in place (see drawing #824-0106-XX, Sheet 1, in Section 5, *Diagrams*).

CAUTION

Work only at a static-protected work station while assembling the EMP.

1. If necessary, set the rubber gaskets in their proper places as shown in 824-0106-XX, Sheet 1.
2. Carefully set the rear panel onto the chassis, watching that no gasket slips out of its channel and becomes pinched between rear panel and chassis.
3. Press the rear panel onto the chassis until the tabs snap in place to secure the two pieces.
4. Set the battery pack on the rear chassis, leaving enough clearance to connect the power cable to the SpO_2 module.
5. Connect the battery cable to the SpO_2 module.
6. Slide the battery pack into the SpO_2 module chassis.
7. Attach the monitor as described in **Attaching the SpO_2 Module** in this section.

Replacing the SpO_2 Circuit Boards

The following instructions describe how to replace the two SpO_2 module circuit boards. Instructions for the SpO_2 module attached to a monitor and for EMP installations are included in the following steps.

CAUTION

When replacing the SpO_2 circuit boards, remove both circuit boards with the patient connector side panel still connected. Attempting to disconnect the patient connector side panel from the SpO_2 circuit board before removing both circuit boards with the side panel can damage the flex-cables between the side panel and the SpO_2 circuit board.

Removing the SpO_2 Circuit Boards

1. For SpO_2 module installations, separate the monitor from the SpO_2 module as described in **Separating SpO_2 Module from Monitor** above.

   For EMP installations, separate the monitor from the SpO_2 module as described in **Separating EMP from Monitor** above.

2. For SpO_2 module installations, open the SpO_2 module as described in **Opening the SpO_2 Module** above.

   For EMP installations, open the EMP as described in **Opening the EMP** above.

CAUTION

In the next step, the connector securing clips are fragile and will break if not handled carefully.

3. Disconnect the expansion cable and printer main board cable from the SpO_2 SCP board by carefully prying the securing clips (see 824-0106-XX, Sheet 1, in Section 5, *Diagrams*) away from the connectors and removing the connectors.
4. Disconnect the speaker cable from the SCP board.
5. Remove the two screws securing the SCP board and SpO_2 board to the rear panel.
6. Carefully lift out the two circuit boards and patient connector side panel as a unit. (The side panel easily slides out.)
7. Using equal pressure on both sides of the connector, carefully disconnect each patient connector side panel connector from the SpO_2 circuit board.
8. Disconnect the two circuit boards by carefully pulling them apart.

Installing the SpO_2 Circuit Boards

1. Connect the two circuit boards together.
2. Connect the patient connector side panel connectors to the SpO_2 circuit board (824-0106-XX, Sheet 1).
3. Set the two circuit boards and side panel in place.
4. Secure the boards with the two screws removed earlier.
5. Reconnect the printer and expansion cables to the SCP board.
6. For SpO_2 module installations, close the SpO_2 module as described in **Closing the SpO_2 Module** above.

   For EMP installations, close the EMP as described in **Closing the EMP** above.
7. Attach the monitor to the SpO_2 module or EMP as described earlier in this section.

Replacing Side Panels

The side panels easily slide out once the chassis and rear panel are separated. If the patient connector side panel is being replaced, this side panel and the two circuit boards must be removed together before disconnecting the side panel from the circuit board. See **Replacing the SpO_2 Circuit Boards** earlier. If the speaker side panel is being replaced, simply separate the chassis and rear panel as described earlier in this section, disconnect the speaker from the SCP board, and slide out the speaker side panel.

Section 4

Theory of Operation

Introduction

This section is divided into three subsections, providing descriptions of the basic Propaq Series Electronics and of two options, the Expansion Module with Printer (EMP) and the Pulse Oximetry option (SpO_2).

In each subsection, a system-level description is followed by functional block descriptions and detailed circuit descriptions, referenced to the schematics in Section 5.

Disassembly and handling of the internal components of the Propaq monitors should be carried out only at a static-protected workstation. Please read the following warning to protect your equipment.

STATIC DISCHARGE WARNING

Propaq monitors are manufactured with static-sensitive CMOS devices. All calibration, service, and repair must be done at a static-protected work station. Failure to protect against damage due to static discharge may reduce monitor operation life and increase repairs. Any time the monitor's casing is opened, the monitor should be placed in a static protected work area.

This section should provide the technician with a detailed understanding of how the Propaq monitor's electronics work and the kind of parts necessary to repair the monitor at the component level. However, because of the specialized equipment and knowledge required to manufacture and repair the Propaq, Protocol Systems, Inc. recommends that only Protocol's authorized repair facilities provide component-level repair. If service by other than Protocol's authorized repair facilities is required, such a repair facility must have the necessary equipment to service and repair surface mount technology electronics as well as the specialized equipment to repair Propaq monitors. Contact Protocol Systems, Inc. for more information.

Propaq Series Electronics

System Level Description

Refer to Section 5, drawing #800-0025-XX, Sheet 1, for a system-level block diagram. The Propaq series electronics consist of the monitoring electronics, the power system electronics, and the cuff pneumatics system.

Monitoring Electronics

The monitoring electronics perform these vital functions:

- acquire the physiological signals through coupling devices (electrodes, tranducers, and probes),
- convert the signal to computer data,
- process the data for display and alarm monitoring,
- display the data and any alarm conditions
- convert the data to analog signals for analog output

Although a Propaq monitor operating on internal battery power is totally isolated from any ac mains source, precautions have been taken to isolate the patient side of the monitoring electronics from other parts of the monitor. Isolation is achieved through a transformer and optical couplers that provide the required electrical isolation in accordance with current medical electronics standards. This isolation barrier is clearly indicated in 800-0025-XX, Sheet 1.

The isolation barrier divides the monitoring electronics into two parts. The isolated side performs patient signal acquisition through various patient channels, signal multiplexing, analog-to-digital conversion, and data processing and storage (ISO CPU). The non-isolated side controls the display of data, the output of analog data, and the pump and valve for NIBP. (For most functions of NIBP monitoring, the isolated processor is the master processor, and the non-isolated processor is the slave processor.)

Except for the NIBP channel, all patient inputs are electrical. The NIBP channel contains a pressure transducer that converts the cuff pressure to an electric signal for analog-to-digital conversion and processing.

NIBP Pneumatics

Cuff pressure is increased by pumping air into it using a pump and decreased by bleeding air from it through an electromechanical valve. Cuff pressure is monitored using a transducer to convert the pressure to an electrical signal. Pump and valve control is through the non-isolated CPU subsystem.

When the pump runs, the valve is closed so air is contained in the cuff. With the pump off and the valve closed, a one-way check valve keeps air from leaking back through the pump and deflating the cuff.

To bleed the cuff, the pump remains off and the electromechanical valve is opened to allow air to escape to the cuff vent on the left side of the monitor.

An air filter between the cuff vent and the air system removes particulates from the air system.

Power Electronics

The Propaq monitors operate from an internal battery. A switching power supply draws energy from the battery for the monitoring electronics and supplies the necessary current at several different regulated and unregulated voltages. Power sources to isolated patient electronics are isolated from the battery and ac mains source.

The Propaq ac power adapter may be plugged in during normal monitor use. The ac adapter provides direct current to a recharger circuit in the monitor for battery recharging.

Functional Level Description

Circuitry in the PROPAQ is divided into four major groups. They include the isolated patient circuits, display circuitry, main power supply and battery recharger.

The isolated patient circuits, as shown in 800-0025-XX, Sheet 2, contain the analog input circuits, an analog to digital converter, and a microprocessor with associated components.

The non-isolated circuitry as shown in 800-0025-XX, Sheet 3, includes the display microprocessor, LCD controller, analog output and serial interface. Optical coupling is used to transmit information across the main patient isolation barrier. Operation of the monitor is controlled by 5 soft keys located below the liquid crystal display. The display microprocessor will label the keys and decode the key strokes.

Power for the isolated and non-isolated circuitry is supplied by the main switching power supply shown in 800-0025-XX, Sheet 4. A specially constructed transformer, T601, is used to bridge the patient barrier and supply power to the isolated patient circuits.

The battery recharger, shown in 800-0025-XX, Sheet 4, supplies current to recharge the internal batteries. The recharger will operate from a 10 to 32 V, 10.5 W dc source. Several external power adapters are available for operating the Propaq monitors from a mains ac power source. Use only ac power adapters that are approved for medical applications (e.g., UL544) when operating the monitor from an ac power source.

Power Distribution

Several regulated and unregulated power sources in the Propaq series monitors provide power to several monitor circuits. A power distribution diagram (800-0025-XX, Sheet 4) shows the distribution of current from these power sources.

Cabling Diagrams

Figures 5-2 through 5-18 show the cabling and cables for the Propaq series monitors.

Detailed Circuit Descriptions

These detailed circuit descriptions are referenced to schematics in Section 5, Diagrams.

Main Board

Schematic 800-0010-XX (Section 5)

The Main Board schematics are on twelve pages. The following descriptions identify the pages covered.

ECG Circuits

Schematic 800-0010-XX, Sheet 2 of 12

Signal Input and Lead Select

Three patient leads, LA, RA, and LL, connect the ECG signal to lead select switches, U200, U201, through circuitry designed to protect the monitor from high voltage defibrillator and electrocautery signals. The patient cable has 1K Ω resistors in series with each lead to limit current to neon bulbs, LP200, LP201, LP202. The neon bulbs turn on at 90 V and limit the high voltage present at the input to the ECG circuitry. Diodes within U200 and U201 clamp the inputs to +VS and –VS to protect the ECG selector switches. Resistors R200, R201, R203, R204, R206, and R207 limit current to U200 and U201 inputs. The resistors and capacitors between the neon bulbs and the selector switches form a low pass RC filter to attenuate RF transients during electrocautery.

The lead selector switches connect to the buffer amplifiers U203D and U203A the two patient leads appropriate for the desired ECG vector. The remaining lead is a driven reference lead from U203B. This common mode reference signal is tapped from the buffers through R213 and R214. This configuration eliminates any common mode component of noise or offset voltage coming from the patient. Following the buffer amplifiers is a X10 differential amplifier, U203C.

Lead Fail

Lead failures are detected using the VLF input to the A-D converter, U1007. If a single signal input lead is removed or open, the input to U203A or U203D is pulled up to +2.5 V through 100 MΩ resistor R209 or R210. The signal input lead that remains connected is pulled to –2.5 V by U203D. Because R246 and R247 that establish VLF are unequal, the polarity and magnitude of VLF indicate which electrode(s) are unhooked (e.g., if VLF is ≈+1.2 V, the + input is open; if VLF is ≈–1.2 V, the – input is open; and if VLF is ≈+2.5 V, either the driven lead or any two leads are open). Once a lead fail is detected, the CPU can determine which lead is open by switching through the lead select positions and measuring the voltage on VLF. Capacitor C225 is for suppressing electro-surgical interference in the VLF signal.

Trace Restore

The ECG signal from U203C goes to the bandpass and trace restore circuit, U204A, U204B and associated components. This circuit

auto-centers the baseline and quickly returns the signal to center screen after a lead fail or lead select change. Both U204A and U204B are inverting amplifiers, each within the other's feedback loop. U204A has a gain of 8.34 with a high frequency roll-off. U204B is an integrator whose capacitor, C216, charges to the average level of the ECG signal and keeps the average output of U204A at a constant level. Because switch U300B is normally off, current available to charge C216 is small. Because the time constant is long, ECG pulses will not change the baseline level. Diode D206 prevents high amplitude pacer pulses from significantly distorting the ECG baseline as well. If the level of VECG at the input to the A-D converter is outside a certain voltage window due to a lead fail or lead select change, the CPU will turn on switch U300B, shorting out R227, shortening the time constant. The short time constant enables C216 to quickly charge to a new average level and restore the baseline and ECG signal to center screen. The switch does not stay turned on in order to prevent continuous base line restoration of the signal. From the restore circuit, the ECG signal is applied to U204C with a passband of ≈0.5 to 42 Hz. U204C is a non-inverting amplifier with a gain of 6.11. The total ECG circuit gain is 500 from the ECG input to the input of the A-D converter.

Pacer Detector

The last stage of the ECG circuit is a pacer detector. Pacer pulses are detected if their slope is fast enough to pass through the high pass filter circuit formed by C223, R248, U204D and R249. This filter circuit will pass pacer pulses, but not QRS signals. U205B and associated components form a bandpass filter, which amplifies the pacer pulses while limiting high-frequency noise. After the pacer signal is conditioned, it goes to window comparator U205A which generates a logic signal to flag the CPU indicating that a pacer pulse has occurred. Diode D203 is biased so only pacer pulses larger than a certain amplitude will generate the logic signal.

The short pacer pulse will cause two pulses to occur at the output of U205B, one pulse from the rising edge and one from the falling edge. U205A is a full-wave rectifier which converts the two opposite-polarity input pulses into two single polarity output pulses. The logic signal output from Q200 is two pulses. The time duration between the pulses is equal to the duration of the original pacer pulse from U203C.

Invasive Blood Pressure Circuits

Schematic 800-0010-XX, Sheet 3 of 12

The main ECB has two separate chopper-stabilized invasive blood pressure channels. Each channel has a bi-polar transducer power supply. Output signals from the transducers are multiplexed through a common amplifier circuit. The invasive pressure input circuits are protected from electrocautery and defibrillator signals by capacitors C325 through C332, resistors R342 through R345, and diodes D322 through D325, D330 and D331. The output circuits are protected by C317, C318, C321, C322, D320, D321, D328 and D329.

The CPU controls the multiplexer U302, which in turn routes the positive and negative input signals of INV1 and INV2 to the common amplifier.

Switch U302 will select INV1 when the INVSEL line is low and select INV2 when it is high. A separate output (VPCF) from the common amplifier is a logic signal input to the A-D converter. This signal flags the CPU when a transducer is present. If no transducer is present, R306 and R307 will pull the inputs of U205C and U205D positive, saturating their outputs. When this occurs, VPCF is driven high, indicating to the CPU that no pressure transducer is present.

The level of VPCF for both pressure channels is monitored while the transducer excitation is applied, and while the excitation is zero. If VPCF is ≈zero while a channel's excitation (driver output) is zero, a transducer is considered to be connected to that channel. Additionally, if the above condition is met, but VPCF is HI while that same channel's excitation is ON, an inappro- priate transducer (namely an HP 1290A type) is considered to be present.

The transducer power supplies are controlled by the logic lines INVPWR1/ and INVPWR2/, which are cycled at 181 Hz by the CPU at an appropriate duty factor (see below).

Transducer driver negative outputs VBL01 and VBL02 are directly sensed by the A-D converter and monitored by the CPU to verify proper negative driver operation and to sense transducer shorts. Transducer driver positive outputs VBHI1 and VBHI2 are not directly monitored. Rather, signals for each channel—which are related to both the positive output voltage and to each channel's output current—are multiplexed by U302, sensed by the A-D converter and then monitored by the CPU. From these signals, the CPU can not only verify proper positive driver operation and detect transducer shorts, it can also determine the dc load resistance of the transducer and set driver duty factor accordingly.

Having two possible driver duty factors, based on load impedance, provides a good compromise between power consumption and the unique drive requirements of an HP 1290C option J06 quartz transducer for monitors with the HP side panel option. This transducer contains active circuitry which, when used with pulsed dc excitation, basically cannot be left without power for more than ≈0.5 msec. Its dc resistance mimics an ≈1.1 kΩ resistor when the transducer is excited by 5 V. By providing an excitation duty factor of ≈91% only for transducer impedances of >900 Ω, the HP 1290C requirement is met, and chopper stabilization can still occur, since the excitation is still pulsed. For transducer impedances lower than ≈900 Ω, the excitation duty factor is ≈11%, thus minimizing power consumption.

The invasive input signals are multiplexed into an instrumentation amplifier, beginning with non-inverting buffers, U205C and U205D. Their gain and hi pass frequency response are controlled by R321, RP301 and C310. The buffer stage has a gain of 92.5 at the multiplex frequency and no gain at dc. This attenuates any dc or low frequency drift while passing the IBP samples. Potentiometer RP301 adjusts the gain of the buffer stage to calibrate the IBP amplifier.

After passing through the buffer stage, the differential signal is amplified by U303A. This stage has a gain of approximately 21.5. The switch U300A, which is controlled by the CPU through logic line INVCAP, controls the charge on C304 in order to cancel any dc offset from the IBP

signal. In operation, U300A grounds the output end of C304 while U302 is set to a channel whose excitation is off. During this interval, C304 is charged with any offset voltage errors. Next, U300A is opened and excitation applied to the selected transducer. The voltage change at the output end of C304 is then proportional to the sum of the measured pressure and that transducer's residual offset. (The latter is subtracted off by software after the transducer is zeroed.) The line VINV is the IBP input to the A-D converter.

Non-Invasive Blood Pressure Circuits (CUFF)

Schematic 800-0010-XX, Sheet 4 of 12

The NIBP circuit consists of a transducer bi-polar power supply, a dc-coupled amplifier to condition the pressure being measured, and an ac-coupled amplifier to condition the oscillometric signal.

NIBP Transducer Driver

The bi-polar supply for the transducer is always on, despite having switch U304B. The latter may be utilized in the future, but at the time of this writing, U304B is always left open.

Pressure Amplifier

The differential pressure signal from the transducer is amplified by U402C and U401D. (U402D buffers the + transducer output, so that the transducer is not loaded by the low input impedance of the minus input of U402C.) The output of U401D is a dc signal (VPRS) to the input of the A-D converter. This signal corresponds to the pressure in the blood pressure cuff. Potentiometers RP400 and RP401 respectively adjust the gain and zero the pressure measurement circuit. Software automatically tracks and compensates for small offset drifts in VPRS.

Oscillometric Amplifier

The oscillometric component of the pressure signal, which occurs at the pulse rate, is ac coupled to the amplifier U402B. Only the changing portion of the NIBP signal is amplified by this stage. Between measurements, when pressure in the cuff is bleeding to the next value, switches U300C and U300D are closed to keep the bleed step from appearing as a signal to VOSC line. The CPU controls the switches by the logic line OSCSW. Amplifying stage U402A provides gain, high frequency noise attenuation and a baseline offset adjustment, RP402. Components R415 and C405 form an additional low pass filter at the input to the final amplifier stage, U401C. Software automatically tracks and compensates for small offset drifts in VOSC.

Temperature Circuits

Schematic 800-0010-XX, Page 5 of 12

The temperature circuit has inputs for three types of temperature probes. The resistance of all three temperature probe types decreases with increasing temperature. This resistance is in parallel with part of a voltage divider network. The three voltage dividers are multiplexed through U501

and a common amplifier, U303B. The output of U303B is applied to the input of the A-D converter. A reference voltage divider, R516, R517, and R518 is also multiplexed through U501 and U303B. Software periodically checks the tap points in the latter divider to determine and cancel any offset and gain errors in the U303B stage. Since all four voltage dividers use the same reference supply (+VR), any voltage drift in the reference supply will appear on the reference divider. Using a common reference supply and amplifier compensates for changes in amplifier gain or reference voltage drift. D501, D502, D503, C502, C504, C506 protect the temperature inputs from electrocautery and defibrillator signals, and electro-static discharge during plug-in or removal of the temperature probe.

The Electromedics Temperature Probes use the mini-phone jack and the YSI 400 and YSI 700 probes share the standard size phone jack. The YSI 400 probe makes contact with the tip connector of the jack. The YSI 700 probe touches both the tip and the ring. Except for fault testing, the CPU ignores the tip portion of a YSI 700 probe when the ring is making contact.

Isolated CPU (ISO CPU)

Schematic 800-0010-XX, Sheet 6 of 12

The Isolated CPU, U1000, uses crystal X1000 to generate its own reference clock. The low address byte latch, U1002, latches and holds the low address byte while the high address byte simultaneously appears at Port P2.X. Depending on the previous program instruction, the data bus will transfer a data byte to or from the CPU at Port P0.X following the low address byte. Prom U1003 is the program memory, and U1004 is the RAM for the data memory. No address decoder is required in this circuit. U1004 is selected when line A15 is high. When A15 is low, U1006 is selected. Latch U1006 is used to control various circuits in ECG, temperature, IBP and CUFF channels. Microprocessor U1000 controls the ECG lead selection from Port P1.4 and P1.5. The ±2.5 V levels on these lines are shifted to -2.5 V or +5.7 V levels by Q1000 and Q1001 as required by the ECG lead select multiplexer.

The P3.4 output of U1000 is used to select the A-D converter for data transfer. Outputs P1.0, P1.1, and P1.2 are the three data lines used to select the desired analog input and read the A-D converter. (Serial data is simultaneously written to and read from the A-D converter as clocked by P1.0.)

Voltage followers U303C and U303D and diode networks U1008 and U1009 clamp the inputs to the A-D converter, U1007. Clamping begins at ±2.5 V, and hard limits at ≈±2.8 V. The output of U1007 will be incorrect if the inputs are within ±2.8 V.

The ECG data from the A-D converter (U1007) is analyzed by a software routine that detects the QRS portion of the ECG signal. The software routine is designed to recognize the difference between the QRS complex, pacemaker signals and noise. A trigger signal is present on P1.7 of U1000 when a QRS complex is detected by microprocessor U1000. This signal is

coupled across the isolation barrier through optocoupler U606 and is available as the defibrillator sync signal on the analog output jack.

Display CPU

Schematic 800-0010-XX, Sheet 7 of 12

Clock Generator

U700 provides two clock frequencies, 10.752 MHz and 18.432 MHz. The 10.752 MHz clock is used by the Display Processor U704 and is also divided down by U703 to provide 2.625 kHz TONE signal for the speaker and 42 kHz clock for U704. The 10.752 MHz clock is also used for the display clock signal (DISPCLK) for monitors with LCD displays. The 18.432 MHz clock is used by the UART U714, and for the display clock (DISPCLK) when the monitor has an EL display.

The display clock frequency is automatically selected for EL or LCD displays by U719. When the EL display is present, pins 2 and 12 of U719A are pulled low by the ELCLK/ line allowing the 18.432 MHz clock to be selected for the DISPCLK at pin 6 of U719B. When an LCD display is present the ELCLK/ line is high and the output at pin 6 is the 10.752 MHz clock frequency.

Display CPU

U704 can address 64K of ROM and another 64K of RAM. Port P0.X is the lower byte of address and Port P2.X is the higher address byte. Port 0's lines are multiplexed between the lower address byte and data. Port P1.X is used to read the panel key switches, watchdog timer interrupt, battery level measurement and main power supply shut down. Port P3.X is used for internal timing and interrupt control, read and write strobes for peripherals, serial transmit and receive communications with the isolated CPU, and with auxiliary Propaq options like SpO_2 and printer.

Address Latch and Decoder

The address latch, U705 latches and holds the low address byte while the high address byte simultaneously appears at Port P2.X. Depending on the previous program instruction, the data bus will transfer a data byte to or from the CPU following the low address byte. Once the high address is present, the address decoder, U712 will decode and select the proper memory chip.

Program and Data Memory

The 8031 display CPU can access two separate 64 kByte memory spaces. Both memory spaces use the same data and address bus. The program memory (PROM U706) uses the CPU signal, $\overline{PSEN}$, as the read strobe. The data memory space (RAM, UART, display controller, analog output DAC, and real-time clock) uses the RD and WR strobes to control the read/write functions. The chip select decoder, U712, selects the chip.

U716, a 32 kByte RAM, is the data memory. U716 has a battery back-up power supply. Since they always retain data, U716 and the clock calendar chip, U805, must be protected against glitches on the RD and WR lines during reset, power up and power down. This is accomplished by battery

backup supervisor chip U717 protecting U716, and by logic signal CS1PRO which takes about 3 seconds to enable U805 when the monitor powers up or down.

Serial Communcations (UART)

UART U714 converts parallel data to serial data and communicates with RS-423 transmitters and receivers U1101, U1102, and U1103. See Sheet 10 discussion below about RS-423 transmitters and receivers.

LCD Controller

Schematic 800-0010-XX, Sheet 8 of 12

Display Controller

U800 is a special microprocessor used to control the liquid crystal (LCD) display. U800 can receive and send data to the DISPLAY CPU (U704). U801 is the display RAM and holds the data for the display. Data in the display RAM is updated constantly by U800. U800 provides all the necessary clock and data signals to operate the LCD and EL displays. U807B divides the DISPCLK signal by 8 before it is sent to U800.

Clock/Calendar

U805 is a real time clock/calendar controlled by the CPU. Crystal X800 is the reference time base for the clock/calendar. The CPU polls the clock/calendar chip once per second to obtain the current time and date. The logic signal, CSIPRO, is used to protect U805 data from startup and shutdown glitches. U805 operates in a special low power state ("sleep mode") to maintain the current time while the Propaq is off.

Control Latch With Circuits

U803 is an 8-bit latch used to control a number of output circuits.

- Q1 output increments U807A which controls the LCD screen contrast (i.e., viewing angle). U807A is reset at power-up to initialize the contrast setting. This function is not used in monitors with EL displays.
- Q2 output can be used as an auxiliary reset for external devices.
- Q3 output, in conjunction with Q8 output, selects speaker volume.
- Q4 output controls the pump logic line.
- Q5 output controls the valve logic line.
- Q6 output controls the red alarm LED and EEPROM serial clock.
- Q7 output controls the amber alarm LED and EEPROM serial data input.
- Q8 output, in conjunction with Q3 output, selects speaker volume.

Monitor Configuration Storage

EEPROM U810 is programmed at the factory to indicate to the CPU which features and options are enabled, which language is selected, and the instrument serial number.

Analog Outputs

Schematic 800-0010-XX, Sheet 9 of 12

D-A Converter

U900 is a dual D-A converter that is used for three different functions. The lines DACA_P and DACA_S are analog outputs from the monitor. DACA_P has a gain of 250 mV/mV as referred to the input and DACA_S has a gain of 1000 mV/mV. The line DACB is an additional analog output for P1 that doubles as a successive approximation A-D conversion of the battery voltage. Once every 15 seconds, under software control, the DACB output provides an analog voltage that is equivalent to the last measurement of the battery voltage. This output is scaled down to be of the same proportion as the voltage on pin 2 of U902A. U902A compares these two voltages and sends the logic signal BATLEV to the CPU. Depending on the value of BATLEV, the CPU will increment, decrement, or hold the count it feeds temporarily to U900 to compare with the present battery voltage value. This brief comparison is fast enough that R906 and C904 filter most of it out of the DACB output signal.

Speaker Driver

The Speaker Driver circuit, made up of Q910, Q911, Q912, Q913, and U720C, provides 3 levels of speaker output. The 2.6 kHz TONE signal enters Q910 and passes through Q911, R933, and R932 at low level, Q912 and R932 at medium level, or Q913 only at high level as selected by SPEAKER_A and SPEAKER_B signals and gate U720C.

Interface

Schematic 800-0010-XX, Sheet 10 of 12

RS423 Transmitters and Receivers

Serial communication between the monitor and a peripheral device is accomplished by U714, U1101, U1102, and U1103. Parallel data from the CPU is sent to the UART, U714, on the data bus. The data is sent to U1101 in serial form. U714 also sends a handshake signal RTS/ (ready to send) to U1101 which is in turn transmitted to the serial device. The peripheral device sends a handshake, CTS (clear to send) back to U714 when it is ready to receive data. When U714 receives a full byte of data, it will send an interrupt signal to the CPU telling it to retrieve the data.

QRS Sync Output Circuits

The Propaq provides a digital output pulse when its software algorithms detect a QRS signal. (The delay is about 30 msec from the peak of the QRS to the leading edge of this pulse.) U708F provides a 5 V, normally low, pulse to the outside world, and to the Baq Paq for the C-LOCK function of SpO_2. Q1103, Q1104, Q1106, U708E and the associated circuitry provide a 15 V, normally low, pulse to the outside world if JP100 is opened and pins 2 and 3 of P10 are shorted (sheet 1). Except for instruments built for Siemens, all Propaqs are configured for a 5 V output pulse. Pulse duration is set by software.

Power Supply

Schematic 800-0010-XX, Sheet 11 of 12

Power Regulator

The main power supply for the monitor operates from the battery supply, +VSW, and uses U602 as the switching regulator. When the main power switch is turned on, C609, being initially discharged, will turn on Q603. This connects the supply +VSW to U602, pin 5 and starts the regulator. The output of the regulator is a square wave, which is applied to primary winding pins 11 and 12 of T601. The VCC supply output is fed through voltage divider, R614 and R613 to pin 2 of U602 to achieve a regulated +5 V at TP600. The +5 V supply VCC is regulated by the duty cycle output of U602. When the supplies are operating, the +4 V output on C614 is fed back to U602 pin 5. By this time, C609 has charged, turning off transistor Q603. The +4 V supply will then provide the voltage to pin 5 of the regulator to keep it operating. U602 has internal current limiting of its output at pin 4 to protect U602 from supply shorts, etc.

Soft-Start Circuit

The regulator has a "soft start" circuit. When the regulator is first turned on, C610 begins to slowly charge. This in turn, controls the voltage on U602 pin 1 which creates the "soft start".

Power Supply Shutdown

To prevent destroying programmed data stored in the clock/calendar chip and U716 RAM during a power shutdown, the shutdown must be accomplished in a controlled manner. The Vcc supply voltage must drop smoothly to <1 V and not try to restart itself. To that end, when the display CPU, U704, receives data that indicates battery voltage is low, or that the power switch has been turned off, U704 starts the shutdown by sending a low logic level on the SHUTDN/ line, turning on Q607. Two things occur when Q607 turns on. First, transistor Q606 turns on and pulls U602 pin 1, to GND. This turns off the regulator, shutting down the power supply. Second, transistor Q609 turns on and discharges C614, taking away the input to the regulator U602, pin 5 to ensure that the regulator does not restart. The time-constants of the R-C networks containing C623 and C608 also prevent the regulator from restarting.

Isolated Supplies

The isolated secondaries, ±VB and ±VS are the high current, unregulated supplies for the isolated circuitry. U603 is a regulator whose output is determined by the ratio of R611 and the parallel combination of R669 and R612. U603 pin 7 is internally compared to a +1.235 V reference and adjusts the output on U603 pin 1 accordingly. U604C and Q610 supply +VD to the digital circuits. U604A is an inverting amplifier with a gain of one to supply Voltage -VR that tracks +VR. U604B and Q612 supply -VD to the digital circuits. D616, D615 and D614 protect the circuits against reverse polarity, in case of a failure of their respective power supplies. Zeners D204 and D205 provide clamping of the ±VS supplies for transients from ESD or defibrillator pulses.

The magnitudes of ±VD are about 0.2 V greater than the magnitudes of ±VR so that the clamp circuits at the input of A-D converter, U1007, can function satisfactorily. This voltage difference permits inputs in the range of ±2.5 V to be unrestricted, yet prevents inputs from exceeding the supply voltages of the converter. EMI Null Adjust, RP601, permits nulling the switching frequency noise that would otherwise be developed across T601's isolation barrier.

Opto-Couplers

Schematic 800-0010-XX, Sheet 12 of 12

Opto-couplers are used to bridge the patient safety barrier and provide communication between the ISO and display CPU's. The opto-couplers are also used by either CPU to reset the other CPU. The transmit and receive lines are at a high level most of the time during normal communication. Capacitors C700 (sheet 7) and C1000 (sheet 6) charge to this high level through R604 and R606, respectively. The voltages on C700 and C1000 are inverted thru U708A and U1010A to provide the RESET signals to the DISPLAY and ISO CPU's. An inverter is used to provide the correct polarity reset pulse to the CPU. If one CPU must be reset by the other, it will drop and hold the transmit line low. When that happens, the opto-coupler will couple a low through R604 or R606 to discharge C700 or C1000. As the capacitors discharge, the reset line at the input to the CPU will go high and stay high until the transmitting CPU pulls its transmit line high.

U606 couples the QRS sync pulse across the isolation barrier.

EMP System

This subsection provides detailed circuit descriptions of the Propaq Expansion Module with Printer. Disassembly and assembly instructions for replaceable modules are provided in Section 3. Schematics and parts lists for the EMP can be found in Sections 5 and 6, respectively.

System Level Description

The Expansion Module with Printer shares battery power with the monitor, but contains its own power supply. The EMP processor communicates with the monitor's processor over the address data bus through the expansion connector and cable.

Overview

The Expansion Module is designed to house the Propaq Printer and other circuit boards for additional parameters. The main circuit board in the Expansion Module with Printer (EMP) is the Printer Main Board. The schematic of this circuit board consists of five pages (Drawing number 800-0007-XX) and is provided in Section 5. An additional circuit board (keypanel) in the EMP front chassis contains the pushbuttons and LED.

The Printer Main Board is attached to the printer mechanism and should be replaced as a unit with the printer mechanism if repair is needed. The unit is called the printer module.

The Printer Main Board connects to the Propaq, the battery pack, the EMP pushbuttons on the front panel, the printer mechanism (motor and print head), and the paper out and head up sensors.

Although the EMP has local processing power using an 80C552 microprocessor, the EMP receives print data and control information from the Propaq, and the EMP sends data to the Propaq. Communication between the two systems (Propaq and EMP CPUs) is done by sending and receiving data packets over serial communication lines.

Print Head

The print head assembly contains ten print heads consisting of 5 thermal printing dots each, a 320-bit shift register, and a 320-bit latch. The fifty printing dots cover the width of the printer paper (1 row). Forty bytes of print data are clocked one byte at a time into the shift register from the Printer Main Board. Once the data has been clocked in, it is copied to the latch by a latch enable control signal. Upon printing, only two print heads are enabled at one time to conserve power. All print heads are enabled within a 5.7 ms period. The enable period of each print head depends on the head temperature, which is sensed by the CPU through a head temperature sensing circuit. Once printing of the data is complete, the motor moves the paper to print the next row of dots.

Functional Level Description

The Printer Main Board consists of four functional blocks: CPU, printer, system power, and printer power. (See drawing # 800-0007-XX Sheet 1.) These blocks are interconnected by several control lines and buses. External to the main board are the keypanel housed in the EMP front chassis and the printer motor and print head, both parts of the printer mechanism.

The CPU block receives data and control information from the Propaq and sends data to circuits that control the functions of the printer.

The Printer block controls the motor speed, senses when paper is out, monitors the print head temperature, interfaces with the Propaq, and writes print head data (numerics and waveform data) to the print head.

The System Power block provides several dc power supplies to the EMP.

The Printer Power block provides the +24 V printer power supply.

Detailed Circuit Descriptions

Refer to the listed schematics located in Section 5, Diagrams, and to the parts lists located in Section 6, Replacement Parts.

CPU Subsystem

Drawing # 800-0007-XX Sheet 2

The CPU subsystem is designed around the 80C552 microprocessor with a multiplexed 16-bit address/8-bit data bus. The subsystem is comprised of the 80C552 microprocessor (U431), 32 k bytes of ROM (U550), and 32 k bytes of RAM (U540; with an option to install an additional 32 k bytes of RAM: U440).

The 80C552 contains four 8-bit ports plus an 8-port analog-to-digital converter internal to the device. Port P0 provides the lower 8 bits of address and the data bus lines. Port P2 provides the upper 8 bits of address lines. U530, when activated, latches the lower 8 bits of address to the address lines A0 to A7. Port P1 provides several control lines (designated PT0 to PT7) used throughout the EMP. Pins P3.4 and P3.5 are additional control lines (PT8 and PT9). Except for P3.4 and P3.5, port 3 provides several processor control lines and the serial transmit/receive ports for communicating with the Propaq CPU. Except for two pins, Port 4 provides the printer motor control lines. Pins P4.4 and P4.5 provide control lines used in RAM bank switching and device selection (RAM bank switching is not implemented in the EMP).

Port 5 provides 8 analog input lines to the internal A-D converter. These lines are used to monitor the print head temperature, EMP housing temperature, battery voltage, and +24 V supply.

The CPU controls the state of the EMP front panel LED using PT8 and U532C. The LED turns on when the printer is ready. It is off when the printer is not ready due to paper out, door open (head up), or other internal conditions.

The CPU enables the print heads through U332, U331, and U330. Only two print heads are enabled at one time by selecting one of the Y1 to Y5 outputs of U332. The signal drives one of the lines HEAD0 to HEAD4 high and enables the selected print heads. The time to enable all five print heads is 5.7 ms.Y6 of U332 (HEAD5) enables the latch in the print head. Y7 of U332 (HEAD 6) enables and disables the +24 V supply. HEAD6 is kept low whenever the printer is not used.

Prior to enabling the print heads, Y0 of U332 is selected to trigger the one-shot, U230A. During the one-shot's time-out, its Q/ output is held low, allowing the enable signals to be written. Once U230A's time-out expires, all enable lines are disabled.

The CPU writes and reads I/O devices by selecting them through U520. Address lines A12, A13, and A14 select the desired device. Port P4.5, P4.4 (IDLE/) and A15 enable U520.

Printer Subsystem

Drawing # 800-0007-XX Sheet 3

The motor controllers (U410 and U510) drive the printer stepper motor. Each motor controller drives one winding of the printer motor.

Print data is sent to the print head one byte at a time through the parallel-to-serial converter, U541. The CPU loads the print data onto the address bus AD0 to AD7 and then selects U541 by resetting WR/ and DEV0. Once the data is loaded into U541, PSEN/ is clocked once for each bit to be shifted out of U541 and clocked into the print head's shift register.

U231C, U231B, and U231D provide serial communications control between the Propaq CPU, the EMP CPU, and future expansion processors. Q244 connected to the output of U231C prevents any communication between the EMP and Propaq once the Propaq's VCC power supply shuts down. Without Q244, internal circuitry of U231C could possibly imply a communication status to the Propaq.

U531B detects when paper is out. Front panel LED power (PLED) provides current through Q411 to a photo-transistor in the printer assembly. When paper is present, light from the photo-transistor's LED reflects off the paper onto the photo-transistor's receptor. This signal is amplified by U531B, which results in the paper-out signal to the CPU. R510 and R511 connect to the cathode of the photo-transistor's LED. R530 connects to the photo-transistor's emitter.

The enable periods of the print heads depend on the print head temperature. U333C is a gain stage for the head temperature sensor circuit. Signal lines THERM1 and THERM2 connect to a thermistor in the print head assembly. The thermistor is the feedback resistor for the stage and controls the output of U333C. The output of U333C is digitized by the CPU (ADC0) to determine the head temperature.

System Power Subsystem

Drawing # 800-0007-XX Sheet 4

The EMP system power supply operates similar to the Propaq power supply. The EMP power supply is a high-efficiency switching power supply using an LT1071 regulator (U250). The regulator operates from battery power only upon startup. Once it is running at nominal operation, the power supply generates its own source (V3.5). The EMP power supply starts when the Propaq power supply is energized and the Propaq's Vcc supply (PP_VCC) is at nominal. PP_VCC then turns on Q140, which turns on Q240. By the time the EMP's power supply is operating, C140 has charged, turning off Q140 and Q240. The regulator then operates from the V3.5 supply.

As the regulator first starts, pin 1 of U250 is at ground potential. A soft start of the EMP supply is initiated as PP_VCC slowly charges C250, which slowly turns off Q243, raising U250 pin 1 from ground.

The EMP supply is turned off when PP_VCC drops as the Propaq shuts down. When PP_VCC goes low, Q241 turns off, allowing the base of Q242 to rise, turning it on. This pulls U250 pin 1 to ground, turning off the regulator.

The output of the regulator is connected to T350 and D350. When the regulator output is high, current flows through the transformer and the diode to C251, charging it. When the regulator output is off, C251 provides energy to the transformer.

Except for the +24 V printer supply, all supplies are generated at the output of T350.

U430 is a precision 5 V reference, which generates the AVREF+ voltage source.

U333D is a gain stage for another temperature sensor circuit. The thermistor is placed over the printer assembly to monitor the temperature in the EMP near the printer.

U333A is a unity gain voltage follower to apply the divided voltage to the A/D converter. This is to prevent loading of the voltage divider and changing the divide ratio.

Printer Power Subsystem

Drawing # 800-0007-XX Sheet 5

The +24 V supply, a variation of the boost converter, provides current for the print heads and motor. U220, a pulse width modulator controller, provides the pulses that switch Q310 and Q110. U210 is a driver device for the switching FETS, Q310 and Q210. T210 and its associated components provide cycle-by-cycle current limit to U220.

The +24 V supply is monitored and digitized by CPU using Q440 and its associated components.

Pulse Oximetry Option (SpO_2)

System Level Description

The Propaq pulse oximetry option (SpO_2) hardware includes two circuit boards, appropriate side-panel connectors, and related hardware. The pulse oximetry option can be installed either in the pulse oximetry option module attached to the rear of the monitor or in the EMP.

The two circuit boards include the SpO_2 Communications Processor (SCP Board) and the SpO_2 Board. The SpO_2 Board provides all necessary circuitry to receive and process oxygen saturation data from the Nellcor oxygen sensor. The SCP Board prepares the data for processing by the monitor's processor, and it handles all communications with the monitor.

This section gives a detailed circuit description on the pulse oximetry option. For cabling information, see Section 5. See Section 3 for details on opening and closing the EMP. Details include replaceable module removal/replacement procedures.

Overview

The SpO_2 option hardware consists of the following items:

- monitor/option interface circuit board (SCP board)
- SpO_2 circuit board,
- side-panel connectors (9-pin D and LEMO),
- in the case of the monitor/pulse oximetry option, the case attached to the rear of the monitor,
- in the case of the EMP, the expansion module case attached to the bottom of the monitor.

As shown in Figure 4-1, the SpO_2 signal provided by the oxygen transducer or sensor is first processed by the SpO_2 circuit board where it is converted to data, then the signal is passed to the SCP board where it is prepared for transmission to the Propaq monitor's main microprocessor. If both pulse oximetry and the printer are installed, the SpO_2 option is installed in the expansion module. If the pulse oximetry alone is installed, an SpO_2 option case is installed onto the rear of the monitor.

With the addition of Propaq options (Pulse Oximetry and/or printer), the single monitor battery was replaced with a dual battery pack containing two identical, lead acid batteries. This battery pack provides all power to the monitor and any added options. An SpO_2 option isolated power supply, powered by monitor batteries, resides on the SCP board, supplying power to the SpO_2 circuits. If the SpO_2 option is part of the expansion module, the SpO_2 power supply does not provide power to the printer in the expansion module. The printer circuit board provides power to the printer.

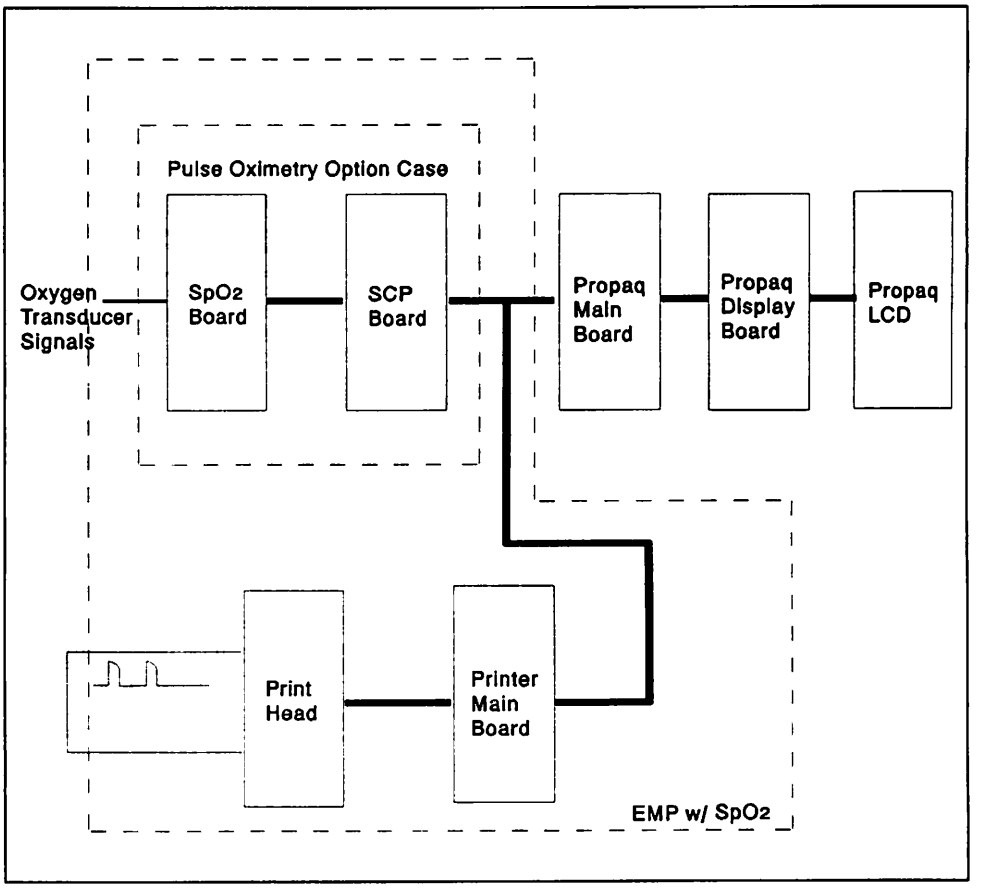

Fig. 4-1. SpO2 System Block Diagram

Two connectors on the side panel allow connection of either a NELLCOR patient cable (to the round LEMO connector) or an oxygen transducer (to the 9-pin D-type connector) directly to the Propaq. The patient cable includes a current-to-voltage (V-I) converter to convert the pulse oximetry current signal from the transducer to voltage before it is processed by the SpO_2 circuits. This V-I converter is also located on the SpO_2 circuit board, allowing direct connection of the transducer to the Propaq. When the transducer is directly connected, the internal converter is automatically switched into the pulse oximetry signal path; when the NELLCOR patient cable is connected, the converter is automatically switched out of the signal path.

Oxygen Transducers

The NELLCOR oxygen transducer senses oxygen content of functional arteriolar hemoglobin through the use of light passed through the sensor site. The reflective characteristics of hemoglobin at the wavelengths used allow the pulse oximetry circuits to obtain changing saturation levels, which can be processed to obtain the oxygen saturation percentage.

Wavelengths in the red and the infrared regions of light are produced by light emitting diodes (LEDs) manufactured to emit light at the required wavelengths. The reflected light is collected by a photodiode, which converts the light to an electrical signal. The LEDs are switched off and on under control of the SpO_2 microprocessor. Both are not on at the

same time. As the system receives the signal from the photodiode, it knows whether the signal was derived from the red or infrared LED. Because the photodiode is sensitive to light emitted from sources other than the LEDs (ambient light), an ambient light component must be considered during the processing of the SpO_2 data.

An internal calibration resistor in the transducer is used to identify the wavelengths of light produced by the LEDs. This information is required for proper processing of the SpO_2 data.

Functional Level Description

Figure 4-2 shows a functional block diagram of the SpO_2 circuit board. Refer to Figure 4-2 during the following discussion. The SpO_2 board consists of the following subsystems:

- internal preamp and switch
- ac-coupled amplifier
- inverting amplifier with variable gain stage
- synchronous detector
- splitter
- 5-pole low pass filters
- 16-bit ADC
- internal calibration amplifier
- CPU/Control
- LED current drivers
- compare amplifiers

The SpO_2 signal is provided by a transducer either directly connected to the D-connector or through a NELLCOR patient cable connected to the LEMO connector.

NOTE

Later versions of the Propaq Pulse Oximetry Option do not have the LEMO connector.

The CPU can determine which connector is used by looking for the calibration resistor signal. If the calibration resistor is sensed through the VCALIN1 line, the CPU knows the LEMO connector is being used, and a NELLCOR patient cable is connected. Sensing the calibration resistor through the VCALIN2 line indicates the D-type connector is being used. If transducers are connected to both connectors, a determination cannot be made, and the Propaq initiates an equipment alarm. Once the determination is made, the CPU can select the appropriate connector through the switch S1. The input signal is ac-coupled to remove the dc offset present within it. The result is a pulse wave form representing light levels from three sources: red LED, infrared (IR) LED, and ambient. An inverting pre-amplifier with a variable gain stage scales the signal to allow processing the best available pulse oximetry information.

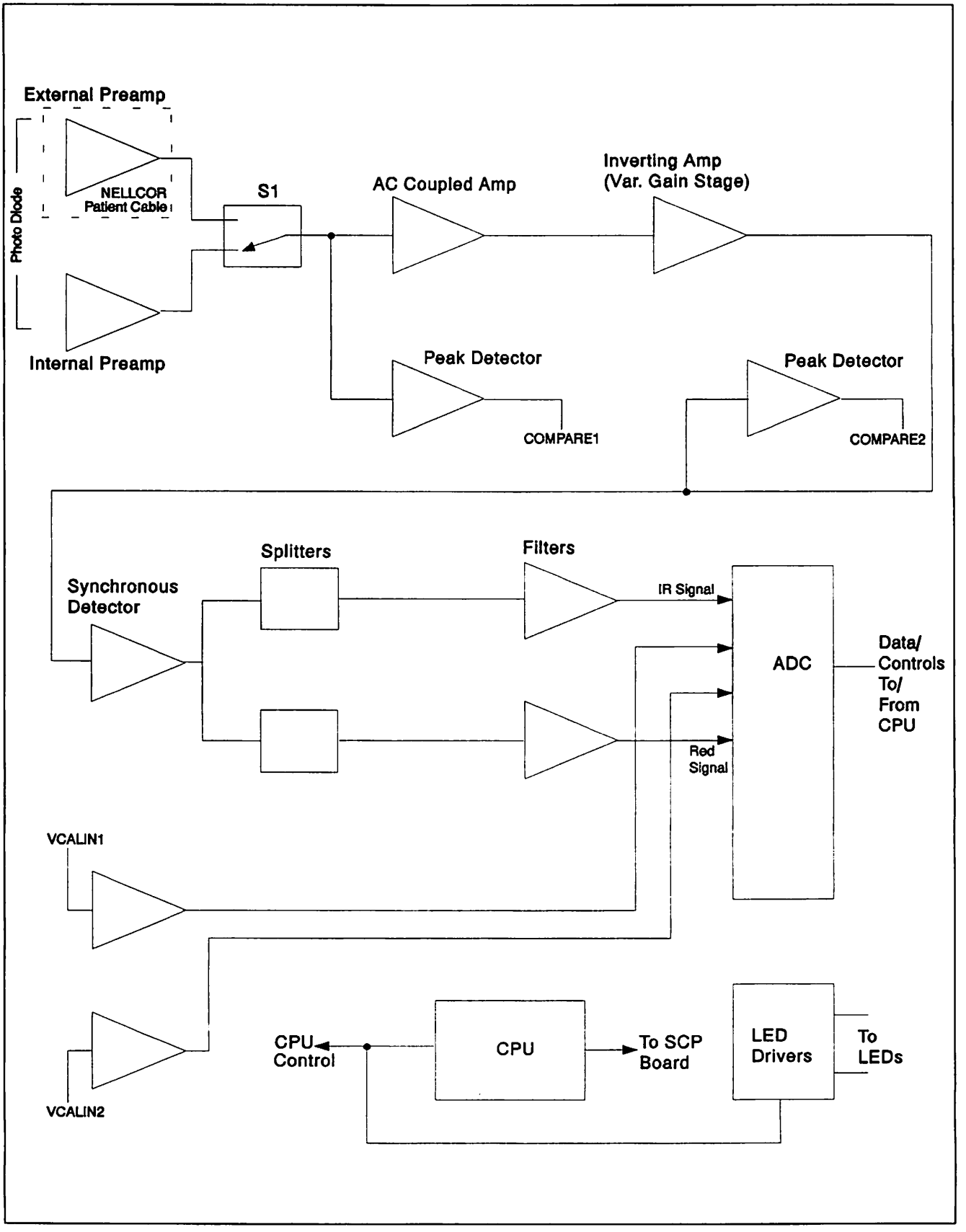

Fig. 4-2. SpO2 Functional Block Diagram

The CPU knows which pulse level of the wave form represents which wavelength of light, because it controls the current to the LEDs. When the red LED is activated, the wave form level indicates red light plus ambient light. When the IR LED is activated, the wave form level indicates IR light plus ambient light. When both LEDs are not activated, the waveform level indicates ambient light. All these levels are used to determine the SpO_2 saturation value. The synchronous detector inverts the ambient light signal so that the ambient light signal can be subtracted from either the red plus ambient light signal or the IR plus ambient light signal.

The pulses are filtered through 5-pole filter networks to remove the signal components above about 8 Hz. The resulting signals indicate the detected RED and IR light levels and can then be digitized. The data from the ADC is processed by the CPU and then sent to the SCP board for transmission to the Propaq monitor's CPU.

SpO_2 signal level is controlled through the variable gain stage of the inverting amplifier and the output current of the LED current driver. By controlling both signal gain and current drive, the CPU can maintain the best possible signal level for processing. Amplifiers sense the SpO_2 signal levels at two points, directly sending their outputs to the CPU. The CPU monitors these levels as it sets the gain stages of the inverting amplifier and LED current driver.

Detailed Circuit Descriptions

This section provides detailed descriptions of the SpO_2 circuitry. Component designators found on the schematics located in Section 5, Diagrams, are used in this description to identify components. Grid locations of the components on the schematics are indicated in parantheses, for example (B4).

SpO_2 Board

Schematic Drawings 00950; 7 pages

Input Selector/Amplifier

Schematic 2 of 7

Since there are two different input connectors providing unamplified (D-connector) or amplified (LEMO connector) signals, the CPU determines by the presence of a calibration resistor, which connector is being used, and selects the appropriate input. If the D-connector is being used, an internal amplifier must be switched into the signal path.

NOTE

Later versions of the Propaq Pulse Oximetry Option do not have the LEMO connector.

The CPU determines which connector is used by detecting the presence of the calibration resistor located inside the transducer through either the LEMO connector or D-connector. Once the determination has been made (LEMO or D connector), the CPU "sets up" the signal path accordingly.

If the transducer is connected to the D-type connector, the calibration resistor is sensed through VCALIN2 (H5), U21B (C5), and VCAL2 (A5); if a NELLCOR patient cable is connected to the LEMO connector, the calibration resistor is sensed through VCALIN1 (H5), U21A (D4), and VCAL1 (A4). Sensing through either connector is performed identically. The following description is for sensing VCALIN1.

VCALIN1 is connected to one end of the calibration resistor in the transducer. The other end of the resistor is connected to ground. Typically, the resistor value is from 6 kΩ to 10 kΩ. The resistor, in conjunction with R17 (E4), forms a voltage divider. The top of the voltage divider is supplied by a +2.5 V reference, REF2.5 (A4). With a transducer connected, the sensed voltage is in the range of +1.1 to +1.4 V. Without a transducer, the input of U21A is pulled to +2.5 V. The sensed voltage is buffered by U21A. The output of U21A connects to one of the SpO_2 ADC inputs (U20 on page 5 of 7, grid location G4) via switch U24 (page 5 of 7, grid locations C1 and C3) of the CPU. (Do not confuse the CPU's internal ADC with the SpO_2 ADC, U20 (F3), on page 5 of the schematics). Once the CPU determines which connector is being used, it sets the switch in U10A to select the output of the appropriate pre-amp.

There are two separate signal paths depending on which connector is used. If the D-connector is used, the input signal must first be converted from current to a voltage by U8 before it is passed to XX (output signal) through switch U10A (C1). If the LEMO connector is used, the converter in the patient cable has already made the I-V conversion, and the signal is routed directly through U10A to XX.

U10A is an electronic, 2-pole switch. When pin 15 of U10A is 0 V (D-connector selected), D2 is connected to S2, and D1/S1 is open. When pin 15 is 5 V (LEMO connector selected), D2/S2 is open and D1/S1 is closed. The LEMO control line (A2) from the CPU switches U10A to select the appropriate input. If the D-connector is selected, the LEMO control line activates U8 by closing switches U4C (C2) and U4D (C4). The +15 and -15 supply lines supply power to U8, allowing the converter to operate. The positive input of U8 rests at about +8 V due to a voltage divider network using R44 (F3) and R38 (F4).

AC-coupled Amplifier, Variable Gain Inverting Amplifier, Synchronous Detector, and Splitter

Schematic 3 of 7

The output signal XX is ac-coupled through R59 (D1), C55 (D1), and U13B (E1). U13B is an inverting amplifier with a gain of -1. The signal now contains positive and negative signal excursions. The composite signal is then selectively attenuated from 1/256 to 255/256 times to obtain the best signal level for further processing. The CPU controls the attenuation level through a multiplying DAC, U9 (E2), and amplifier U13A (G2). The output from the attenuator is then amplified again by U14B (B4), an inverting amplifier with a gain of X51. The combination of the processor controlled attenuator and U14B provides amplification factors from 0.20 to 51 in 1/256th step increments.

The CPU can continually monitor the input signal before and after amplification through two peak detector circuits, U7A (C2) and U7B (A4). These circuits operate identically with the exception that U7A is an inverting amplifier and U7B is non-inverting. This is due to the input signal inversions taking place through the signal path. By the time the input signal (XX) reaches U7A, it has been inverted once (negative going). The signal contains negative excursions with a maximum possible level of -15 V (although the signal should never reach this voltage). Only the U7A circuit is described here.

When the circuit first begins to acquire the transducer signal, C34 (B2) is at ground potential. As the negative excursions drop approximately 0.6 V below the charge on C34, D2 (B1) conducts, charging C34 through R37 (B2). The time constant of this RC network is 47 μseconds. As the signal rises, D2 stops conducting. C34 retains its charge for a period due to the relatively long time constant (23.5 mseconds) of C34 and R39 (C2). As the signal again drops to the conduction point of D2, C34 charges more and then retains the charge when D2 stops conducting. The charge on C34 builds and is maintained as long as the signal excursions continue to cause D2 to conduct. In this manner, C34 provides a peak voltage level representing the maximum excursions of the input signal. The CPU periodically monitors the output of U7A, checking the voltage level. If the CPU detects voltage levels approaching clipping voltage, the CPU can reduce the LED drive current (see the description of the LED drivers later in this description).

Since the CPU controls when the LEDs are turned on and off, it knows the precise time at which the input signal levels represent the three types of light. It is at these switch points that the input signal is switched between the inverting and non-inverting inputs of U14A. After the signal has been amplified, checked for safe operating levels, and rectified, the signal components representing red and infrared light levels are split from each other. As with rectification, the timing required to split the signals is controlled by the CPU. U15A (F4) and U15B (F3) are opened and closed at precise times, allowing only red or IR signals to pass through. The control line REDGATE/ (A5) controls U15B; the control line IRGATE/ (A5) controls U15A.

Filter Networks

Schematic 4 of 7

After the signals are split into their respective red and IR components, the high-frequency components of the pulse wave form are removed through the filter networks. Each of the three 5-pole active filters has a -3 dB point of aproximately 8 Hz. The red filter network gain is approximately 9.1. the IR filter network gain is X4.6. Both signals are slightly elevated above ground through voltage divider network, R12 and R68 (B5) and REF2.5 (+2.5 V). The output signals from these filters are slowly changing levels following the blood pulses through the sensor site. The IR wave form data is used to create the SpO_2 plethysmograph.

ADC

Schematic 5 of 7

U20 (F3) is a 16-bit ADC. The device is clocked by an 800 kHz crystal (pins 3 and 4) and can select one of two inputs (pins 19 and 24). Input selection is controlled by the CPU (pin 13). The voltage reference is +2.5 V (pin 20) from the REF2.5 reference line. The converted data is clocked to the CPU (SDATA pin 15) by a signal controlled by the CPU (SCLK pin 14).

There are four inputs signals that are periodically digitized: VCAL1, VCAL2, RED_ADC, and IR_ADC. VCAL1 and VCAL2 are digitized about eight times per second. RED_ADC and IR_ADC are digitized about 57 times per second. To set up the inputs for digizing, the CPU selects the desired ADC input channel using ADCCHN (H4), which is connected to pin 13 of the ADC, and selects either the resistors or the transducer light signals for digitization using the RESISTORS control line (A3) connected to electronic switches U24A, U24B, U24C, and U24D. (Since only one of the resistors is present, only one will be digitized.) Once the appropriate switches are closed and the channel is selected, the CPU signals the ADC to start by setting pin 12 (ADCSTART/) high.

U19 (B3) is the +2.5 V reference (REF2.5). U18 (C5) is the -5 V supply (-VA).

LED Drivers

Schematic 6 of 7

The LED drivers provide up to 50 mA to the LEDs. The CPU controls how much current is provided by dynamically adjusting the reference voltage to the driver amplifier, U3A (E2). U1 (C4) provides the reference voltage, which is selectively switched for the IR and red LEDs using U4A (E4) and U4B (E5). The CPU adjusts the reference voltage for red or IR by changing the data to U1 (a multiplying DAC) before the voltage is switched to the amplifier. The CPU attempts to maintain the best possible drive current without clipping the signal from the transducer.

The control signals REDLED/ and IRLED/ (A2) control the switches U4A and U4B and the transistor network that drives the LEDs. The LEDs are never on at the same time, however, they are both off to detect ambient light.

When REDLED/ is low (IRLED/ is high), U4A is closed, placing the red reference voltage at pin 3 of U3A. Because REDLED/ is low, Q5 (F3) is off allowing Q3 (F3) to turn on and conduct current from the LED through R1 (G3), the sense resistor. With REDLED/ low, Q2 (G1) turns on allowing current to flow from the positive supply to the red LED anode. Because IRLED/ is high, Q1 (F2) is off (no current conduction) and Q6 (G3) is on, which pulls the base of Q4 (G2) to ground, ensuring it remains off. The current path is from VCC, through Q2, the red LED, through Q3 and the sense resistor R1.

The voltage across the sense resistor is fed back to U3A, which compares it to the reference voltage and adjusts the drive on Q3 accordingly.

When REDLED/ goes high and IRLED/ goes low, the reference voltage is applied through U4B to U3A. With REDLED/ high, Q2 is off and Q5 is on, turning off Q3. With IRLED/ low, Q1 is turned on, allowing current to pass to the IR LED anode. Q6 is turned off, allowing U3A to pull up the base of Q4 until it conducts. The current path is from VCC, through Q1, the IR LED, Q4 and the sense resistor R1. The voltage across the sense resistor is fed back to U3A, which compares it to the reference voltage and adjusts the drive on Q4 accordingly.

When both IRLED/ and REDLED/ are high, both switches (U4A and U4B) are open and all the drive transistors are off. The voltage divider network, R2 (F4), R4 (G4), and R3 (G4) pulls the reference input of U3A slighly negative. This causes U3A to drive its output negative. However, D1 (E3) prevents the output of U3A from going more than about 0.6 V below ground so that the drive transistors Q3 and Q4 can quickly be turned on when needed.

CPU

Schematic 7 of 7

U5 (C3) is the CPU, which is the processor used elsewhere in the Propaq. U6 (G2) provides 64 k bytes of ROM. U12 (F3) provides 8 k bytes of RAM. U2 (E2) is an address bus latch controlled by the ALE line (pin 48) of the CPU. U16 (E1) is a shift register allowing the DAC data to be serially shifted out of the CPU into U16 and clocked onto the DAC data lines. U11A (A1) and U11B (A4) provide the REDGATE/ and IRGATE/ signals that control the splitter switches. The rest of the components below the CPU are the typical Propaq reset and startup network. See the Propaq monitor circuit descriptions for details.

SCP Board

Schematic Drawings 810-0008-XX; 4 pages

The SCP board provides the following three functions:

- isolation barrier between Propaq and SpO_2 circuits
- power to the SpO_2 circuits
- SpO_2 sound generation
- transmission of SpO_2 data to monitor processor

Power Supply and Isolation

Schematic 2 of 4

The SpO_2 power supply subsystem operates similar to the other power supply subsystems in the Propaq. Battery voltage is supplied to a switching regulator (U2) that generates a pulse wave form on the primary side of T1. The secondary side of T1 uses several taps to generate different voltage levels, which are rectified and filtered as necessary. Feedback regulation is provided through U1 on the isolated side and ISO1 across the isolation barrier.

As with the Propaq monitor, signals crossing the isolation barrier are transmitted and received through opto-couplers.

CPU

Schematic 3 of 4

The SCP board's CPU is similar to other Propaq processor configurations. The CPU (U6) is an 80C552 supported by ROM (U11), RAM (U7), and address latch (U9). The CPU processes the SpO_2 data and packetizes it for transmission to the Propaq. The CPU also receives data and information from the Propaq. The information is sent and received via U10.

Sound Generator

Schematic 4 of 4

The speaker in the SpO_2 option is driven by a sound generator (U4), which is controlled by a pulse width modulator and filter network.

Section 5
Diagrams

This section contains all electrical schematics, power distribution and cabling diagrams, block diagrams, board layouts (where applicable) and assembly drawings (where applicable) for the Propaq 100-Series monitors and the EMP and SpO_2 options.

For a list of replaceable parts related to these diagrams, see Section 6, Replacement Parts. The following table lists schematics/board layouts as they are ordered in the foldout pages at the rear of this section.

LIST OF SCHEMATICS/BOARD LAYOUTS		
Title	**Drwg #**	**# Sheets**
Cabling Diagrams		
Cable Location Diagram	Fig. 5-1	N/A
Main Board to Recharger Board Cable	Fig. 5-2	N/A
AAMI ECG to Main Board Cable	Fig. 5-3	N/A
HP ECG to Main Board Cable	Fig. 5-4	N/A
6-Pin P1/P2 to Main Board Cable	Fig. 5-5	N/A
HP P1/P2 to Main Board Cable	Fig. 5-6	N/A
T1/T2 to Main Board Cable	Fig. 5-7	N/A
Analog and Speaker Output to Main Board Cable	Fig. 5-8	N/A
RS423 to Main Board Cable	Fig. 5-9	N/A
Recharger Board to Battery Cable/Expansion Connector	Fig. 5-10	N/A
Battery Compartment Temperature Sensor Cable	Fig. 5-11	N/A
External Power Connector to Recharger Board Cable	Fig. 5-12	N/A
Expansion Connector Cable	Fig. 5-13	N/A
LCD to Recharger Board Cable	Fig. 5-14	N/A
LEDs and Switch to Recharger Board Cable	Fig. 5-15	N/A
SpO_2 Cables	Fig. 5-16	N/A
Pump Cable	Fig. 5-17	N/A
SCP Board to Rear Chassis Expansion Conn. Cable	Fig. 5-18	N/A
Expansion Module Battery to Printer Cable	Fig. 5-19	N/A
SCP Board to Printer Main Board Cable	Fig. 5-20	N/A
Printer Main Board to Key Board Cable	Fig. 5-21	N/A
Printer Main Board to Rear Chassis Expansion Connector Cable	Fig. 5-22	N/A
SOOM Board to Sub D Oximeter Sensor Cable	Fig. 5-23	N/A
SOOM Board to LEMO Oximeter Sensor Cable	Fig. 5-24	N/A

LIST OF SCHEMATICS/BOARD LAYOUTS		
Title	**Drwg #**	**# Sheets**
Block Diagrams		4
System Level Block Diagram	Sheet 1	
Isolated Patient Circuits Block Diagram	Sheet 2	
Non-Isolated Circuits Block Diagram	Sheet 3	
Recharger and Power Supplies/Distribution	Sheet 4	
Main Board		
PCB 1st Level	824-0147-XX	2
PCB 2nd Level	824-0171-XX	5
Schematics	800-0010-XX	12
Recharger Board		
PCB 1st Level	824-0145-XX	1
PCB 2nd Level	824-0170-XX	1
Schematics	800-0012-XX	4
Interconnect Board		
PCB	824-0173-XX	1
Schematic	800-0015-XX	1
EL Monitor, Assembly Drawing	824-0151-XX	1
EL Front Panel, Assembly Drawing	824-0149-XX	2
EMP EL Front Panel, Assembly Drawing	824-0177-XX	1
Rear Chassis, EL, Assembly Drawing	824-0150-XX	4
HP Vent Plumbing, Assembly Drawing	824-0184-XX	1
HP Cuff Plumbing, Assembly Drawing	824-0185-XX	1
Cardiac Monitor, Assembly Drawing	824-0009-XX	1
Printer Board		
PCB	824-0064-XX	3
Schematic	800-0007-XX	5
Expansion Module/Monitor, Assembly Drawing	824-0070-XX	1
Expansion Module/Monitor, Assembly Drawing	824-0069-XX	3
Paq10 Keyboard Schematic	800-0006-XX	1
SCP Board		
PCB	824-0108-XX	2
Schematic	800-0008-XX	4
Minisoom Assembly		
PCB	079590	1
Schematics	009590	7
SpO_2 for Propaq, Assembly Drawing	824-0106-XX	2

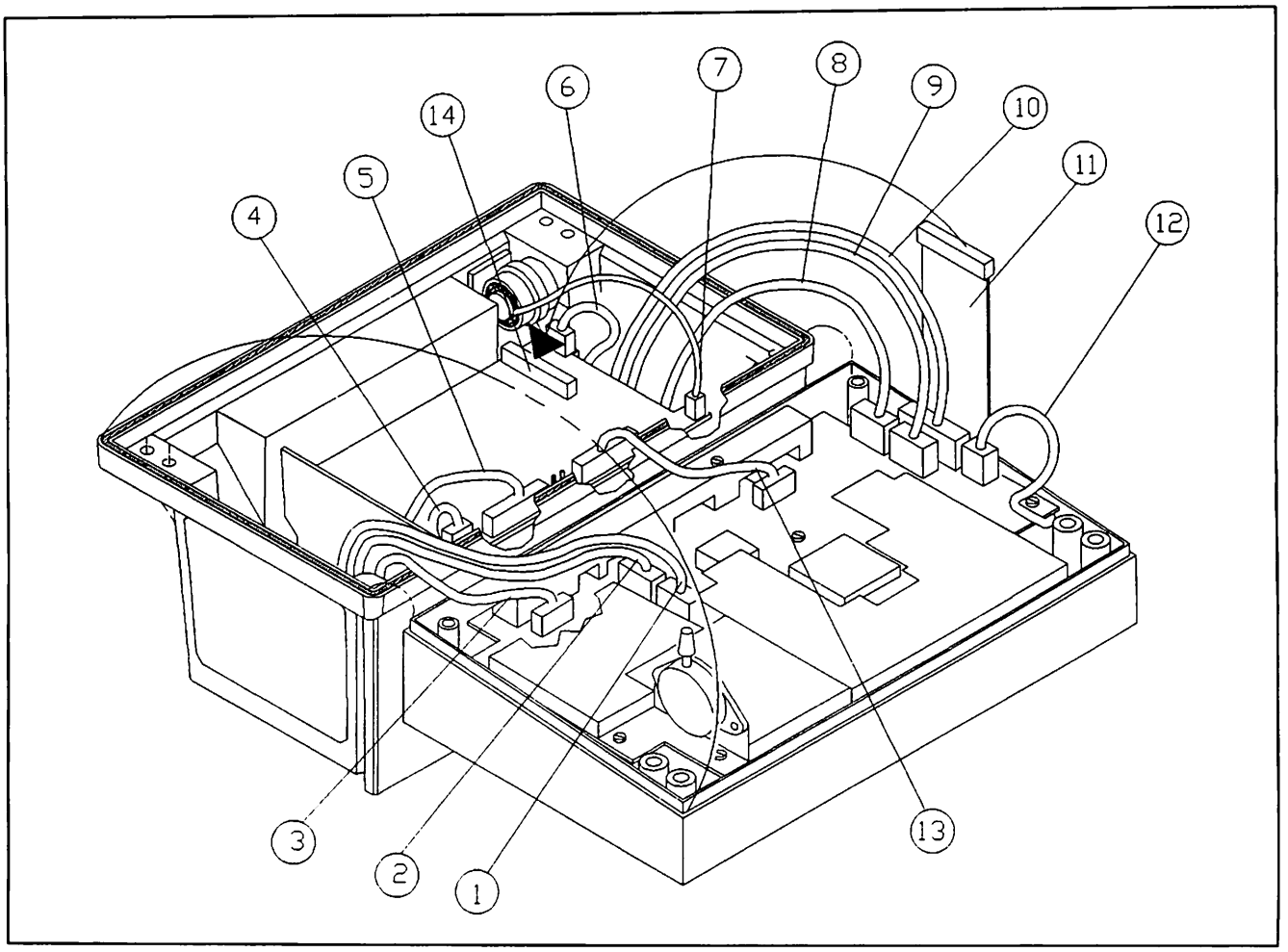

Fig. 5-1. Cable Location Diagram

Table 5-1. Location of Cables and Connectors

No.	Description or From Location	To Connector	On Board
1	Temperature (T1 and T2)	P8	Main
2	IBP Connector (P1 and P2)	P7	Main
3	ECG Connector	P6	Main
4	Battery Compartment Temperature Sensors	P1	Recharger
5	Battery and Expansion Connector	P4	Recharger
6	Power Switch and LED (Right Side Panel)	P2	Recharger
7	Dc Input Connector	P3	Recharger
8	Communications Connector	P3	Main
9	Analog Output and Speaker Connector	P5	Main
10	Expansion Connector	P4	Main
11	To Main Interconnect Board	P6	Recharger
12	Alarm LEDs	P9	Main
13	Connector P5 on Recharger Board	P1	Main
14	Pump Power Cable	P7	Recharger

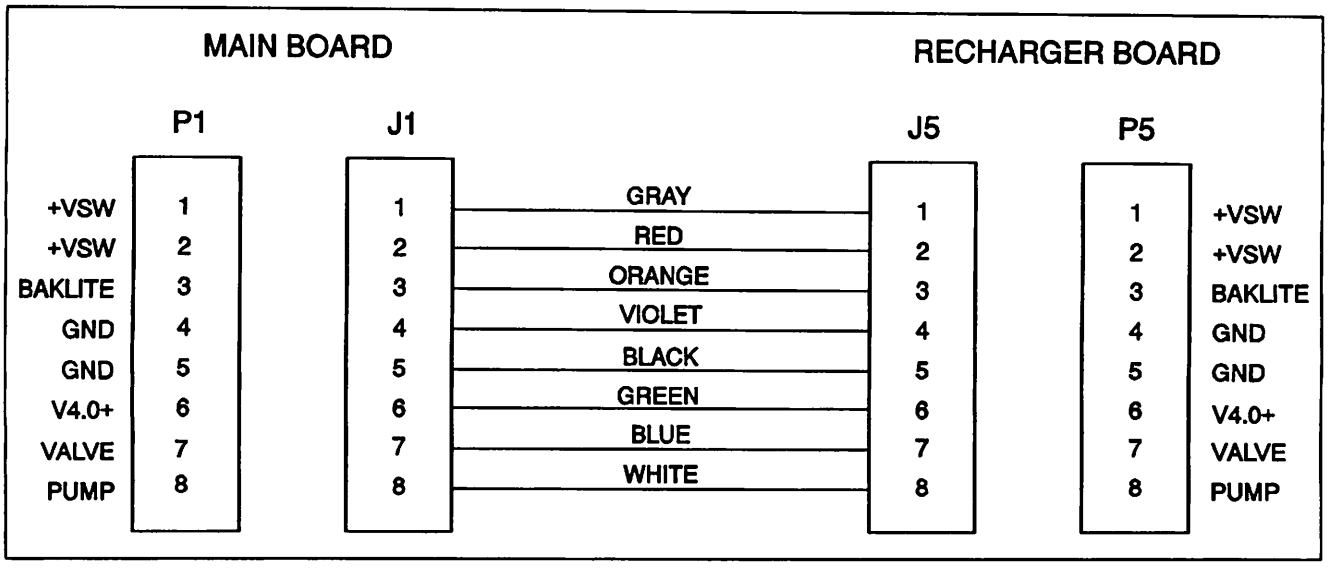

Fig. 5-2. Main Board to Recharger Board Cable

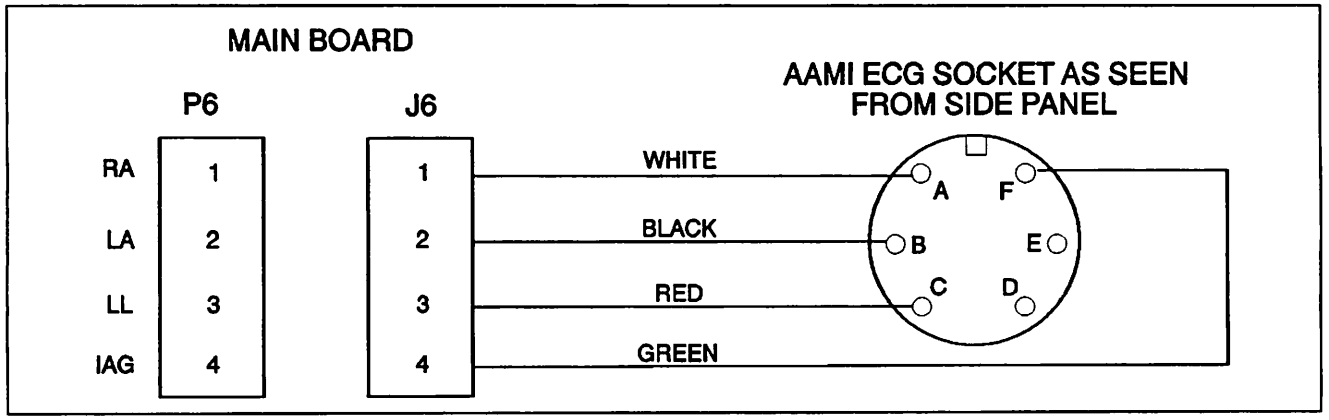

Fig. 5-3. AAMI ECG to Main Board Cable

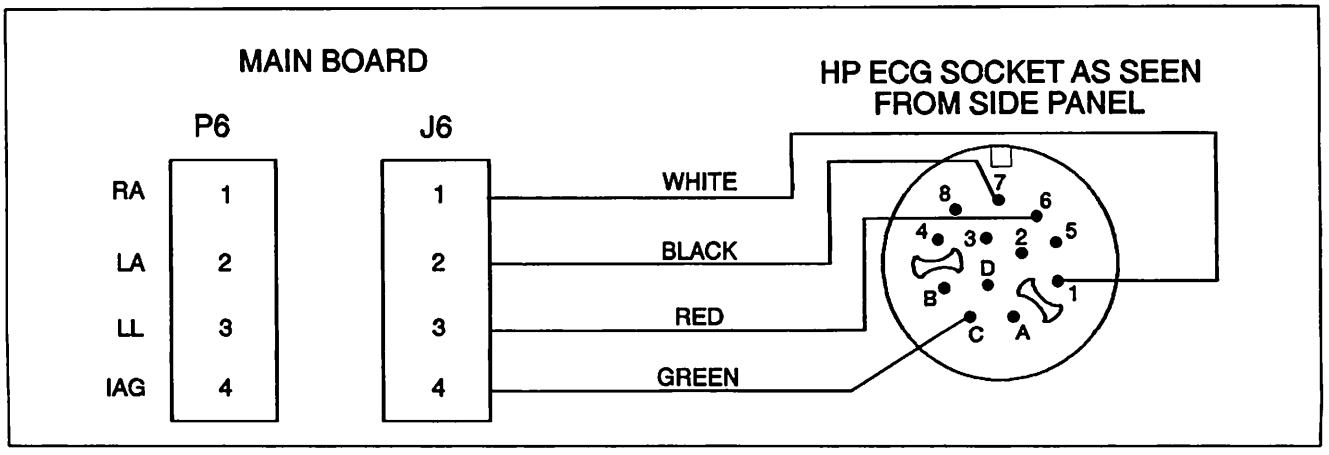

Fig. 5-4. HP ECG to Main Board Cable

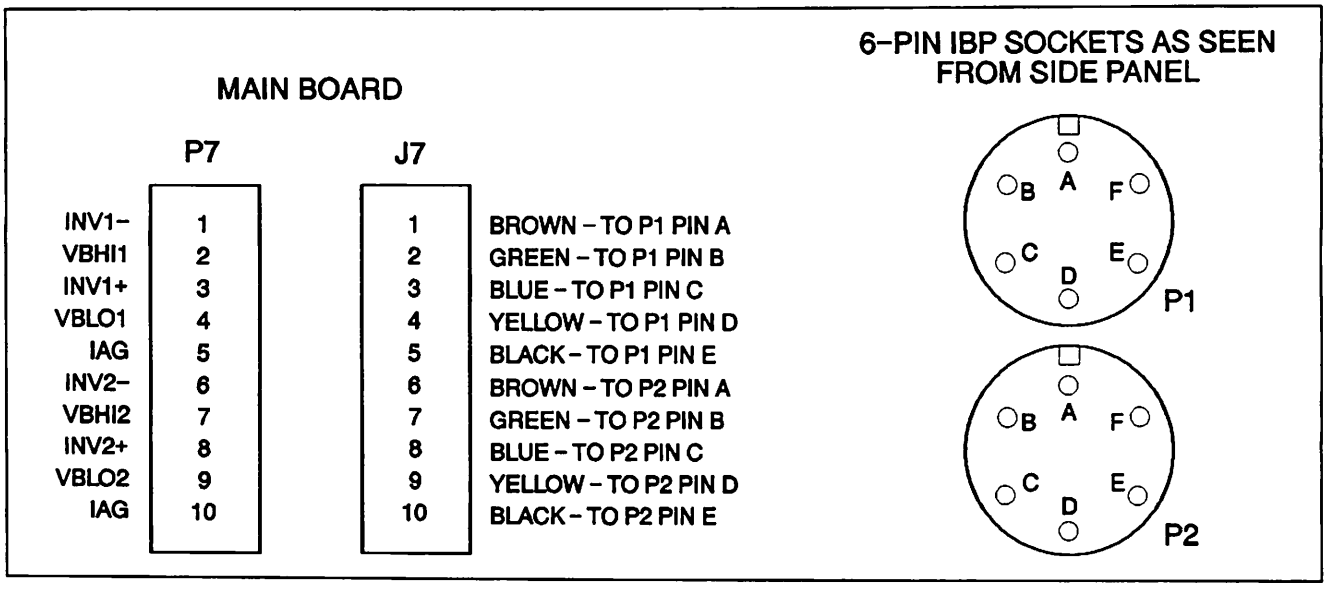

Fig. 5-5. 6-Pin P1/P2 to Main Board Cable

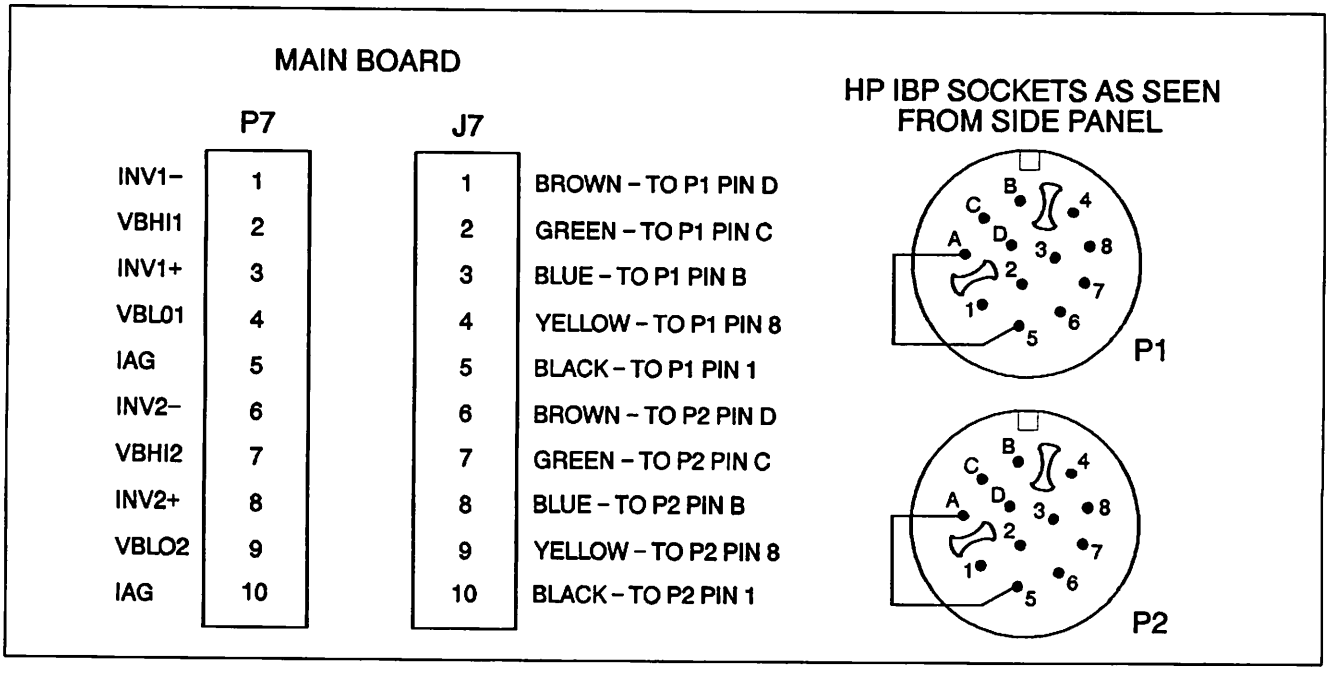

Fig. 5-6. HP P1/P2 to Main Board Cable

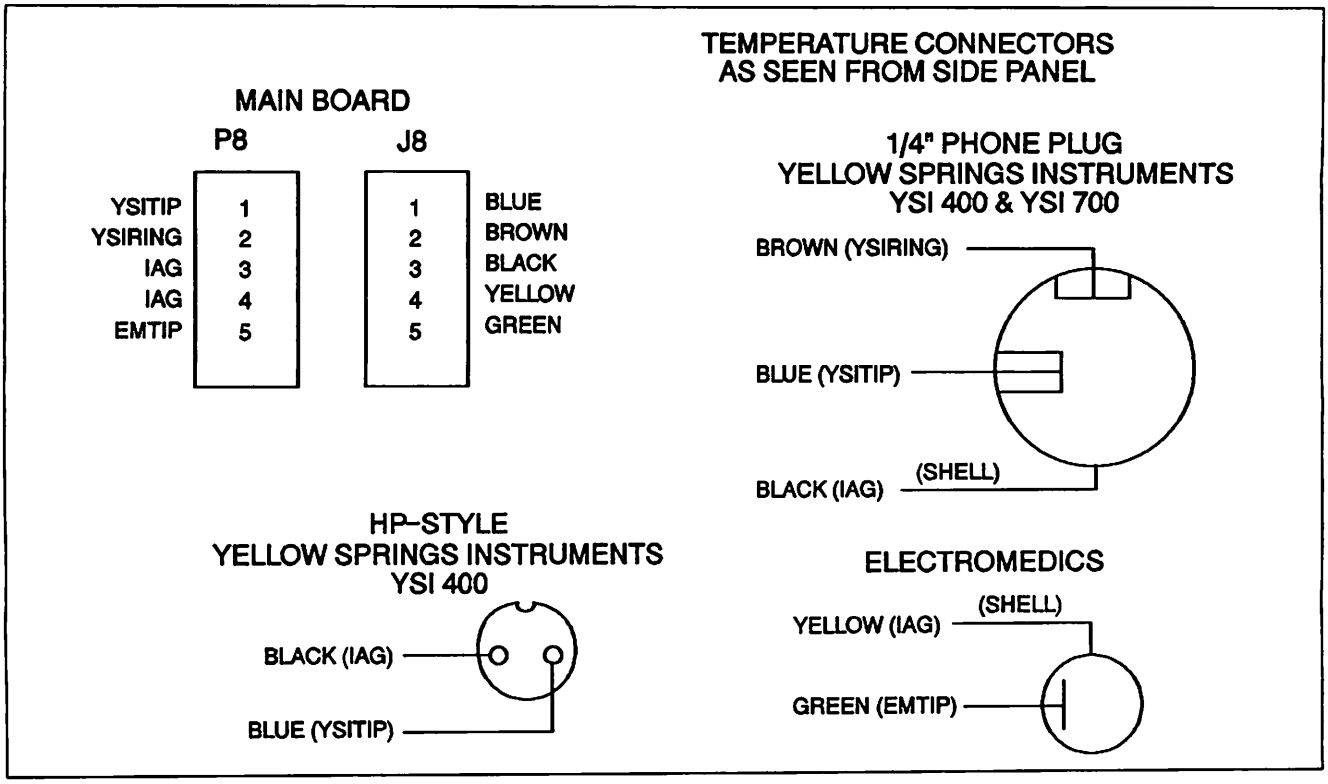

Fig. 5-7. T1/T2 to Main Board Cable

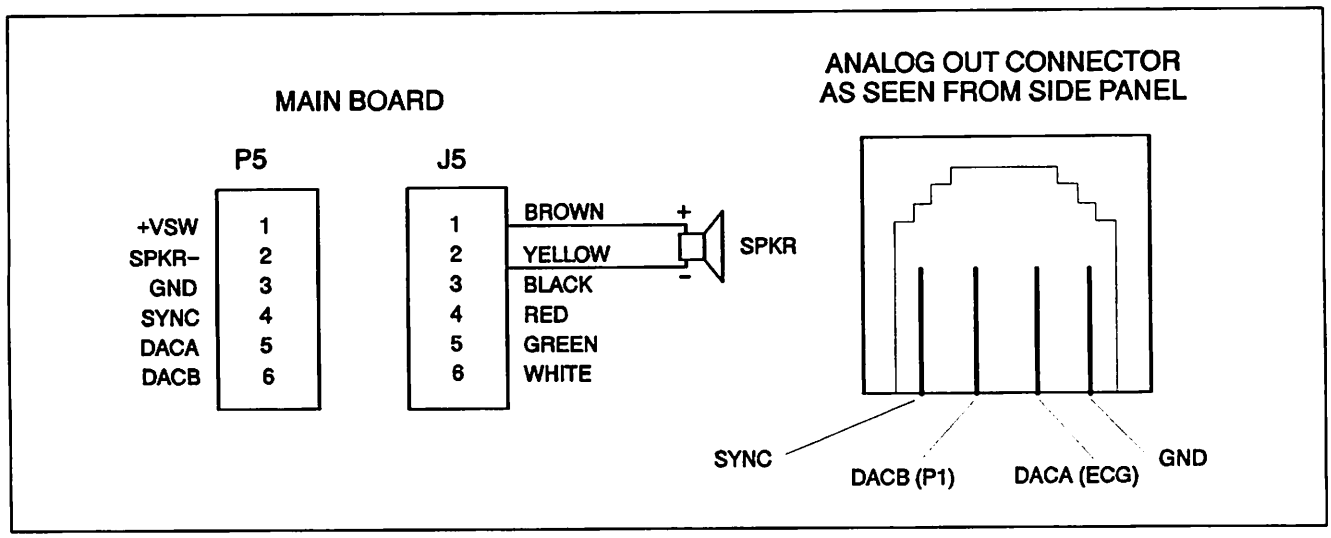

Fig. 5-8. Analog and Speaker Output to Main Board Cable

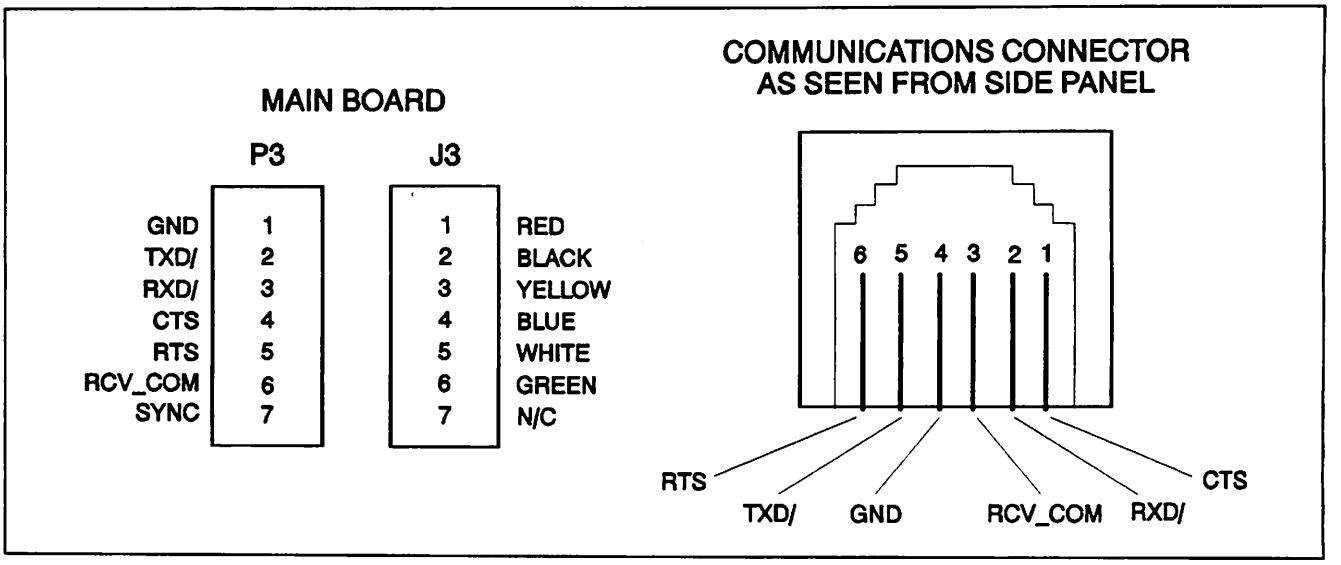

Fig. 5-9. RS423 to Main Board Cable

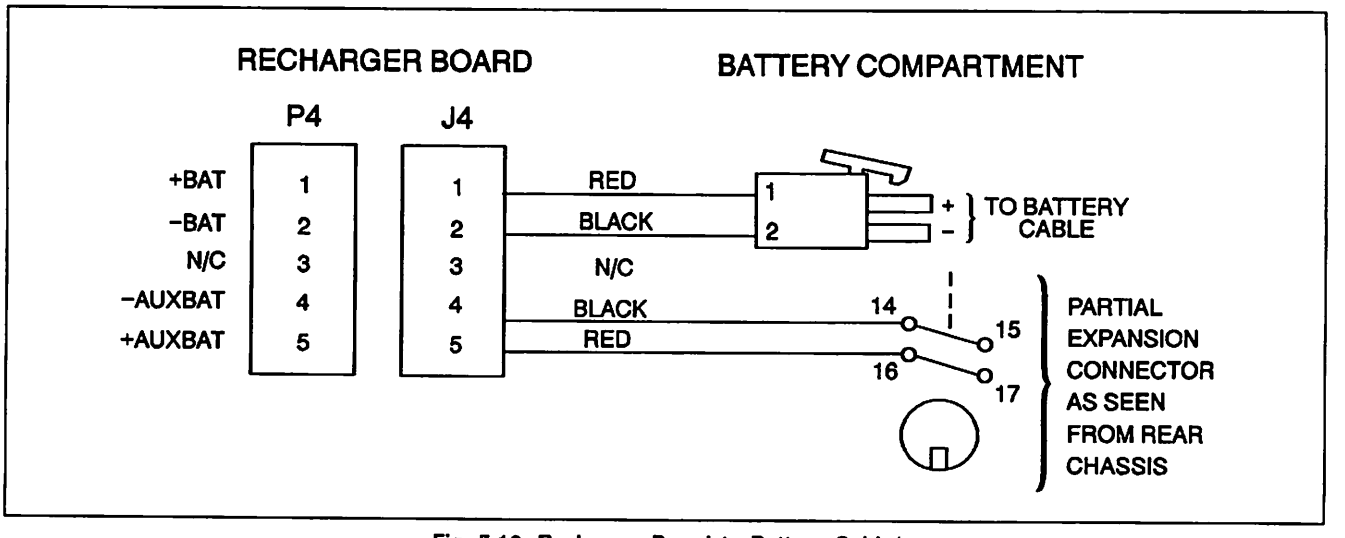

Fig. 5-10. Recharger Board to Battery Cable/ Expansion Connector

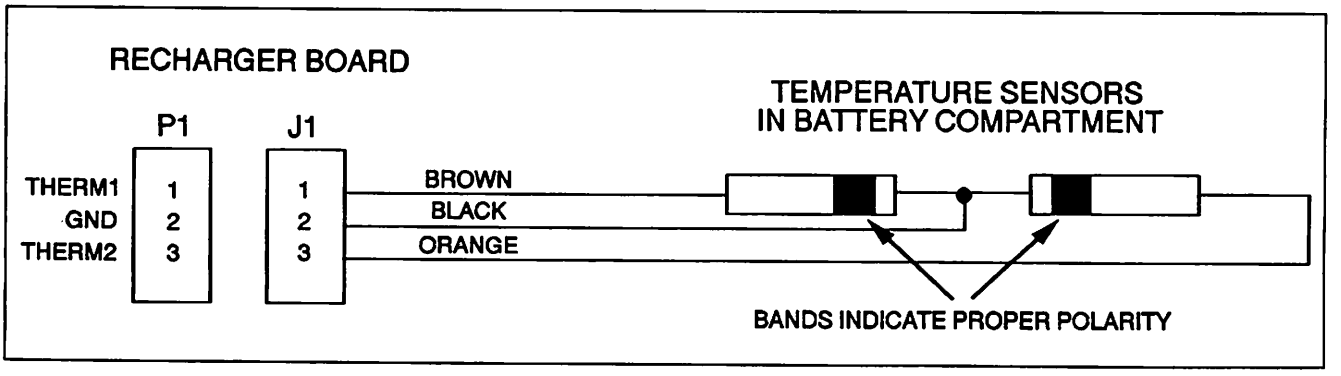

Fig. 5-11. Battery Compartment Temperature Sensor Cable

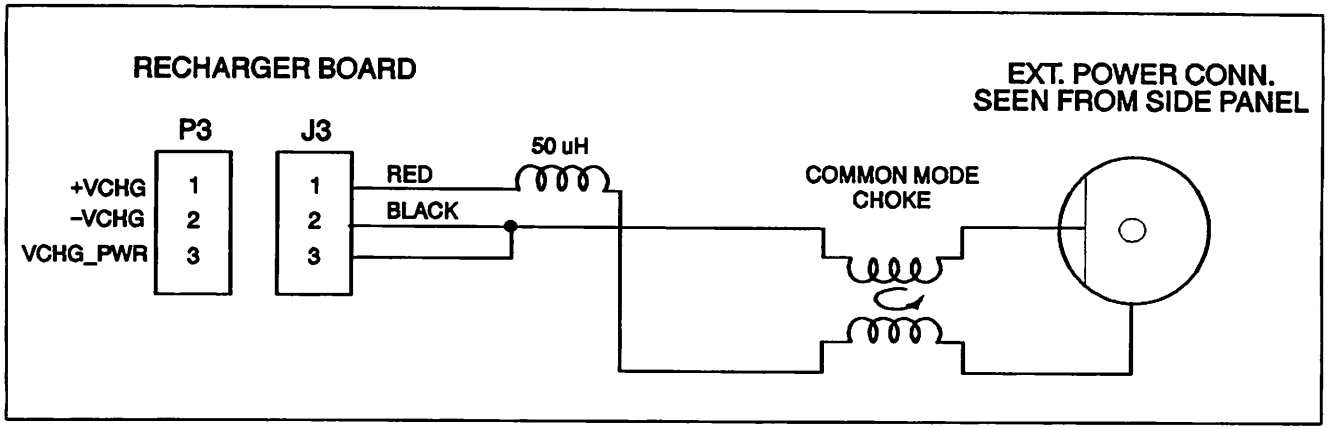

Fig. 5-12. External Power Connector to Recharger Board Cable

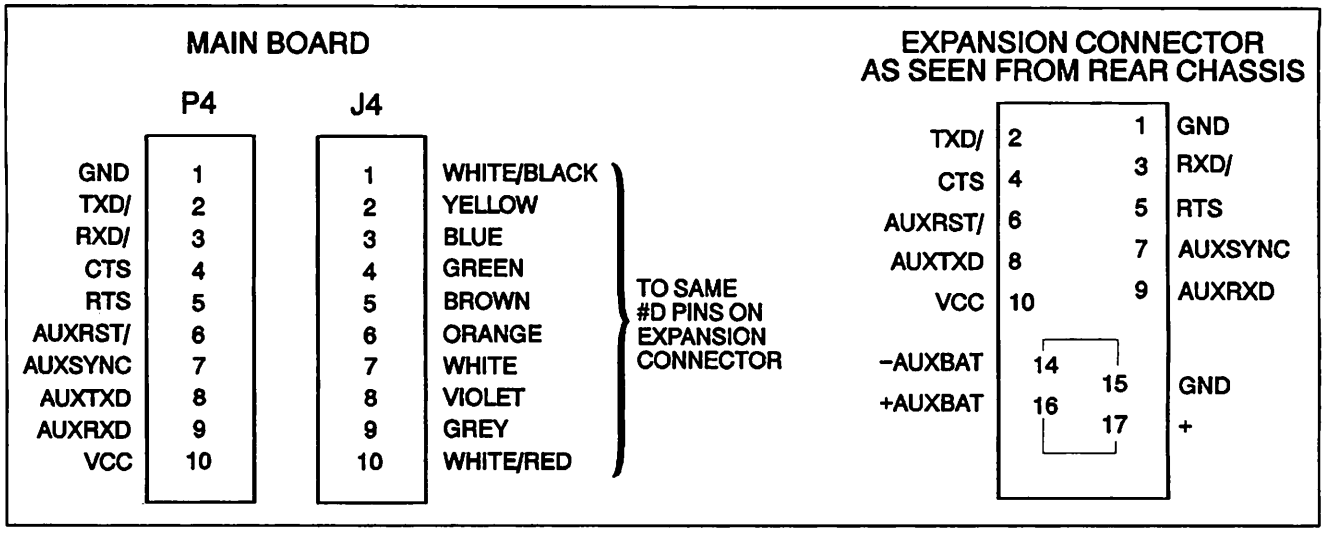

Fig. 5-13. Expansion Connector Cable

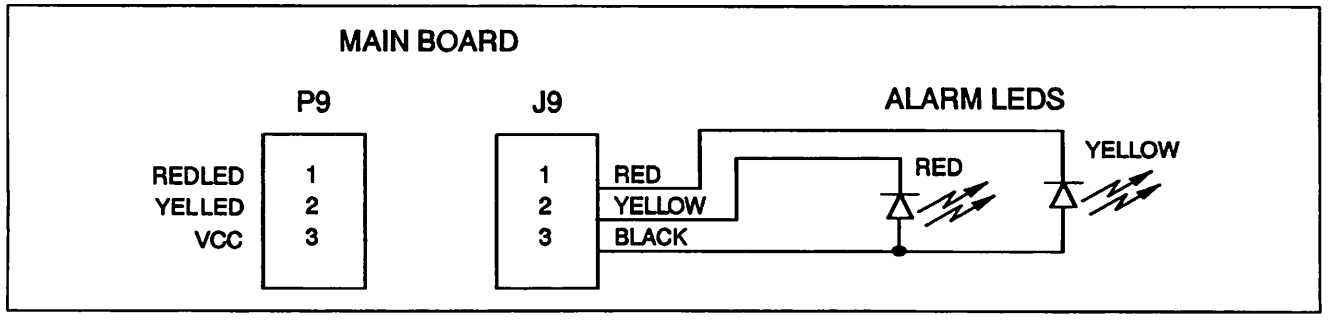

Fig. 5-14. LCD to Recharger Board Cable

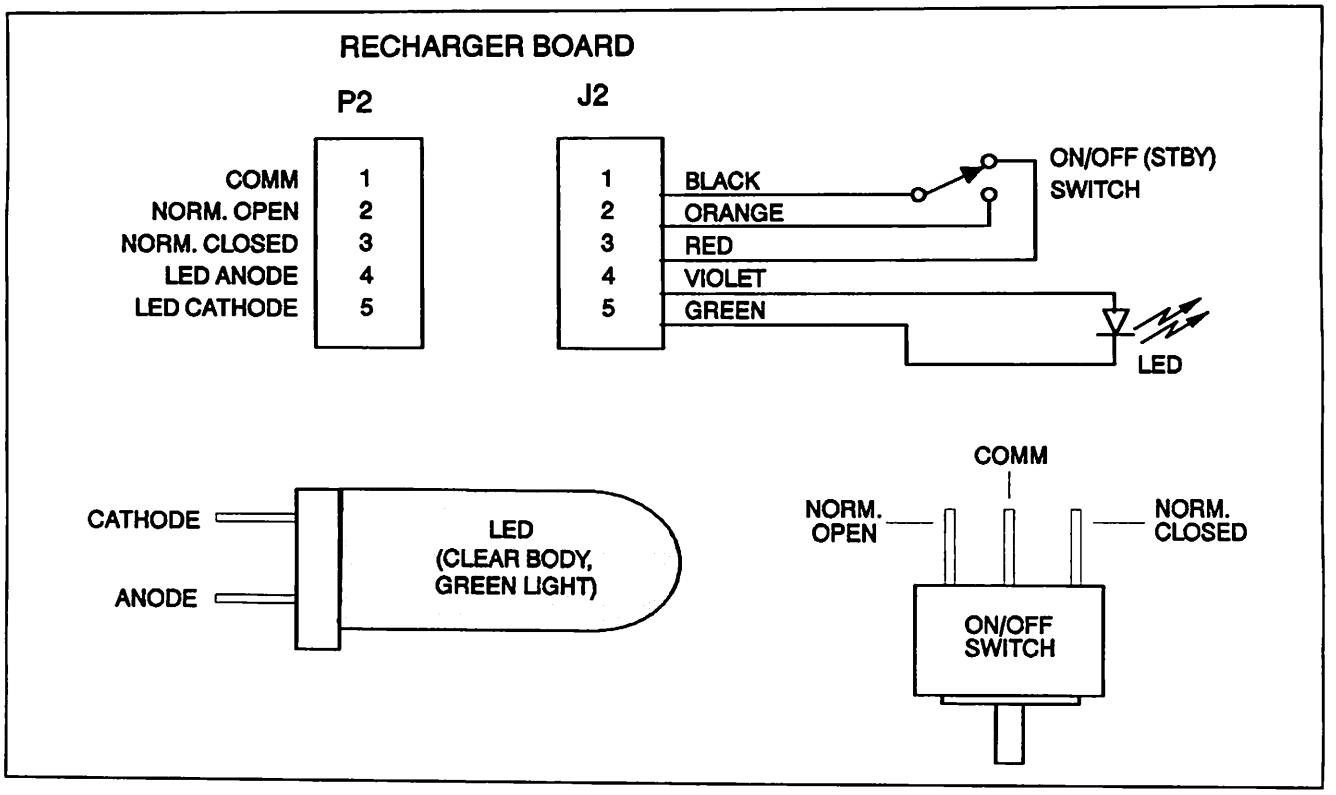

Fig. 5-15. LEDs and Switch to Recharger Board Cable

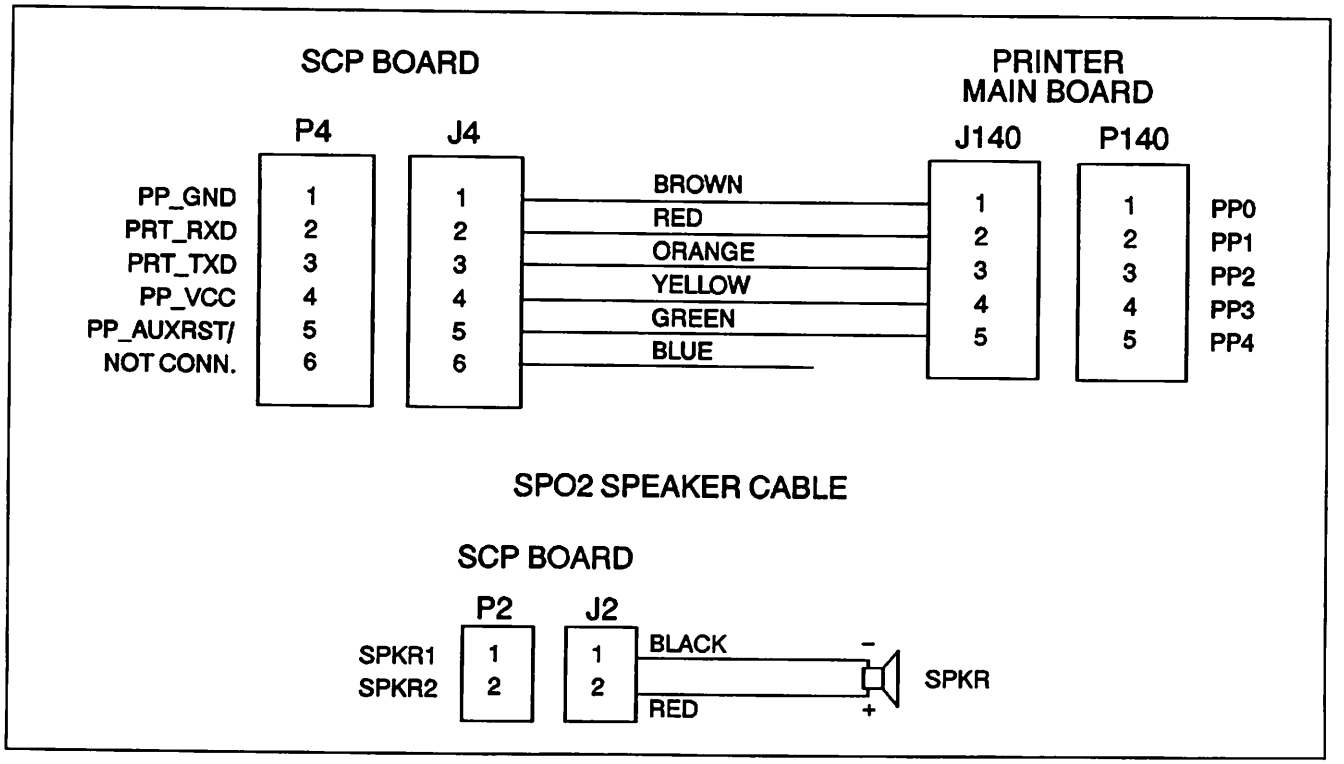

Fig. 5-16. SpO2 Cables

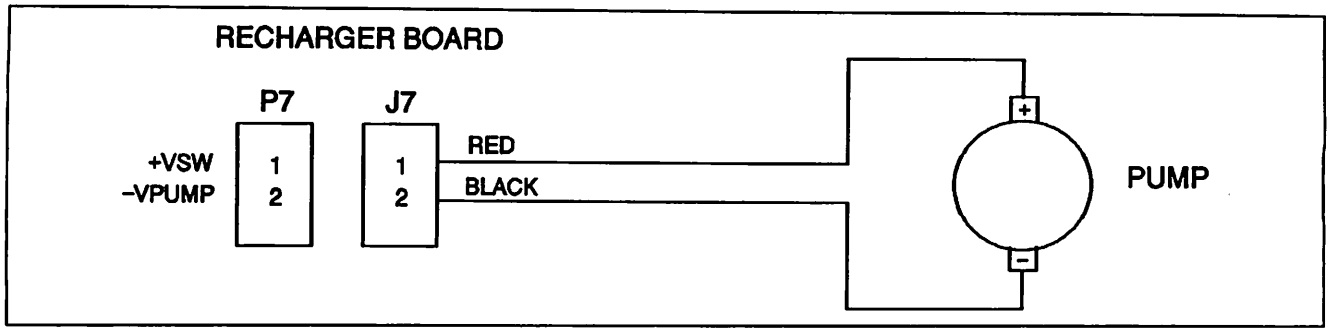

Fig. 5-17. Pump Cable

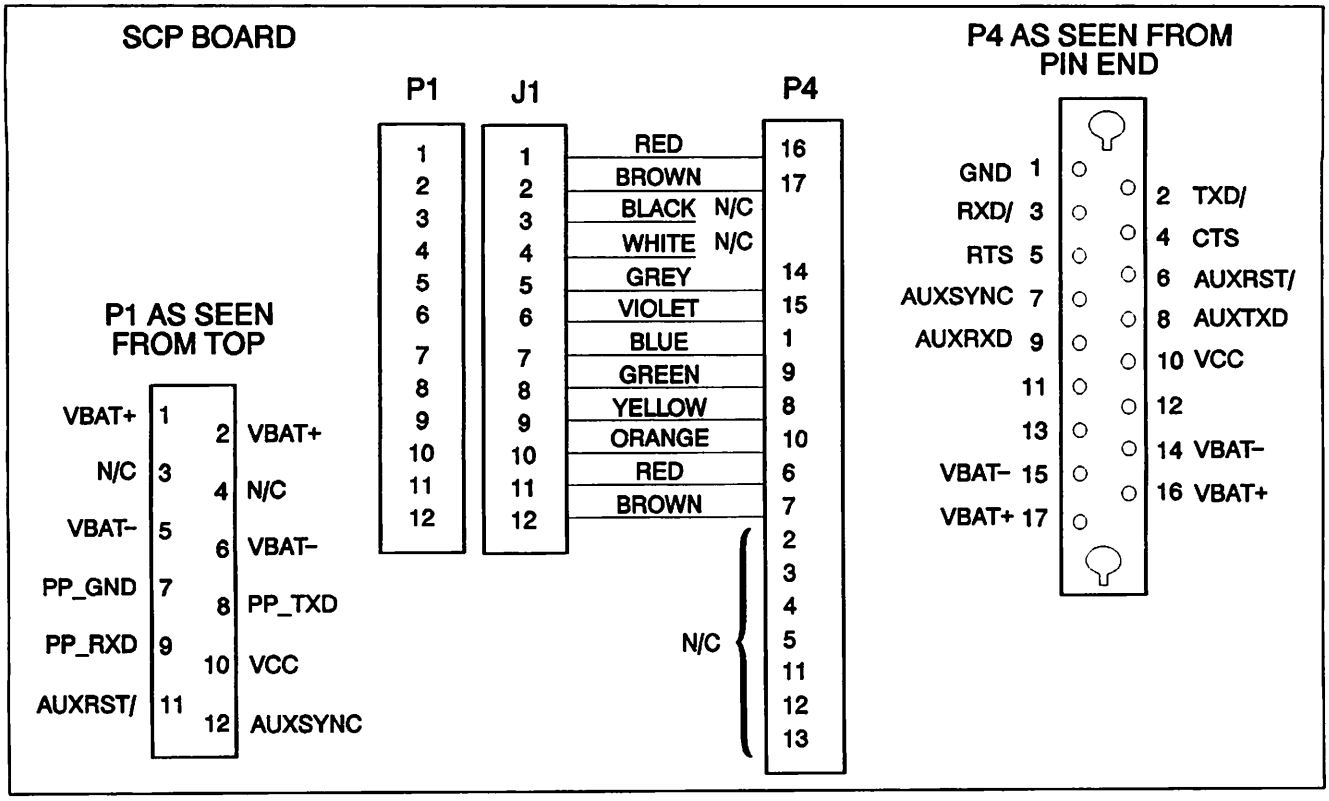

Fig. 5-18. SCP Board to Rear Chassis Expansion Connector Cable

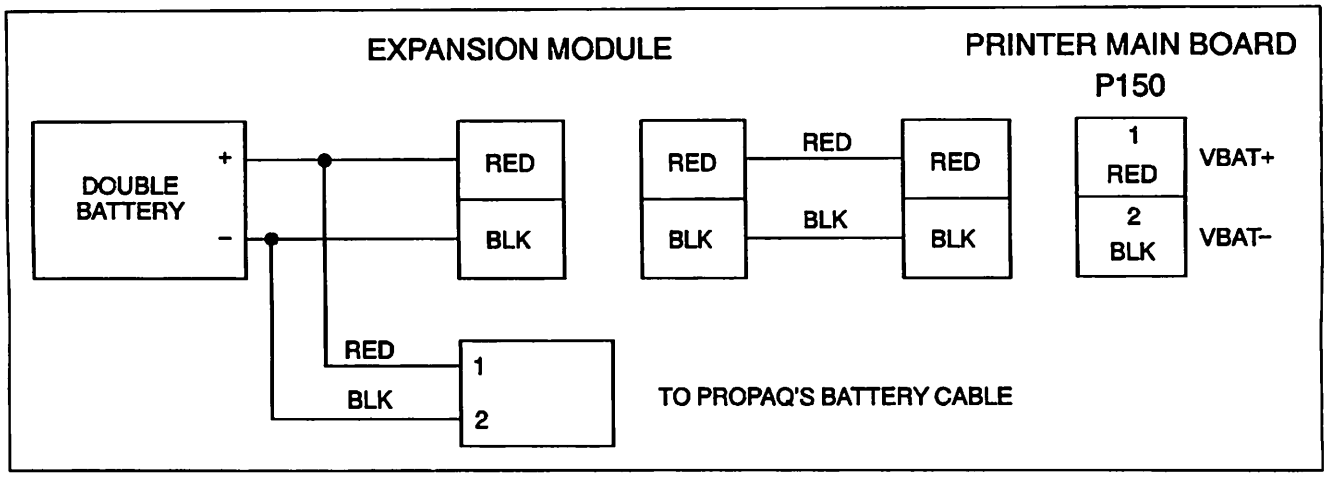

Fig. 5-19. Expansion Module Battery to Printer Cable

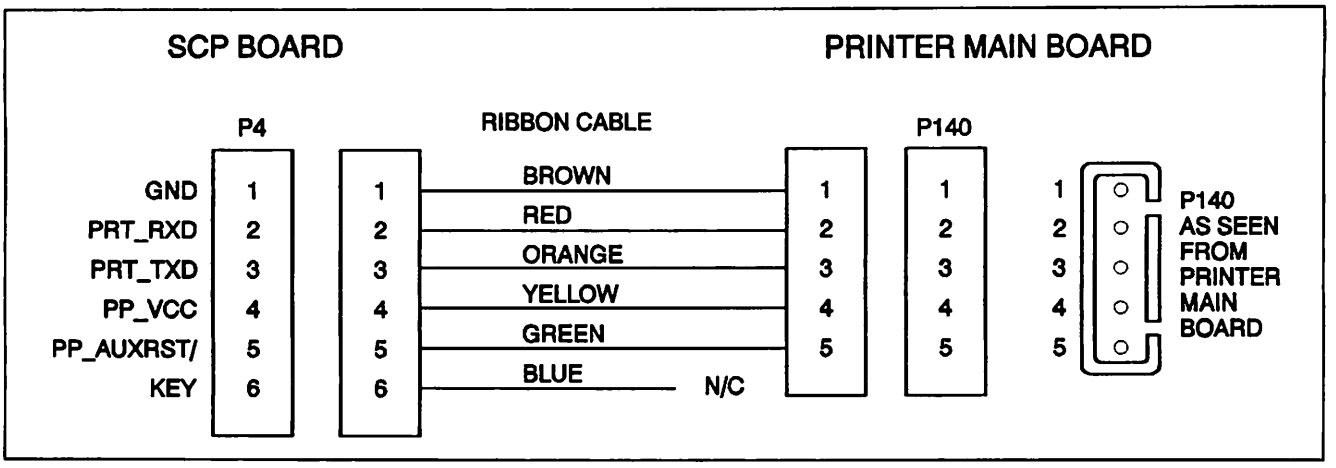

Fig. 5-20. SCP Board to Printer Main Board Cable

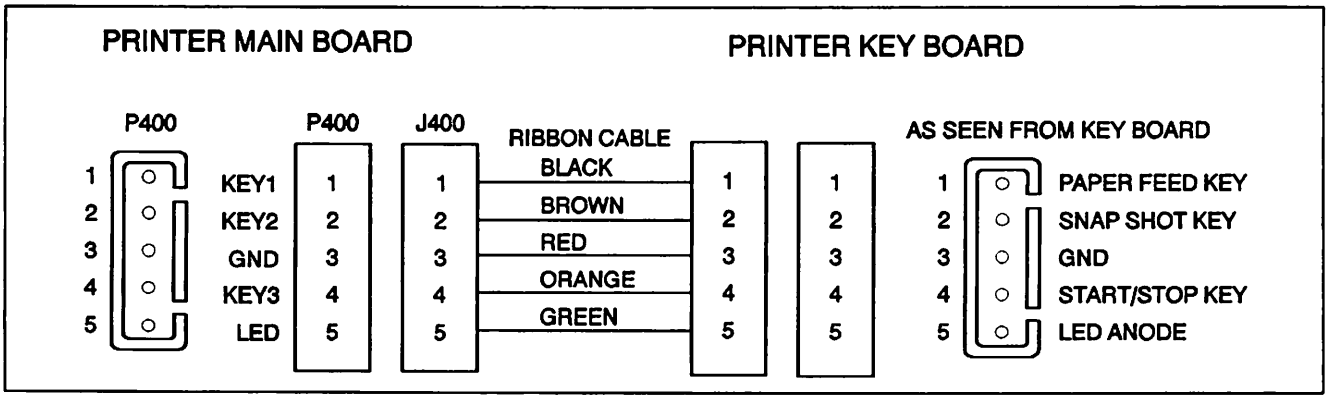

Fig. 5-21. Printer Main Board to Key Board Cable

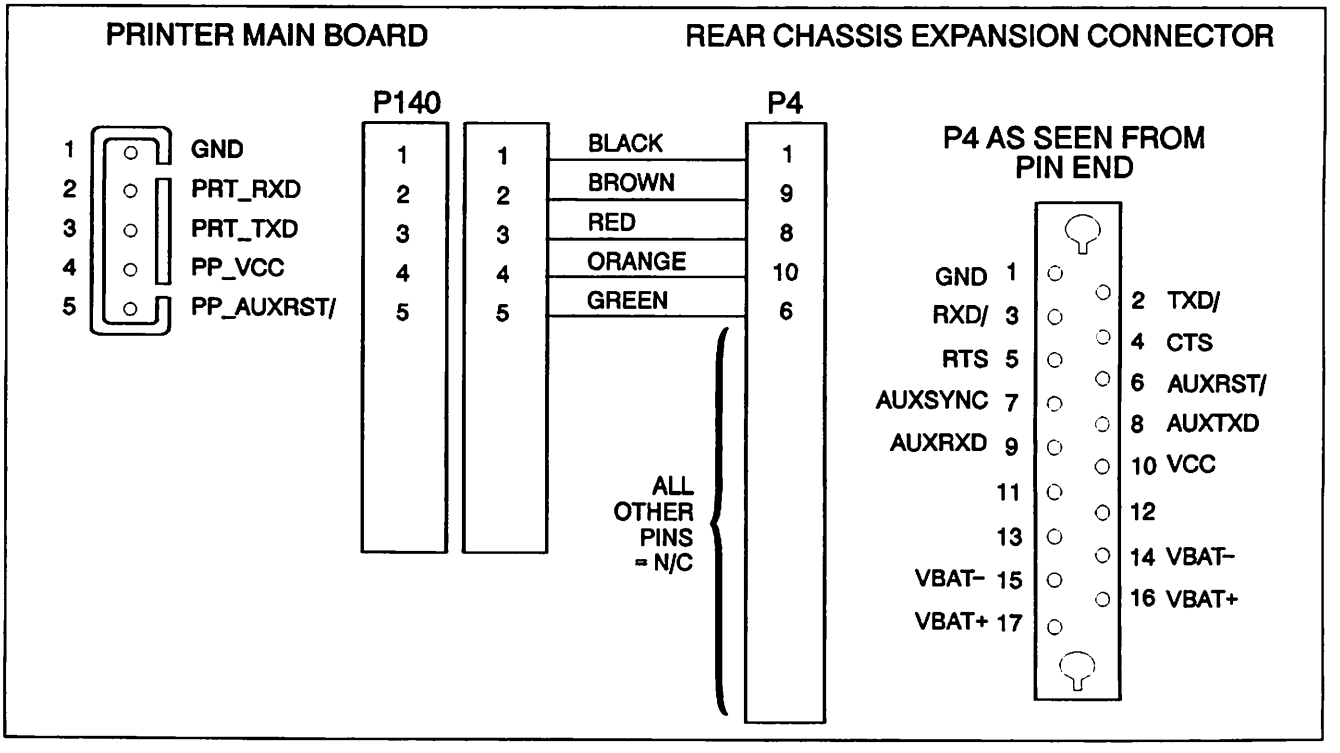

Fig. 5-22. Printer Main Board to Rear Chassis Expansion Connector Cable

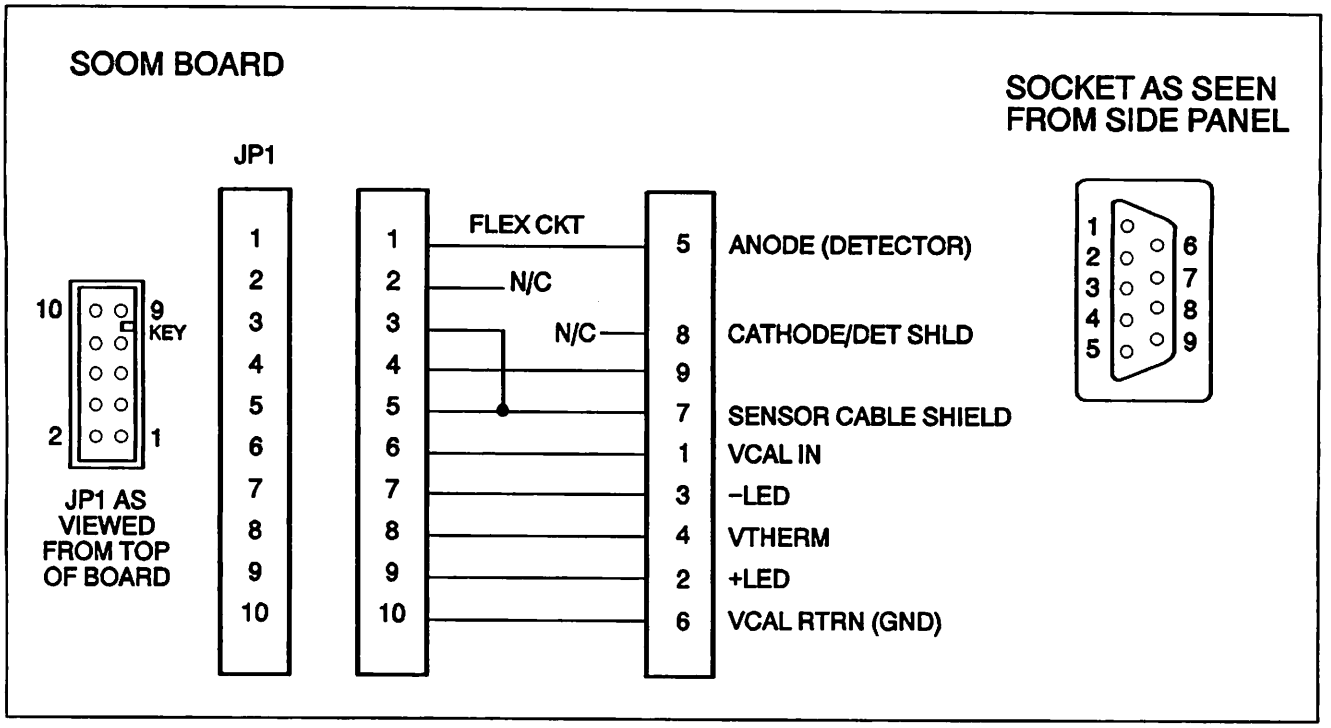

Fig. 5-23. SOOM Board to Sub D Oximeter Sensor Cable

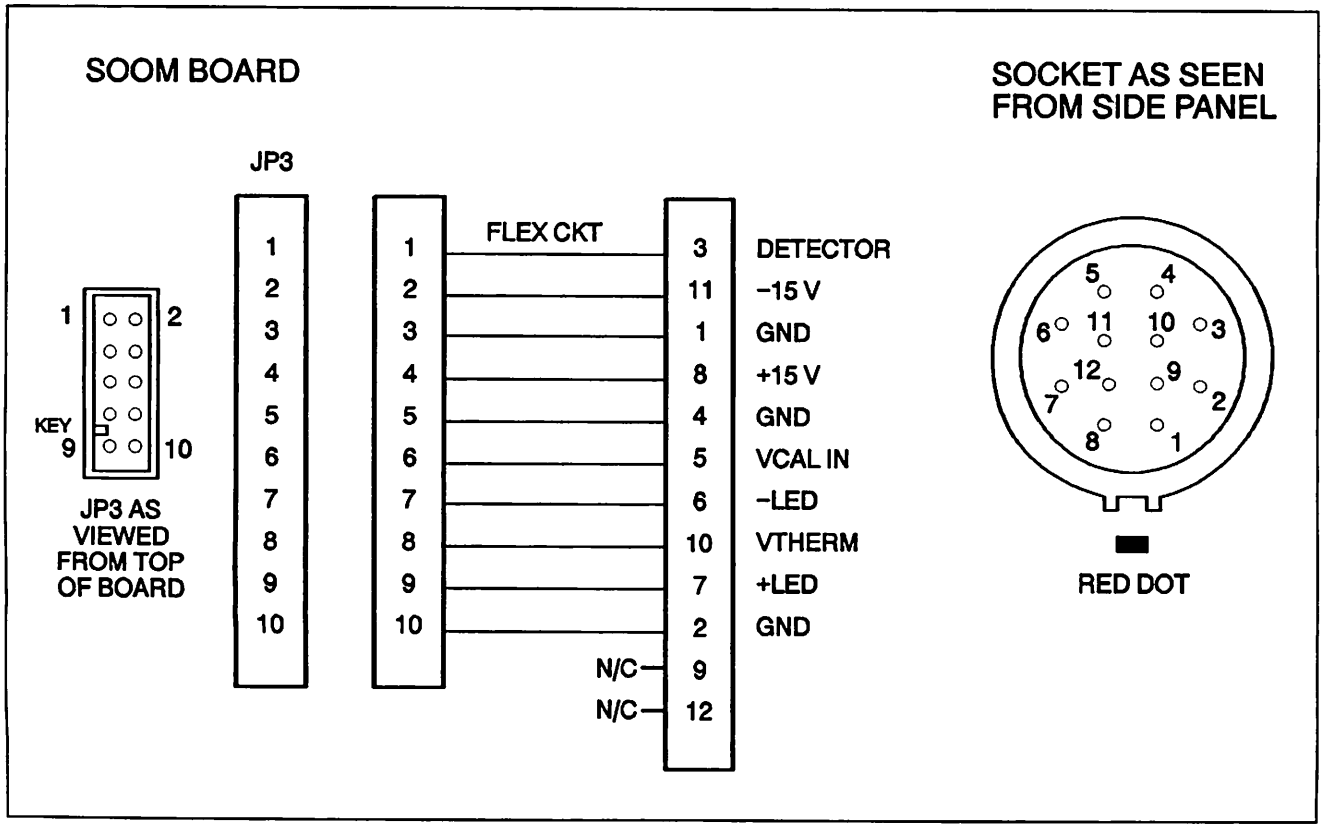

Fig. 5-24. SOOM Board to LEMO Oximeter Sensor Cable

Section 6

Replaceable Parts

Introduction

This section lists the replaceable and servicable parts that you can purchase from Protocol Systems. Table 6-1 lists the replaceable assemblies and related parts in the Propaq series monitors and options.

Replaceable assemblies should be purchased only from Protocol Systems or its authorized service or sales representatives. Software may be purchased only on an exchange basis. Contact Protocol Systems for the current sale price or exchange fee.

For removal and replacement procedures, see Section 3.

Table 6-1. Replaceable Assemblies and Related Parts

Propaq Model	Description	Protocol Part No.
	Circuit Boards	
All	Main Board	020-0152-XX
All	Recharger Board	020-0167-XX
	Front/Rear Chassis Assemblies	
All	Front Chassis/Window Assembly[a]	020-0169-XX
All	Display Module	020-0168-XX
All	Rear Chassis[a]	020-0170-XX
All	Key Assembly	020-0030-XX
	Side Panels	
102/104	Left Side Panel[a]	020-0012-XX
106	Left Side Panel[a]	020-0039-XX
All	Right Side Panel[a]	020-0171-XX
All	Left Side Panel, HP Connectors	020-0172-XX
	Batteries[b]	
All	Single Battery Pack	010-0025-XX
All	Dual Battery Pack	501-0006-XX
	Printer	
All	Printer Assembly	020-0068-XX
All	Main Chassis	020-0069-XX
All	Front Panel[a]	020-0174-XX
All	Rear Panel[a]	020-0071-XX
All	Paper Door[a]	020-0074-XX
All	Side Panel Kit	020-0076-XX
	SpO_2 Module (non-EMP installation)	
All	SpO_2 Input Board	031-0008-XX
All	SCP Board	031-0010-XX
All	Rear Panel[a]	020-0123-XX
All	Front Chassis	020-0122-XX
All	Mounting Screw Kit	020-0126-XX
All	Speaker Side Panel	020-0125-XX
All	Patient Connector Side Panel[a]	020-0124-XX
All	Wiring Harness (communication connector to SCP)	020-0127-XX
All	D-Connector Lock	630-0038-XX
All	Label, Connector Side Panel	640-0114-XX
All	Rear Panel	640-0119-XX

[a] Requires Separate Label(s). [b] See Battery Information later in this section.

Table 6-1 (Cont). Replaceable Assemblies and Related Parts

Propaq Model	Description	Protocol Part No.
	NIBP Parts	
All	NIBP Air Filter	020-0063-XX
All	NIBP Check Valve	020-0064-XX
All	NIBP O-Ring Kit	020-0021-XX
All	NIBP Fitting, Side Panel Mount	020-0035-XX
All	NIBP Pump, Vane Type	020-0036-XX
All	NIBP Fittings, Quick Disconnect	020-0065-XX
All	NIBP Valve, Pressure Release	680-0007-XX
	Labels	
102	Label, Logo, Propaq 102-EL	640-0155-XX
104	Label, Logo, Propaq 104-EL	640-0156-XX
106	Label, Logo, Propaq 106-EL	640-0157-XX
All	Label, Alarm Panel, Propaq, English	640-0030-XX
All	Label, Right Side Panel, Propaq, English	640-0028-XX
102	Label, Left Side Panel, 102, English	640-0034-XX
104	Label, Left Side Panel, 104, English	640-0035-XX
106	Label, Left Side Panel, 106, English	640-0029-XX
All	Printer Label Kit, English	020-0175-XX
All	Printer W/SpO_2 Label Kit	020-0176-XX
	Miscellaneous Electrical Parts	
All	Wire Harness—Main Board to Recharger Board	020-0060-XX
All	Lithium Battery	020-0061-XX
All	Fuse Kit, 10 pieces	020-0062-XX
All	Alarm LEDs & Harness Assy	010-0019-XX
All	Power Switch	680-0010-XX
	Miscellaneous Mechanical Parts	
All	Foot Pads, 24 pieces	020-0033-XX
All	Monitor Handle	020-0034-XX
All	Fasteners (screws, nuts, washers, etc.)	020-0020-XX
All	Battery Cover	020-0016-XX
All	Boot Seal, Power Switch	680-0006-XX
All	Fastener Kit, Printer	020-0072-XX
All	Wiring Harness, Printer, Keypad	020-0114-XX
All	Wiring Harness, Printer, Communication (w/o SpO_2)	020-0115-XX
All	Wiring Harness, Printer, Power	020-0116-XX
All	Wiring Harness, Printer, Communication (w/SpO_2)	020-0127-XX
All	Wiring Harness, Printer to SCP	010-0054-XX

Replaceable Parts Lists

The replaceable parts lists on the remaining pages of this section are referenced to the schematics, component layouts and block diagrams in Section 5, *Diagrams.*

824-0009-00—Assy Drwg, 102 Cardiac Monitor (Drawing Designator "P")

Ref. #	Part No.	Description	Qty.
3	640-0061-00	LABEL,RT SIDE,BLUE,FRENCH	1.0000
4	640-0100-00	LABEL,GERMAN,APPROVAL NUMBER	1.0000
5	640-0031-00	LABEL,BACK PANEL,PROTOCOL,BLUE	1.0000
5	640-0041-00	LABEL,REAR PANEL-SIRECUST	1.0000
5	640-0073-00	LABEL,REAR,GERMAN,SIRECUST	1.0000
5	640-0092-00	LABEL,S630,REAR PANEL,FRENCH	1.0000
5	640-0094-00	LABEL,SIRECUST,REAR PANEL,SPANISH	1.0000
6	640-0029-00	LABEL,LEFT SIDE PANEL,P106,BLUE	1.0000
6	640-0029-01	LABEL,LEFT SIDE 106,GRAY	1.0000
6	640-0034-00	LABEL,LEFT SIDE PANEL,P102,BLUE	1.0000
6	640-0034-01	LABEL,LEFT SIDE 102,GRAY,ENGLISH	1.0000
6	640-0035-00	LABEL,LEFT SIDE PANEL,P104,BLUE	1.0000
6	640-0035-01	LABEL,LEFT SIDE 104,GRAY,ENGLISH	1.0000
6	640-0038-00	LABEL,620 LEFT SIDE PANEL	1.0000
6	640-0046-00	LABEL,610 LEFT SIDE,SIRECUST	1.0000
6	640-0047-00	LABEL,630 LEFT SIDE PANEL,SIRECUST	1.0000
6	640-0060-00	LABEL,P106,LEFT SIDE,FRENCH	1.0000
6	640-0060-01	LABEL,P106,LEFTSIDE GRAY PANEL,FRENCH	1.0000
6	640-0076-02	LABEL,S610,LEFT SIDE,GERMAN	1.0000
6	640-0077-02	LABEL,S620,LEFT SIDE,GERMAN	1.0000
6	640-0078-02	LABEL,S630,LEFT SIDE,GERMAN	1.0000
6	640-0087-00	LABEL,P102,LEFT SIDE,FRENCH	1.0000
6	640-0087-01	LABEL,P102,LEFTSIDE GRAY PANEL,FRENCH	1.0000
6	640-0088-00	LABEL,P104,LEFT SIDE,FRENCH	1.0000
6	640-0090-00	LABEL,S630,LEFT SIDE,FRENCH	1.0000
6	640-0097-00	LABEL,S630,LEFT SIDE,SPANISH	1.0000
6	640-0098-00	LABEL,S620,LEFT SIDE,SPANISH	1.0000
6	640-0099-00	LABEL,S610,LEFT SIDE,SPANISH	1.0000
6	640-0152-00	LABEL,LEFT SIDE,102,HP	1.0000
6	640-0153-00	LABEL,LEFT SIDE,P104,HP	1.0000
6	640-0154-00	LABEL,LEFT SIDE,P106,HP	1.0000
6	640-0187-00	LABEL,LEFT SIDE, HP 102,FRENCH	1.0000
6	640-0188-00	LABEL,LEFT SIDE,HP 104,FRENCH	1.0000
6	640-0189-00	LABEL,LEFT SIDE,HP 106,FRENCH	1.0000
8	640-0027-00	LABEL,PROPAQ106,BLUE	1.0000
8	640-0032-00	LABEL,LOGO 102,BLUE	1.0000
8	640-0033-00	LABEL,LOGO 104,BLUE	1.0000
8	640-0037-00	LABEL,SIEMENS LOGO	1.0000
8	640-0044-00	LABEL,610 LOGO,SIRECUST	1.0000
8	640-0045-00	LABEL,630 LOGO,SIRECUST	1.0000

824-0009-00 (Cont)–Assy Drwg, 102 Cardiac Monitor (Drawing Designator "P")

Ref. #	Part No.	Description	Qty.
8	640-0113-00	LABEL,JAPANESE 104,FRONT PANEL	1.0000
8	640-0115-00	LABEL, P102, FRONT, JAPANESE	1.0000
8	640-0116-00	LABEL, P106, FRONT, JAPANESE	1.0000
8	640-0155-00	LABEL,102 EL LOGO	1.0000
8	640-0156-00	LABEL,104 EL LOGO	1.0000
8	640-0157-00	LABEL,106 EL LOGO	1.0000
9	640-0028-01	LABEL,PROPAQ RIGHT SIDE,GRAY,ENGLISH	1.0000
9	640-0028-02	LABEL,RIGHT SIDE,COOL GRAY	1.0000
9	640-0039-00	LABEL,RIGHT SIDE PANEL-SIRECUST	1.0000
9	640-0075-00	LABEL,GERMAN RIGHT SIDE,SIRECUST	1.0000
9	640-0089-00	LABEL,S630,RIGHT SIDE,FRENCH	1.0000
9	640-0095-00	LABEL,SIRECUST,RT SIDE, SPANISH	1.0000
9	640-0112-00	LABEL, RIGHT SIDE, JAPANESE	1.0000
9	640-0180-00	LABEL,RIGHT SIDE PANEL,EL,FRENCH	1.0000
9	640-0181-00	LABEL,RIGHT DEFIB SYNC,GRAY	1.0000
10	650-0025-00	TAPE,WHITE VINYL,7/8" DIA. CIRCLE	2.0000
11	600-0048-00	COVER, FIGURE 8	1.0000
11	600-0124-00	WASHER,.380ID,.750OD,.025THK,NYLON OR METAL	1.0000
11	600-0125-00	WASHER,.437OD,0-.172ID,.093THK,NYL	1.0000
12	600-0173-00	PLUG,HANDLE,SIRECUST,GERMAN,BLACK	2.0000
19	640-0030-00	LABEL,ALARM,BLUE	1.0000
19	640-0030-01	LABEL,ALARM,GRAY,ENGLISH	1.0000
19	640-0040-00	LABEL,ALARM,SIRECUST	1.0000
19	640-0059-00	LABEL,ALARM,FRENCH	1.0000
19	640-0059-01	LABEL,ALARM,GRAY,FRENCH	1.0000
19	640-0074-00	LABEL,GERMAN ALARM,SIRECUST	1.0000
19	640-0091-00	LABEL,ALARM,S630 FRENCH	1.0000
19	640-0096-00	LABEL,SIRECUST,ALARM,SPANISH	1.0000
20	640-0009-00	LABEL,COMPUTER PRINTABLE,1.25"X.375"	3.0000

824-0069-01—Assy Dwg, Expansion Module (Drawing Designator "AQ")

Ref. #	Part No.	Description	Qty.
5	500-0007-00	PRINTER,THERMAL HOT DOT,2 IN PAPER	1.0000
6	504-0038-00	WIRE,HOOKUP,14GA,RED	1.3000
7	504-0039-00	WIRE,HOOKUP,14GA,BLACK	1.3000
9	031-0006-01	SUBASSY,PRINTER MAIN PCB	1.0000
13	600-0073-00	BRACKET,PRINTER	1.0000
14	600-0154-00	GEAR ARM	1.0000
15	600-0155-00	BRACKET,CHOKE	1.0000
16	600-0156-00	PAPER SPINDLE	1.0000
17	600-0158-00	BRACKET,PAPER GUIDE	1.0000
18	600-0160-00	SPRING,PAPER TENSION	1.0000
19	600-0162-00	SHAFT,DOOR	1.0000
20	600-0164-00	SUBASSY,GEAR BRACKET	1.0000
21	600-0165-00	INSULATOR PAPER,PRINTER AREA	1.0000
23	600-0167-00	INSULATOR,FRP,PRINTER REAR	1.0000
29	610-0059-00	HOUSING,BLACK,30 AMP	2.0000
31	610-0060-00	HOUSING,RED,30 AMP	2.0000
33	610-0061-00	CONTACT,30 AMP	4.0000
35	620-0035-00	SCREW, 6-32, 3/4" LONG, PAN HEAD, PHILLIPS, SS	2.0000
36	620-0041-00	SCREW, SS, 4-40X1/2", PANHEAD, PHILLIPS	3.0000
40	620-0065-00	WASHER,#8 SPLT LK SS	3.0000
44	620-0081-00	SPACER,#4,ID.116 OD,.187,.062THK,NYLON	1.0000
45	620-0082-00	SCREW,6-32X2.5 PHL PHD,SS	2.0000
46	620-0084-00	SCREW,8-32X1 1/2,BHD,SOCKET,SS,5/32 HEX HEAD	1.0000
47	620-0135-00	SCREW,8-32X5/8L,PH,PH,NYL	1.0000
48	620-0086-00	SPRING,.016 DIA WIRE,1"LONG,SS	2.0000
50	620-0088-00	TIE-WRAP,1 1/4 BUNDLE DIA,NYLON,LOCKING	2.0000
51	620-0089-00	WASHER,FLAT #8,.170X.375X.033,SS	4.0000
52	620-0090-00	WASHER,#5,.140OD,9/32,.030THK,NYL,REDUCED OD	4.0000
53	620-0091-00	SCREW,2-32X.19,TYPE B,PHD,PHL,SS	1.0000
56	620-0094-00	SCREW,4-40X.25,PHL,PHD,SS	2.0000
58	620-0095-00	EDGING,GROMMET	0.1300
59	620-0096-00	RETAINER,SHAFT 3/16ID,TYPE 3,SS	1.0000
60	620-0158-00	SCRW,6-19X.375,TF,PHL,PH,ST,ZINC,PLASTITE	1.0000
62	620-0100-00	SCREW,8-32X1.50,PH,PH,SS	2.0000
67	630-0017-02	CHASSIS,EMP	1.0000
68	630-0018-02	PANEL,REAR CHASSIS,RECORDER	1.0000
69	630-0024-00	DOOR,BOTTOM	1.0000
70	630-0025-00	LATCH,DOOR	2.0000
72	630-0030-00	PANEL,FILLER,TOP	1.0000
73	630-0031-00	PANEL,FILLER-BOTTOM	3.0000

824-0069-01 (Cont)—Assy Dwg, Expansion Module (Drawing Designator "AQ")

Ref. #	Part No.	Description	Qty.
74	640-0071-00	LABEL,FUSE	1.0000
82	600-0168-00	TUBING,.50IDX.63OD,VINYL,CLEAR	0.1000
83	620-0042-00	SCREW,4-40X3/8,BH,PH,SS,W/NYPATCH	2.0000
87	620-0110-00	SCREW,SEM,METRIC,3X6,PH,PH,YELLOW ZINC,STEEL	3.0000
122	620-0114-00	WASHER,#8,.192"ID,.370"0D,.062"THICK,NYL	5.0000
123	010-0055-00	SUBASSY,COMMUNICATION HARNESS	1.0000
124	010-0056-00	SUBASSY,PRINTER KEYPAD HARNESS	1.0000
127	620-0032-00	TIE WRAP MOUNT, 1" SQUARE, ADHESIVE MOUNTING	2.0000
128	620-0036-00	TIE WRAP, NYLON, 3 1/2" LONG	2.0000
131	600-0062-00	SHRINK TUBING,MP,BL,1/8"	6.0000
132	620-0169-00	WASHER,.375 OD,.242 ID,.062 THK,NYLON	3.0000
134	504-0048-00	WIRE WRAP	1.0000

824-0070-01—Assy Dwg, Expansion Module/Monitor (Drawing Designator "AF")

Ref. #	Part No.	Description	Qty.
1	640-0063-00	LABEL,FRONT,ENGLISH,EMP	1.0000
1	640-0063-01	LABEL,FRONT RECORDER PANEL,GRAY,ENGLISH	1.0000
1	640-0103-00	LABEL,FRONT,FRENCH EMP	1.0000
1	640-0170-00	LABEL,EMP FRONT PANEL,EL MONITOR	1.0000
1	640-0178-00	LABEL,EMP FRONT PANEL,EL MONITOR,FRENCH	1.0000
2	640-0065-00	LABEL,DOOR,ENGLISH,EMP	1.0000
2	640-0102-00	LABEL,DOOR,FRENCH EMP	1.0000
3	640-0066-00	LABEL,REAR,ENGLISH,EMP	1.0000
3	640-0066-01	LABEL,EMP REAR PANEL,M/L,EN,FR,SP	1.0000
17	640-0114-01	LABEL,SPO2 LEFT SIDE PANEL,GRAY,ENGLISH	1.0000
88	600-0171-01	BUMPER,.30X.50X.093 HIGH,WHITE	2.0000

824-0106-01—Assy Dwg, SPO2 (Drawing Designator "BU")

Ref. #	Part No.	Description	Qty.
1	010-0048-00	ASSY, EXPANSION CABLE	1.0000
2	031-0010-02	SUBASSY,PCB,SCRAP,SP02	1.0000
3	501-0006-00	BATTERY ASSEMBLY	1.0000
4	600-0013-00	PAD,FOOT,WHITE,.5" SQ. X.12" HIGH,SILICONE	2.0000
5	600-0014-00	O-RING CORD, .070 INCH OD	1.2000
6	600-0166-00	O-RING,5 1/4ID,SECTION 1/16	1.0000
7	620-0115-00	SCREW,6-32X2.75"L,PHL,PHD,SS	4.0000
8	620-0092-00	WASHER,#6,SPLT LK,SS	4.0000
9	620-0093-00	WASHER,#6 FLAT,SS,.150X.375X.033	4.0000
10	650-0003-00	LOCKTITE,THREADLOCKER,ELECTRICAL,222	0.0010
12	630-0036-00	PANEL,REAR,SPO2	1.0000
13	630-0037-00	CHASSIS,SPO2	1.0000
14	640-0064-00	LABEL,BATTERY AREA	1.0000
15	640-0069-00	LABEL,SAFETY AGENCY	1.0000
16	640-0011-00	LABEL, PRODUCT SERIAL NUMBER WITH CSA	1.0000
16	640-0070-00	LABEL,PRODUCT SERIAL NUMBER	1.0000
17	640-0114-03	LABEL,SP02 CONNECTOR,GRAY,ENGLISH	1.0000
17	640-0148-02	LABEL,SP02 CONNECTOR,GRAY,FRENCH	1.0000
17	640-0177-00	LABEL,SP02,CONNECTOR PANEL,JAPANESE	1.0000
17	640-0177-02	LABEL,JAPANESE,SPO2 LEMOLESS	1.0000
18	640-0119-00	LABEL, SPO2, REAR PANEL	1.0000
18	640-0119-01	LABEL,SP02 REAR PANEL,M/L,EN,FR,SP	1.0000
18	640-0176-00	LABEL,SP02,REAR PANEL,JAPANESE	1.0000
19	640-0120-00	LABEL, SPO2, FUSE	1.0000
20	650-0018-00	TAPE, ACRYLIC FOAM, DOUBLE COATED 3/4 X.080	0.0010
23	010-0049-00	SUBASSY, SPEAKER CABLE	1.0000
24	010-0105-00	SUBASSY,CONN PANEL W/FERRITE BEAD,MOUNTING	1.0000
25	031-0008-00	SUBASSY,MAIN BOARD,SPO2	1.0000
27	600-0182-01	GASKET,SPEAKER	1.0000
29	610-0078-00	SOCKET, 10 PIN, DUAL ROW, BOARD MOUNT	1.0000
30	600-0260-00	PIN,BAQPAQ MECHANICAL SUPPORT	1.0000
31	620-0112-00	WASHER,#2,SHLD,.098ID,NYLON	2.0000
32	620-0124-00	SCREW, 4-40 X 1/4, PHL, PHD, SEMS	2.0000
33	630-0035-01	PANEL,SPEAKER SP02	1.0000
34	630-0038-00	LOCK,"D"CONNECTOR	1.0000
35	660-0015-00	CABLE, FLEX "D" CONNECTOR, SPO2	1.0000
39	680-0016-00	SPEAKER,SP02,BLACK CONE	1.0000
40	650-0001-00	ADHESIVE, LOCKTITE ELECTROBOND NO. 495	0.0000
42	650-0006-00	TAPE,WHITE,PLASTIC,3/4" WIDE	0.0000
43	650-0007-00	TAPE,BLACK,.750" WIDE	0.0000

824-0147-00—Assy Dwg, EL Main PCB, 1st Level (Drawing Designator "F")

Ref. #	Part No.	Description	Qty.

824-0149-00—Assy Dwg, Propaq EL Front Panel (Drawing Designator "A")

Ref. #	Part No.	Description	Qty.
1	500-0014-00	E.L. PANEL	1.0000
2	010-0019-00	WIRE HARNESS,ALARM LED	1.0000
4	600-0007-00	LENS, LED, RED	1.0000
5	600-0008-00	LENS, LED, AMBER	1.0000
6	600-0211-01	ADHESIVE,PREFORM WINDOW	1.0000
7	031-0016-00	SUBASSY,EL,INTERCONNECT PCB	1.0000
7	031-0016-01	SUBASSY,EL INTERCONNECT PCB	1.0000
8	620-0157-00	RIVET,SNAP,NYLON,.039-.079 THICKNESS,WHITE	2.0000
9	600-0212-00	SHIELD,NOMEX	1.0000
13	600-0058-01	BRACE,PBA	1.0000
14	630-0054-00	CLAMP,EL/LCD - TOP	1.0000
15	630-0053-00	CLAMP,EL/LCD - BOTTOM	2.0000
17	500-0017-00	CEF WINDOW,EL PANEL	1.0000
18	630-0050-00	FRONT PANEL,REEL	1.0000
21	620-0137-00	STANDOFF,5/16OD,0.115ID,0.625 LONG,NYL	5.0000
22	620-0150-00	SCREW,4-24X.88 PH,PH,TYPE 25	5.0000
23	620-0152-01	SCRW,2-56X.38,SEMS,PHL,PHD,SPLT LKWASH/FLTWAS	2.0000
24	620-0048-00	SCREW,6-32X.5,PH,PH,NYLOC,SS	5.0000
25	620-0049-00	SCREW,6-32X1,PH,PH,NYLOC,SS	6.0000
29	620-0161-00	"O" RING,0.303 ID,0.070 THICK	1.0000
30	600-0218-00	GASKET,ELECTRICALLY CONDUCTIVE SILICONE	1.0000
31	504-0041-00	WIRE, SOLID, 24 AWG, UNINSULATED	0.0000
32	031-0013-00	SUBASSY,MAIN PCB	1.0000
33	620-0170-00	WASHER,.345OD,.150ID,.040THK,ADH BACK,LEXAN	2.0000
34	620-0171-00	WASHER,.187OD,.091ID,.062THK,NYLON	2.0000
37	610-0120-00	HEADER,DUAL ROW,26 STRAIGHT PIN	1.0000

824-0150-00—Assy Dwg, Propaq EL Chassis (Drawing Designator "B")

Ref. #	Part No.	Description	Qty.
1	630-0005-02	CHASSIS,PROPAQ	1.0000
2	010-0008-00	WIRE HARNESS,MAIN PCB-RECHARGER PCB	1.0000
2	501-0005-00	BATTERY,LEAD ACID,WITH LEADS	1.0000
4	010-0005-01	WIRE HARNESS,THERMISTER	1.0000
4	010-0062-00	ASSY,THERMISTOR CABLE, EL MONITOR	1.0000
5	650-0013-00	GLUE,HOT MELT	0.0000
6	600-0084-00	CUSHION, BATTERY PACK	1.0000
7	660-0005-01	CABLE ASSY,BATTERY PACK	1.0000
9	010-0006-01	SUBASSY,WIRE HARNESS EXP. CONNECTOR	1.0000
11	620-0162-00	MOUNT,CABLE TIE,ADHESIVE BACKED,1"SQ,NYLON	1.0000
13	610-0036-00	CONNECTOR, 5 PIN, .156 CENTERS	1.0000
16	640-0168-00	LABEL,FUSE,EL MONITOR	1.0000
22	031-0012-00	ASSY,RECHARGER SMT	1.0000
22	031-0022-00	ASSEMBLY,PCB,RECHARGER,M/L,EL	1.0000
24	600-0049-00	ADHESIVE PREFORM-SIDE PANEL	2.0000
26	600-0035-01	CLAMP,SIDE PANEL	1.0000
30	600-0214-00	CLAMP,RIGHT SIDE PANEL, BOTTOM	1.0000
31	600-0215-00	CLAMP,RIGHT SIDE PANEL - TOP	1.0000
33	600-0115-00	VALVE, CHECK	1.0000
48	600-0204-00	BARB FITTING,1/8"PIPE TO 1/8"ID TUBING	1.0000
49	600-0145-02	OVERPRESSURE VALVE,CIRCLE SEAL	1.0000
50	600-0205-00	OVER PRESSURE VALVE MOUNTING BRACKET	1.0000
51	650-0021-00	LOCTITE #425 THREAD SEALER	1.0000
53	600-0234-00	SHIELD,FRP PAPER,REAR CHASSIS	1.0000
54	600-0018-00	IN-LINE FILTER	1.0000
55	010-0020-04	SUBASSY,EL RIGHT SIDE PANEL	1.0000
56	010-0021-01	SUBASSY,LEFT SIDE PANEL,CSA APPROVED	1.0000
56	010-0029-01	SUBASSY,LEFT SIDE PANEL,P106	1.0000
56	010-0067-00	LEFT SIDE PANEL,HP CONNECTORS	1.0000

824-0151-00—Assy Dwg, EL Monitor (Drawing Designator "C")

Ref. #	Part No.	Description	Qty.
7	600-0067-00	HANDLE,COATED,MONITOR	1.0000
8	650-0011-00	TAPE,NON-SKID	2.0000

824-0171-00—Assy Dwg, EL Main, 2nd Level (Drawing Designator "K")

Ref. #	Part No.	Description	Qty.
1	600-0071-00	EMI SHIELD #1 MAIN ECB	1.0000
2	504-0037-00	WIRE,SOLID,30GA,BLUE,KYNAR	0.3300
2	600-0072-00	EMI SHIELD #2 MAIN ECB,, 1.0000	
4	620-0016-00	BUSHING,SHOULDER,NYLON,#4,.115ID,.145OD,.250L	2.0000
6	620-0054-00	KEPNUT,4-40 TH,ZINC,CLEAR CHROMATE	2.0000
7	030-0015-00	PCB,ESIS SHIELD,EL MONITOR	1.0000
8	620-0159-00	RIVET,.118-.169 CLAMP THICKNESS,PLASTIC,BLACK	6.0000
9	620-0160-00	WASHER,.120 ID,.187OD,.06 THICK,WHITE	4.0000
10	620-0163-00	WASHER,SHLDR,0.114-ID,0.135-OD,NYLON	2.0000
13	650-0026-00	TAPE,KAPTON INSULATING	1.0000
15	501-0002-00	BATTERY, LITHIUM, 3.0V 180mAH BR2032	1.0000
17	600-0065-00	SHRINK TUBING, MP,BL.,1/16"	0.5000
19	650-0027-00	TAPE,ACRYLIC FOAM,DOUBLE COATED,.090"	5.0000
20	600-0239-00	NOMEX,410,.010 THICK	1.0000
BT800	610-0007-00	BATTERY HOLDER, 20MM LITHIUM BATTERY	1.0000
C699	260-0002-00	CAPACITOR, CERAMIC, .1MFD, 50V, +/-20%, RADIAL LEAD	1.0000
C999	261-0018-00	CAP,SMD,CER,390PF,+/-10%,50V,NPO,1206	1.0000
P6	610-0009-00	HEADER, 4 PIN	1.0000
PT1	503-0003-00	PRESSURE SENSOR,MOTOROLA	1.0000
R1133	208-6802-01	RESISTOR, 68.0K,CARBON FILM, AXIAL LEAD, 1/4 W, 5 %	2.0000
U706	433-0009-02	PROM,27C512,64KX8,HCMOS,PLCC	2.0000
U706	433-0199-02	PROM,DCP,V6.11.00,PROPAQ1XX	1.0000
U706	433-0217-02	PROM,DCP,V6.12.03	1.0000
U810	433-0194-02	EEPROM,REEL MAIN BOARD,ERASE SOFTWARE	1.0000
U1003	433-0201-02	PROM,DAP,V6.11.00,ALL PROPAQS	1.0000
U1003	433-0218-02	PROM,DAP,V6.12.03	1.0000

824-0173-00—Assy Dwg, EL Interconnect PCB (Drawing Designator "Z")

Ref. #	Part No.	Description	Qty.
C17	250-0012-00	CAP,10UF,+/-20%,25V	1.0000
R12	201-1001-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 1000 OHM 1%	1.0000

824-0177-00–Assy Dwg, EMP EL Front Panel (Drawing Designator "AD")

Ref. #	Part No.	Description	Qty.
1	620-0167-00	STANDOFF,5/16 OD,.115 ID,.375 LONG,NYLON	3.0000
2	620-0168-00	SCREW,4-24 X .625 PHL,PHD,TYPE 25	3.0000
3	620-0166-00	SPACER,LED,5/8 LONG,NYLON	1.0000
4	600-0236-00	ADHESIVE,EMP EL WINDOW	1.0000
5	600-0237-00	COVER,EMP EL WINDOW	1.0000
6	600-0238-00	BRACE,EMPL EL WINDOW COVER	1.0000
7	630-0056-00	PANEL,FRONT,EMP REEL	1.0000
9	630-0033-00	KEY CAPS	3.0000
12	640-0169-00	LABEL,WINDOW COVER,EMP-EL	1.0000
14	320-0003-00	LED, GREEN,HLMP3950	1.0000
15	630-0012-00	KEY, ELASTROMERIC	3.0000
16	610-0055-00	HEADER,5-PIN	1.0000
17	030-0004-00	PCB,PRINTER KEYPAD	1.0000

824-0184-00–Assy Dwg, Plumbing, Vent, HP, 102/104/106 (Drawing Designator "BG")

Ref. #	Part No.	Description	Qty.

824-0185-00–Assy Dwg, Plumbing, Cuff, HP, 102/104/106 (Drawing Designator "BH")

Ref. #	Part No.	Description	Qty.
1	600-0078-00	TUBING,SILICONE,.104X.192	1.0000
2	600-0179-00	TUBING,.125ID,.250OD,SILICONE	1.0000
4	600-0059-00	FITTING, 3/32" ID, ELBOW, NYLON	8.0000
5	600-0222-00	FITTING,TEE,3/32ID(2),1/8ID STEM,WHT NYLON	1.0000
6	600-0178-00	FITTING,1/8"ID TUBE,ELBOW,NYL	1.0000
7	600-0043-00	PLASTIC TEE, 1/8" ID BARB, NYLON	1.0000
8	600-0221-00	FITTING,1/8ID-3/32ID ELBOW,WHT NYLON	2.0000
9	600-0016-00	FITTING, 3/32" ID, TEE, NYLON	2.0000

Supplemental Parts List
EL Main Board—Reference Dwg. 810-0147-00

PART NUMBER & REV.	DESCRIPTION.....	QPA.....	B DWG REF.... DSG DESG
650-0026-00 A	TAPE,KAPTON INSULATING	1.5000	
800-0010-00 G	SCHEMATIC,ENHANCED 100 SERIES MAIN PCB	1.0000	
824-0147-00 E	ASSY DWG,EL MAIN PCB,1ST LEVEL	1.0000	
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000	C100
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000	C101
261-0002-00 B	CAPACITOR, SURFACE MOUNT, CERAMIC, 220PF 1% 100V NPO	6.0000	C200
261-0010-00 C	CAPACITOR, SMT, 100PF, 1%, NPO, 1206 PKG	5.0000	C201
261-0011-00 C	CAP,SMD,CER,47PF,1%,50V ,NPO,1	3.0000	C202
261-0002-00	CAPACITOR, SURFACE MOUNT, CERAMIC, 220PF 1% 100V NPO	6.0000	C203
261-0010-00	CAPACITOR, SMT, 100PF, 1%, NPO, 1206 PKG	5.0000	C204
261-0011-00	CAP,SMD,CER,47PF,1%,50V ,NPO,1	3.0000	C205
261-0002-00	CAPACITOR, SURFACE MOUNT, CERAMIC, 220PF 1% 100V NPO	6.0000	C206
261-0010-00	CAPACITOR, SMT, 100PF, 1%, NPO, 1206 PKG	5.0000	C207
261-0011-00	CAP,SMD,CER,47PF,1%,50V ,NPO,1	3.0000	C208
261-0023-00 A	CAP,SMD,CER,4700PF,5%,5 0V,X7R,1206	7.0000	C209
261-0001-00 A	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000	C210
261-0004-00 A	CAPACITOR, SURFACE MOUNT, CERAMIC, .047 UF 5%, 50V X7R	4.0000	C213
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000	C214
265-0001-00 B	CAP,RADIAL LEAD,POLYSTYRENE,1.0UF, 5%,63V	1.0000	C216
261-0023-00	CAP,SMD,CER,4700PF,5%,5 0V,X7R,1206	7.0000	C217
261-0006-00 C	CAPACITOR, SURFACE MOUNT, CERAMIC, 1000 PF, 5%, 50V NPO	2.0000	C218

PART NUMBER & REV.	DESCRIPTION.....	QPA.....	B DWG REF.... DSG DESG
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000	C219
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000	C220
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000	C221
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000	C223
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000	C225
261-0004-00	CAPACITOR, SURFACE MOUNT, CERAMIC, .047 UF 5%, 50V X7R	4.0000	C226
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000	C304
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000	C308
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000	C309
256-0003-00 B	CAPACITOR, SURFACE MOUNT, TANTALUM, 47UF 10% 10 V	13.0000	C310
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000	C311
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000	C312
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000	C314
261-0002-00	CAPACITOR, SURFACE MOUNT, CERAMIC, 220PF 1% 100V NPO	6.0000	C315
261-0002-00	CAPACITOR, SURFACE MOUNT, CERAMIC, 220PF 1% 100V NPO	6.0000	C316
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000	C317
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000	C318
261-0012-00 C	CAP,SMD,CERAMIC,.01UF,+/-5	15.0000	C319

PART NUMBER & REV.	DESCRIPTION.....	QPA.....	B DWG DSG	REF.... DESG
261-0012-00	CAP,SMD,CERAMIC,.01UF,+/-5	15.0000		C320
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C321
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C322
261-0012-00	CAP,SMD,CERAMIC,.01UF,+/-5	15.0000		C323
261-0012-00	CAP,SMD,CERAMIC,.01UF,+/-5	15.0000		C324
261-0023-00	CAP,SMD,CER,4700PF,5%,50V,X7R,1206	7.0000		C325
261-0023-00	CAP,SMD,CER,4700PF,5%,50V,X7R,1206	7.0000		C326
261-0023-00	CAP,SMD,CER,4700PF,5%,50V,X7R,1206	7.0000		C327
261-0023-00	CAP,SMD,CER,4700PF,5%,50V,X7R,1206	7.0000		C328
261-0012-00	CAP,SMD,CERAMIC,.01UF,+/-5	15.0000		C329
261-0012-00	CAP,SMD,CERAMIC,.01UF,+/-5	15.0000		C330
261-0012-00	CAP,SMD,CERAMIC,.01UF,+/-5	15.0000		C331
261-0012-00	CAP,SMD,CERAMIC,.01UF,+/-5	15.0000		C332
261-0012-00	CAP,SMD,CERAMIC,.01UF,+/-5	15.0000		C400
261-0007-00 A	CAPACITOR, SURFACE MOUNT, CERAMIC, 1.0UF 10%, 50V, X7R	2.0000		C401
261-0007-00	CAPACITOR, SURFACE MOUNT, CERAMIC, 1.0UF 10%, 50V, X7R	2.0000		C402
261-0004-00	CAPACITOR, SURFACE MOUNT, CERAMIC, .047 UF 5%, 50V X7R	4.0000		C404
261-0004-00	CAPACITOR, SURFACE MOUNT, CERAMIC, .047 UF 5%, 50V X7R	4.0000		C405
261-0006-00	CAPACITOR, SURFACE MOUNT, CERAMIC, 1000 PF, 5%, 50V NPO	2.0000		C407
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C409
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C414
261-0012-00	CAP,SMD,CERAMIC,.01UF,+/-5	15.0000		C416

PART NUMBER & REV.	DESCRIPTION.....	QPA.....	B	DWG REF.... DSG DESG
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C420
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C422
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C423
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C502
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C504
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C506
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C509
261-0023-00	CAP,SMD,CER,4700PF,5%,50V,X7R,1206	7.0000		C512
261-0012-00	CAP,SMD,CERAMIC,.01UF,+/-5	15.0000		C513
256-0003-00	CAPACITOR, SURFACE MOUNT, TANTALUM, 47UF 10% 10 V	13.0000		C601
256-0003-00	CAPACITOR, SURFACE MOUNT, TANTALUM, 47UF 10% 10 V	13.0000		C602
256-0003-00	CAPACITOR, SURFACE MOUNT, TANTALUM, 47UF 10% 10 V	13.0000		C603
256-0003-00	CAPACITOR, SURFACE MOUNT, TANTALUM, 47UF 10% 10 V	13.0000		C604
256-0003-00	CAPACITOR, SURFACE MOUNT, TANTALUM, 47UF 10% 10 V	13.0000		C606
256-0003-00	CAPACITOR, SURFACE MOUNT, TANTALUM, 47UF 10% 10 V	13.0000		C607
256-0002-00	A CAPACITOR, SURFACE MOUNT, TANTALUM, 10.0 UF 20%, 25V	8.0000		C608
256-0001-00	CAPACITOR, SURFACE MOUNT, TANTALUM, 1.0 UF 20% 15V	6.0000		C609
256-0001-00	B CAPACITOR, SURFACE MOUNT, TANTALUM, 1.0 UF 20% 15V	6.0000		C610
256-0003-00	CAPACITOR, SURFACE	13.0000		C611

PART NUMBER & REV.	DESCRIPTION.....	QPA.....	B DSG	DWG REF.... DESG
	MOUNT, TANTALUM, 47UF 10% 10 V			
256-0003-00	CAPACITOR, SURFACE MOUNT, TANTALUM, 47UF 10% 10 V	13.0000		C612
256-0002-00	CAPACITOR, SURFACE MOUNT, TANTALUM, 10.0 UF 20%, 25V	8.0000		C613
256-0003-00	CAPACITOR, SURFACE MOUNT, TANTALUM, 47UF 10% 10 V	13.0000		C614
256-0003-00	CAPACITOR, SURFACE MOUNT, TANTALUM, 47UF 10% 10 V	13.0000		C615
256-0003-00	CAPACITOR, SURFACE MOUNT, TANTALUM, 47UF 10% 10 V	13.0000		C617
261-0022-00 A	CAP,SMD,CER,.33UF,5%,50 V,X7R,1812	1.0000		C620
250-0024-00 A	CAP,330UF,16V,+/-20%,AL UMINUM ELECTROLYTIC	1.0000		C621
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C623
256-0002-00	CAPACITOR, SURFACE MOUNT, TANTALUM, 10.0 UF 20%, 25V	8.0000		C624
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C625
256-0003-00	CAPACITOR, SURFACE MOUNT, TANTALUM, 47UF 10% 10 V	13.0000		C626
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C632
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C633
261-0012-00	CAP,SMD,CERAMIC,.01UF,+ /-5	15.0000		C634
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C635
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C636
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C637
261-0002-00	CAPACITOR, SURFACE MOUNT, CERAMIC, 220PF 1% 100V NPO	6.0000		C638

PART NUMBER & REV.	DESCRIPTION.....	QPA.....	B	DWG REF.... DSG DESG
261-0012-00	CAP,SMD,CERAMIC,.01UF,+/-5	15.0000		C645
261-0012-00	CAP,SMD,CERAMIC,.01UF,+/-5	15.0000		C646
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C647
261-0010-00	CAPACITOR, SMT, 100PF, 1%, NPO, 1206 PKG	5.0000		C680
261-0010-00	CAPACITOR, SMT, 100PF, 1%, NPO, 1206 PKG	5.0000		C681
256-0002-00	CAPACITOR, SURFACE MOUNT, TANTALUM, 10.0 UF 20%, 25V	8.0000		C700
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C701
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C702
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C703
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C704
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C705
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C706
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C709
256-0002-00	CAPACITOR, SURFACE MOUNT, TANTALUM, 10.0 UF 20%, 25V	8.0000		C715
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C716
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C717
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C719
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C720
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C721

PART NUMBER & REV.	DESCRIPTION.....	QPA.....	B DWG DSG	REF.... DESG
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C800
261-0021-00	CAP,SMD,CER,22PF,+/-10% ,50V,NP0,1206	3.0000		C802
268-0001-00 A	CAPACITOR, SURFACE MOUNT, VARIABLE, 5-30PF, 25V	1.0000		C803
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C805
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C806
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C807
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C808
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C811
256-0001-00	CAPACITOR, SURFACE MOUNT, TANTALUM, 1.0 UF 20% 15V	6.0000		C813
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C814
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C815
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C850
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C851
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C900
256-0001-00	CAPACITOR, SURFACE MOUNT, TANTALUM, 1.0 UF 20% 15V	6.0000		C903
256-0001-00	CAPACITOR, SURFACE MOUNT, TANTALUM, 1.0 UF 20% 15V	6.0000		C904
261-0008-00 A	CAPACITOR, SURFACE MOUNT, CERAMIC, .022UF 20%, 50V, X7R	1.0000		C905
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C906

PART NUMBER & REV.	DESCRIPTION.....	QPA.....	B	DWG REF.... DSG DESG
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C930
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C950
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C951
256-0002-00	CAPACITOR, SURFACE MOUNT, TANTALUM, 10.0 UF 20%, 25V	8.0000		C952
256-0002-00	CAPACITOR, SURFACE MOUNT, TANTALUM, 10.0 UF 20%, 25V	8.0000		C953
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C955
256-0002-00	CAPACITOR, SURFACE MOUNT, TANTALUM, 10.0 UF 20%, 25V	8.0000		C1000
261-0021-00	CAP,SMD,CER,22PF,+/-10% ,50V,NPO,1206	3.0000	B	C1001
261-0021-00	CAP,SMD,CER,22PF,+/-10% ,50V,NPO,1206	3.0000		C1002
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C1003
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C1004
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C1005
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C1006
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C1007
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C1008
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C1009
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C1010
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C1011
256-0001-00	CAPACITOR, SURFACE	6.0000		C1101

PART NUMBER & REV.	DESCRIPTION.....	QPA.....	B DSG	DWG REF.... DESG
	MOUNT, TANTALUM, 1.0 UF 20% 15V			
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C1102
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C1103
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C1104
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C1105
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C1106
261-0012-00	CAP,SMD,CERAMIC,.01UF,+/-5	15.0000		C1107
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C1108
261-0001-00	CAPACITOR, SURFACE MOUNT CERAMIC, 0.1UF 10% 50 V, X7R	80.0000		C1109
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D100
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D101
308-0013-10 A	DIODE,ZENER,16V,5%,225MW	3.0000		D102
306-0001-10 A	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D203
308-0003-08 A	DIODE, ZENER, 6.8V, 5%, 500MW, SURFACE MOUNT	2.0000		D204
308-0003-08	DIODE, ZENER, 6.8V, 5%, 500MW, SURFACE MOUNT	2.0000		D205
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D206
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D210
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D211
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D212
306-0001-10	DIODE ARRAY, GENERAL	41.0000		D300

PART NUMBER & REV.	DESCRIPTION	QPA	B	DWG REF DSG DESG
	PURPOSE,MBAV99,SOT-23 PACKAGE			
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D320
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D321
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D322
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D323
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D324
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D325
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D326
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D328
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D329
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D330
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D331
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D501
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D502
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D503
307-0001-08 B	SCHOTTKY RECTIFIER,SMT,MLL41PKG, 30V	4.0000		D601
306-0002-08 A	DIODE, SWITCHING, 85V, 250MA, LL34 PKG	6.0000		D602
307-0001-08	SCHOTTKY RECTIFIER,SMT,MLL41PKG, 30V	4.0000		D603
306-0002-08	DIODE, SWITCHING, 85V,	6.0000		D604

PART NUMBER & REV.	DESCRIPTION	QPA	B DSG	DWG REF DESG
	250MA, LL34 PKG			
306-0002-08	DIODE, SWITCHING, 85V, 250MA, LL34 PKG	6.0000		D605
306-0002-08	DIODE, SWITCHING, 85V, 250MA, LL34 PKG	6.0000		D607
307-0001-08	SCHOTTKY RECTIFIER,SMT,MLL41PKG, 30V	4.0000		D608
307-0001-08	SCHOTTKY RECTIFIER,SMT,MLL41PKG, 30V	4.0000		D609
306-0002-08	DIODE, SWITCHING, 85V, 250MA, LL34 PKG	6.0000		D613
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D614
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D615
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D616
306-0002-08	DIODE, SWITCHING, 85V, 250MA, LL34 PKG	6.0000		D618
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D619
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D700
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D701
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D801
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D902
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D903
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D905
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D906
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D1000
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23	41.0000		D1003

PART NUMBER & REV.	DESCRIPTION.....	QPA.....	B	DWG REF.... DSG DESG
	PACKAGE			
308-0011-10 A	DIODE,ZENER,12V,5%,SOT-23	4.0000		D1101
308-0011-10	DIODE,ZENER,12V,5%,SOT-23	4.0000		D1102
308-0011-10	DIODE,ZENER,12V,5%,SOT-23	4.0000		D1103
308-0011-10	DIODE,ZENER,12V,5%,SOT-23	4.0000		D1104
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D1105
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D1111
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D1112
308-0013-10	DIODE,ZENER,16V,5%,225MW	3.0000		D1113
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D1114
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D1115
306-0001-10	DIODE ARRAY, GENERAL PURPOSE,MBAV99,SOT-23 PACKAGE	41.0000		D1116
308-0013-10	DIODE,ZENER,16V,5%,225MW	3.0000		D1117
351-1040-01 A	INDUCTOR, 10UH, SURFACE MOUNT	4.0000		L601
351-1040-01	INDUCTOR, 10UH, SURFACE MOUNT	4.0000		L602
351-1040-01	INDUCTOR, 10UH, SURFACE MOUNT	4.0000		L603
351-1040-01	INDUCTOR, 10UH, SURFACE MOUNT	4.0000		L604
500-0001-00 B	LAMP,NEON,A1C	3.0000		LP200
500-0001-00	LAMP,NEON,A1C	3.0000		LP201
500-0001-00	LAMP,NEON,A1C	3.0000		LP202
610-0013-00 A	HEADER, 8 PIN,.100	1.0000		P1
610-0123-00 A	CONNECTOR,CONTACT SOCKETS	14.0000		P2
610-0012-00 A	HEADER, 7 PIN	1.0000		P3
610-0038-00 A	HEADER, 10 PIN, .100 CENTER, LOCKING	2.0000		P4
610-0011-00 A	HEADER, 6 PIN	1.0000		P5
610-0009-00 A	HEADER, 4 PIN	1.0000		P6
610-0038-00	HEADER, 10 PIN, .100 CENTER, LOCKING	2.0000		P7
610-0010-00 A	HEADER, 5 PIN,.100	1.0000		P8

PART NUMBER & REV.	DESCRIPTION.....	QPA.....	B DWG DSG	REF.... DESG
610-0022-00 A	HEADER, 3 PIN, .100 CENTERS	1.0000		P9
610-0123-00	CONNECTOR,CONTACT SOCKETS	14.0000		P11
301-0001-10 A	TRANSISTOR,NPN,SMALL SIGNAL,MMBT3904,SOT23	17.0000		Q200
301-0004-10 A	TRANSISTOR,MMBT2222A,SOT-23PKG	3.0000		Q300
301-0005-10 A	TRANSISTOR,SMT,MMBT2907A,SOT-23 PKG	3.0000		Q301
301-0004-10	TRANSISTOR,MMBT2222A,SOT-23PKG	3.0000		Q302
301-0005-10	TRANSISTOR,SMT,MMBT2907A,SOT-23 PKG	3.0000		Q303
301-0001-10	TRANSISTOR,NPN,SMALL SIGNAL,MMBT3904,SOT23	17.0000		Q304
301-0001-10	TRANSISTOR,NPN,SMALL SIGNAL,MMBT3904,SOT23	17.0000		Q305
301-0003-10 A	TRANSISTOR,PNP DARLINGTON,MMBTA63,SOT23 PK	2.0000		Q603
301-0002-10 A	TRANSISTOR,PNP SMALL SIGNAL,MMBT3906 ,SOT23 PACKAGE	8.0000		Q605
301-0001-10	TRANSISTOR,NPN,SMALL SIGNAL,MMBT3904,SOT23	17.0000		Q606
301-0003-10	TRANSISTOR,PNP DARLINGTON,MMBTA63,SOT23 PK	2.0000		Q607
301-0001-10	TRANSISTOR,NPN,SMALL SIGNAL,MMBT3904,SOT23	17.0000		Q609
301-0004-10	TRANSISTOR,MMBT2222A,SOT-23PKG	3.0000		Q610
301-0005-10	TRANSISTOR,SMT,MMBT2907A,SOT-23 PKG	3.0000		Q612
301-0002-10	TRANSISTOR,PNP SMALL SIGNAL,MMBT3906 ,SOT23 PACKAGE	8.0000		Q680
301-0002-10	TRANSISTOR,PNP SMALL SIGNAL,MMBT3906 ,SOT23 PACKAGE	8.0000		Q681
301-0001-10	TRANSISTOR,NPN,SMALL SIGNAL,MMBT3904,SOT23	17.0000		Q702
301-0002-10	TRANSISTOR,PNP SMALL SIGNAL,MMBT3906 ,SOT23 PACKAGE	8.0000		Q703
301-0001-10	TRANSISTOR,NPN,SMALL SIGNAL,MMBT3904,SOT23	17.0000		Q803
301-0001-10	TRANSISTOR,NPN,SMALL SIGNAL,MMBT3904,SOT23	17.0000		Q804
301-0002-10	TRANSISTOR,PNP SMALL SIGNAL,MMBT3906 ,SOT23 PACKAGE	8.0000		Q806

PART NUMBER & REV.	DESCRIPTION.....	QPA.....	B	DWG REF.... DSG DESG
301-0007-10	XSTR,2N7002,TMOSFET,N-CHANNEL	2.0000		Q807
301-0001-10	TRANSISTOR,NPN,SMALL SIGNAL,MMBT3904,SOT23	17.0000		Q904
301-0007-10 A	XSTR,2N7002,TMOSFET,N-CHANNEL	2.0000		Q905
301-0001-10	TRANSISTOR,NPN,SMALL SIGNAL,MMBT3904,SOT23	17.0000		Q910
301-0001-10	TRANSISTOR,NPN,SMALL SIGNAL,MMBT3904,SOT23	17.0000		Q911
301-0001-10	TRANSISTOR,NPN,SMALL SIGNAL,MMBT3904,SOT23	17.0000		Q912
301-0001-10	TRANSISTOR,NPN,SMALL SIGNAL,MMBT3904,SOT23	17.0000		Q913
301-0001-10	TRANSISTOR,NPN,SMALL SIGNAL,MMBT3904,SOT23	17.0000		Q1000
301-0001-10	TRANSISTOR,NPN,SMALL SIGNAL,MMBT3904,SOT23	17.0000		Q1001
301-0002-10	TRANSISTOR,PNP SMALL SIGNAL,MMBT3906 ,SOT23 PACKAGE	8.0000		Q1101
301-0002-10	TRANSISTOR,PNP SMALL SIGNAL,MMBT3906 ,SOT23 PACKAGE	8.0000		Q1103
301-0001-10	TRANSISTOR,NPN,SMALL SIGNAL,MMBT3904,SOT23	17.0000		Q1104
301-0002-10	TRANSISTOR,PNP SMALL SIGNAL,MMBT3906 ,SOT23 PACKAGE	8.0000		Q1105
301-0001-10	TRANSISTOR,NPN,SMALL SIGNAL,MMBT3904,SOT23	17.0000		Q1106
201-3922-00 A	RESISTOR, SURFACE MOUNT, 1206 PKG, 39.2K, 1%	5.0000		R200
201-8252-00 A	RESISTOR,SURFACE MOUNT, 1206, 82.5K, 1%	4.0000		R201
201-1623-00 A	RESISTOR, SMT, 162.0K,1206 PKG,SCREENED, 1%	10.0000		R202
201-3922-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 39.2K, 1%	5.0000		R203
201-8252-00	RESISTOR,SURFACE MOUNT, 1206, 82.5K, 1%	4.0000		R204
201-1623-00	RESISTOR, SMT, 162.0K,1206 PKG,SCREENED, 1%	10.0000		R205
201-3922-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 39.2K, 1%	5.0000		R206
201-8252-00	RESISTOR,SURFACE MOUNT, 1206, 82.5K, 1%	4.0000		R207
201-1623-00	RESISTOR, SMT,	10.0000		R208

PART NUMBER & REV.	DESCRIPTION.....	QPA.....	B DWG REF.... DSG DESG
	162.0K,1206 PKG,SCREENED, 1%		
200-0001-00 A	RES,100M,+/-10%,0.25W,HV METAL OXIDE,AXIAL	2.0000	R209
200-0001-00	RES,100M,+/-10%,0.25W,HV METAL OXIDE,AXIAL	2.0000	R210
201-1002-00 A	RES,SMT,1206 PKG,10.0K,+/-1%	18.0000	R212
201-1002-00	RES,SMT,1206 PKG,10.0K,+/-1%	18.0000	R213
201-1002-00	RES,SMT,1206 PKG,10.0K,+/-1%	18.0000	R214
201-2211-00 A	RESISTOR, SURFACE MOUNT, 1206 PKG, 2.21K +/-1%	7.0000	R215
201-2211-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 2.21K +/-1%	7.0000	R216
201-2212-00 A	RESISTOR, SURFACE MOUNT, 1206 PKG, 22.1K +/-1%	18.0000	R217
201-2212-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 22.1K +/-1%	18.0000	R220
201-0000-00 B	RES,SMD,0 OHM,1206	3.0000	R221
201-3922-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 39.2K, 1%	5.0000	R222
201-1002-00	RES,SMT,1206 PKG,10.0K,+/-1%	18.0000	R223
201-5112-00	RES,SMD,51.1K,1%,.125W, 1206	2.0000	R225
201-1001-00 A	RESISTOR, SURFACE MOUNT, 1206 PKG, 1000 OHM 1%	17.0000	R226
206-3324-01 A	RES,3.32M,1%, .25W,MF,AXIAL LEAD	1.0000	R227
201-5231-00 A	RESISTOR, SURFACE MOUNT, 1206 PKG, 5.23K 1%	2.0000	R229
201-2212-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 22.1K +/-1%	18.0000	R231
201-4753-00 A	RESISTOR, SURFACE MOUNT, 1206 PKG, 475K 1%	9.0000	R232
201-1002-00	RES,SMT,1206 PKG,10.0K,+/-1%	18.0000	R233

PART NUMBER & REV.	DESCRIPTION.....	QPA.....	B DSG	DWG REF.... DESG
201-1002-00	RES,SMT,1206 PKG,10.0K,+/-1%	18.0000		R234
201-4753-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 475K 1%	9.0000		R235
201-4752-00 A	RESISTOR, SURFACE MOUNT, 1206 PKG, 47.5K 1%	15.0000		R236
201-1002-00	RES,SMT,1206 PKG,10.0K,+/-1%	18.0000		R237
201-4751-00 A	RESISTOR, SURFACE MOUNT, 1206 PKG, 4.75K 1%	25.0000		R238
201-4751-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 4.75K 1%	25.0000		R239
201-4751-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 4.75K 1%	25.0000		R240
201-4752-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 47.5K 1%	15.0000		R241
201-4752-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 47.5K 1%	15.0000		R242
201-1002-00	RES,SMT,1206 PKG,10.0K,+/-1%	18.0000		R243
201-1003-00 A	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R244
201-1623-00	RESISTOR, SMT, 162.0K,1206 PKG,SCREENED, 1%	10.0000		R246
201-4753-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 475K 1%	9.0000		R247
201-2212-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 22.1K +/-1%	18.0000		R248
201-7503-00 A	RES,SMD,750K,1%,.125W,1 206	2.0000		R249
201-3741-00 A	RES,SMD,3.74K,1%,0.125W ,1206,100 PPM/DEG C	1.0000		R250
201-2740-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 274 OHM 1%	4.0000		R253
201-1001-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 1000 OHM 1%	17.0000		R260
201-1001-00	RESISTOR, SURFACE	17.0000		R261

PART NUMBER & REV.	DESCRIPTION.....	QPA.....	B	DWG REF.... DSG DESG
	MOUNT, 1206 PKG, 1000 OHM 1%			
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R300
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R303
201-4753-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 475K 1%	9.0000		R306
201-4753-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 475K 1%	9.0000		R307
201-4751-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 4.75K 1%	25.0000		R310
201-4751-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 4.75K 1%	25.0000		R311
202-0001-00	RESISTOR,100K OHM,0.1%	2.0000	B	R312
202-0001-00	RESISTOR,100K OHM,0.1%	2.0000		R313
201-4751-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 4.75K 1%	25.0000		R314
201-4751-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 4.75K 1%	25.0000		R315
201-100Z-00	RES,SMD,10 OHM,1%,0.125W,+/-250PPM ,1206	4.0000	B	R316
201-100Z-00	RES,SMD,10 OHM,1%,0.125W,+/-250PPM ,1206	4.0000		R317
201-4751-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 4.75K 1%	25.0000		R318
201-2742-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 27.4K 1%	3.0000	A	R319
201-2742-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 27.4K 1%	3.0000		R320
201-6341-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 6.34K 1%	2.0000	A	R321
201-2213-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 221K +/-1%	6.0000	A	R323
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R330
201-100Z-00	RES,SMD,10	4.0000		R331

PART NUMBER & REV.	DESCRIPTION.....	QPA.....	B DWG REF.... DSG DESG
	OHM,1%,0.125W,+/-250PPM ,1206		
201-4751-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 4.75K 1%	25.0000	R333
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000	R334
201-100Z-00	RES,SMD,10 OHM,1%,0.125W,+/-250PPM ,1206	4.0000	R335
201-2213-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 221K +/-1%	6.0000	R336
201-1001-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 1000 OHM 1%	17.0000	R337
201-1001-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 1000 OHM 1%	17.0000	R338
201-1001-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 1000 OHM 1%	17.0000	R339
201-1001-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 1000 OHM 1%	17.0000	R340
201-2212-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 22.1K +/-1%	18.0000	R341
201-4751-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 4.75K 1%	25.0000	R342
201-4751-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 4.75K 1%	25.0000	R343
201-4751-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 4.75K 1%	25.0000	R344
201-4751-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 4.75K 1%	25.0000	R345
201-1002-00	RES,SMT,1206 PKG,10.0K,+/-1%	18.0000	R346
201-1002-00	RES,SMT,1206 PKG,10.0K,+/-1%	18.0000	R347
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000	R350
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000	R351

PART NUMBER & REV.	DESCRIPTION.....	QPA.....	B	DWG REF.... DSG DESG
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R352
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R353
201-2212-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 22.1K +/-1%	18.0000		R354
201-1002-00	RES,SMT,1206 PKG,10.0K,+/-1%	18.0000		R408
201-8453-00 A	RES,SMD,845K,1%,.125W,1 206,TC 100PPM/C	1.0000		R409
201-4751-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 4.75K 1%	25.0000		R410
201-2213-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 221K +/-1%	6.0000		R411
201-2213-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 221K +/-1%	6.0000		R412
201-4751-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 4.75K 1%	25.0000		R413
201-3323-00 A	RESISTOR, SURFACE MOUNT, 1206 PKG, 332K 1%	7.0000		R415
201-5110-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 511 OHM 1%	6.0000		R418
201-1004-00 A	RESISTOR, SURFACE MOUNT, 1206 PKG, 1.0 MEG +/-1%	3.0000		R420
201-1333-00 A	RES,SMD,133K,1%,.125W,1 206,100PPM/DEG C	1.0000		R421
201-3323-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 332K 1%	7.0000		R424
201-4751-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 4.75K 1%	25.0000		R430
201-1002-00	RES,SMT,1206 PKG,10.0K,+/-1%	18.0000		R431
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R435
201-4751-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 4.75K 1%	25.0000		R438
201-4753-00	RESISTOR, SURFACE	9.0000		R439

PART NUMBER & REV.	DESCRIPTION	QPA	B DSG	DWG REF DESG
	MOUNT, 1206 PKG, 475K 1%			
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R442
201-4751-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 4.75K 1%	25.0000		R443
201-4993-00 A	RES,SMD,499K,1%,.125W,1 206	1.0000		R444
201-2213-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 221K +/-1%	6.0000		R445
201-4753-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 475K 1%	9.0000		R446
201-5903-00 A	RES,SMD,590K,1%,.125W,1 206,100PPM/DEG C	1.0000		R451
201-3323-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 332K 1%	7.0000		R452
201-3323-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 332K 1%	7.0000		R453
201-4753-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 475K 1%	9.0000		R454
201-7503-00	RES,SMD,750K,1%,.125W,1 206	2.0000		R455
201-4753-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 475K 1%	9.0000		R456
201-3402-00 A	RESISTOR, SMT, 1206,PKG, 34.0K 1%	2.0000		R501
201-5231-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 5.23K 1%	2.0000		R502
205-0017-00 A	RESISTOR,5.23K OHM,.02%,.1W	1.0000		R503
205-0018-00 A	RESISTOR,1.5K OHM,.02%,.1W	1.0000		R504
205-0021-00 A	RESISTOR,75.0K OHM,.02%,.1W	1.0000		R507
205-0012-00 B	RESISTOR,22.1K, 0.1%, .10W	1.0000		R508
205-0019-00 A	RESISTOR,24.0K OHM,.02%,.1W	1.0000		R511
205-0025-00	RESISTOR,6.81K OHM,.02%,.1W	2.0000		R512
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R515
205-0023-00 A	RESISTOR,59.0K	1.0000		R516

PART NUMBER & REV.	DESCRIPTION	QPA	B DSG	DWG REF DESG
	OHM,.02%,.1W			
205-0024-00 A	RESISTOR,3.32K OHM,.02%,.1W	1.0000		R517
205-0025-00 A	RESISTOR,6.81K OHM,.02%,.1W	2.0000		R518
201-4751-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 4.75K 1%	25.0000		R522
201-2211-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 2.21K +/-1%	7.0000		R602
201-4752-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 47.5K 1%	15.0000		R604
201-4752-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 47.5K 1%	15.0000		R606
201-2551-00 A	RES,SMD,2.55K,1%,0.125W ,1206,+/-100PPM/DEG C	3.0000		R607
201-1002-00	RES,SMT,1206 PKG,10.0K,+/-1%	18.0000		R608
201-2551-00	RES,SMD,2.55K,1%,0.125W ,1206,+/-100PPM/DEG C	3.0000		R610
201-2212-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 22.1K +/-1%	18.0000		R611
201-2212-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 22.1K +/-1%	18.0000		R612
209-3321-00 A	RES,SMD,3.32K,0.5%,1206 ,+/-25PPM/DEGREE C	1.0000		R613
209-1002-00 A	RES,SMD,1206,10.0K,.5%, +/-25PPM/DEG C	1.0000		R614
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R615
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R616
201-1623-00	RESISTOR, SMT, 162.0K,1206 PKG,SCREENED, 1%	10.0000		R618
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R619
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R620
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R621
201-2740-00 A	RESISTOR, SURFACE	4.0000		R622

PART NUMBER & REV.	DESCRIPTION.....	QPA.....	B DSG	DWG REF.... DESG
	MOUNT, 1206 PKG, 274 OHM 1%			
201-4752-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 47.5K 1%	15.0000		R623
201-4752-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 47.5K 1%	15.0000		R624
201-499Z-00 A	RESISTOR,49.9 OHMS,1%,SMT	1.0000		R626
201-1004-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 1.0 MEG +/-1%	3.0000		R627
201-1004-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 1.0 MEG +/-1%	3.0000		R628
201-825Z-00 A	RESISTOR, SMT, 1206 PKG, 82.5 OHM 1%	5.0000		R629
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R630
201-825Z-00	RESISTOR, SMT, 1206 PKG, 82.5 OHM 1%	5.0000		R633
201-1001-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 1000 OHM 1%	17.0000		R635
201-825Z-00	RESISTOR, SMT, 1206 PKG, 82.5 OHM 1%	5.0000		R639
201-825Z-00	RESISTOR, SMT, 1206 PKG, 82.5 OHM 1%	5.0000		R641
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R650
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R660
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R661
201-5112-00 A	RES,SMD,51.1K,1%,.125W, 1206	2.0000		R662
201-2211-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 2.21K +/-1%	7.0000		R663
201-2211-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 2.21K +/-1%	7.0000		R664
201-5110-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 511 OHM 1%	6.0000		R667
201-2212-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 22.1K +/-1%	18.0000		R668

PART NUMBER & REV.	DESCRIPTION.....	QPA.....	B	DWG REF.... DSG DESG
203-2204-00 A	RESISTOR, SMT, 1206 PKG, 2.2 MEG 5%	1.0000		R669
201-1691-00 A	RESISTOR,SMD,1.69K,1%,0 .125W,1206	1.0000		R680
201-4752-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 47.5K 1%	15.0000		R681
201-1501-00 A	RESISTOR,SMD,1.50K,1%,. 125,1206	1.0000		R682
201-4752-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 47.5K 1%	15.0000		R683
201-3322-00 A	RESISTOR, SURFACE MOUNT, 1206 PKG, 33.2K 1%	1.0000		R704
201-1002-00	RES,SMT,1206 PKG,10.0K,+/-1%	18.0000		R709
201-3323-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 332K 1%	7.0000		R710
201-4752-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 47.5K 1%	15.0000		R711
201-4752-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 47.5K 1%	15.0000		R712
201-1002-00	RES,SMT,1206 PKG,10.0K,+/-1%	18.0000		R713
201-4752-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 47.5K 1%	15.0000		R714
201-4752-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 47.5K 1%	15.0000		R716
201-2212-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 22.1K +/-1%	18.0000		R801
201-3323-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 332K 1%	7.0000		R802
201-1623-00	RESISTOR, SMT, 162.0K,1206 PKG,SCREENED, 1%	10.0000		R803
201-8252-00	RESISTOR,SURFACE MOUNT, 1206, 82.5K, 1%	4.0000		R804
201-3922-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 39.2K, 1%	5.0000		R805
201-2002-00	RES,SMD,20.0K,1%,1206,+ /-100 PPM/DEGREE C	2.0000		R806
201-1003-00	RESISTOR, SURFACE	34.0000		R808

PART NUMBER & REV.	DESCRIPTION	QPA	B DWG DSG	REF DESG
	MOUNT, 1206 PKG, 100K, 1%			
201-1001-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 1000 OHM 1%	17.0000		R809
201-1001-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 1000 OHM 1%	17.0000		R810
201-2212-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 22.1K +/-1%	18.0000		R812
201-2212-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 22.1K +/-1%	18.0000		R813
201-2212-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 22.1K +/-1%	18.0000		R814
201-2212-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 22.1K +/-1%	18.0000		R815
201-1001-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 1000 OHM 1%	17.0000		R818
201-4751-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 4.75K 1%	25.0000		R819
201-4751-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 4.75K 1%	25.0000		R820
201-1002-00	RES,SMT,1206 PKG,10.0K,+/-1%	18.0000		R823
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R824
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R825
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R826
201-1001-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 1000 OHM 1%	17.0000		R827
201-0000-00	RES,SMD,0 OHM,1206	3.0000		R840
201-1002-00	RES,SMT,1206 PKG,10.0K,+/-1%	18.0000		R843
201-1002-00	RES,SMT,1206 PKG,10.0K,+/-1%	18.0000		R902
201-1001-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 1000	17.0000		R903

PART NUMBER & REV.	DESCRIPTION.....	QPA.....	B DSG	DWG REF.... DESG
201-1001-00	OHM 1% RESISTOR, SURFACE MOUNT, 1206 PKG, 1000	17.0000		R904
201-2211-00	OHM 1% RESISTOR, SURFACE MOUNT, 1206 PKG, 2.21K	7.0000		R905
201-2211-00	+/-1% RESISTOR, SURFACE MOUNT, 1206 PKG, 2.21K	7.0000		R906
201-1623-00	+/-1% RESISTOR, SMT, 162.0K,1206	10.0000		R907
201-2742-00	PKG,SCREENED, 1% RESISTOR, SURFACE MOUNT, 1206 PKG, 27.4K	3.0000		R908
201-6341-00	1% RESISTOR, SURFACE MOUNT, 1206 PKG, 6.34K	2.0000		R918
201-1003-00	1% RESISTOR, SURFACE MOUNT, 1206 PKG, 100K,	34.0000		R919
203-1005-00 A	1% RESISTOR, SMT, 1206	1.0000		R920
201-2213-00	PKG, 10 MEG 5% RESISTOR, SURFACE MOUNT, 1206 PKG, 221K	6.0000		R926
201-2212-00	+/-1% RESISTOR, SURFACE MOUNT, 1206 PKG, 22.1K	18.0000		R927
201-1623-00	+/-1% RESISTOR, SMT, 162.0K,1206	10.0000		R928
201-3323-00	PKG,SCREENED, 1% RESISTOR, SURFACE MOUNT, 1206 PKG, 332K	7.0000		R929
201-1003-00	1% RESISTOR, SURFACE MOUNT, 1206 PKG, 100K,	34.0000		R930
201-2002-00 A	1% RES,SMD,20.0K,1%,1206,+	2.0000		R931
201-5110-00	/-100 PPM/DEGREE C RESISTOR, SURFACE MOUNT, 1206 PKG, 511	6.0000		R932
201-2551-00	OHM 1% RES,SMD,2.55K,1%,0.125W	3.0000		R933
201-1001-00	,1206,+/-100PPM/DEG C RESISTOR, SURFACE MOUNT, 1206 PKG, 1000	17.0000		R934
201-2212-00	OHM 1% RESISTOR, SURFACE MOUNT, 1206 PKG, 22.1K	18.0000		R935
201-1001-00	+/-1% RESISTOR, SURFACE	17.0000		R936

PART NUMBER & REV.	DESCRIPTION.....	QPA.....	B	DWG REF.... DSG DESG
	MOUNT, 1206 PKG, 1000 OHM 1%			
201-2212-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 22.1K +/-1%	18.0000		R937
201-1001-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 1000 OHM 1%	17.0000		R938
201-1000-00	RES,SMD,100 OHM,1206,1%	2.0000		R939
201-1000-00 A	RES,SMD,100 OHM,1206,1%	2.0000		R940
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R1002
201-4751-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 4.75K 1%	25.0000		R1003
201-4751-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 4.75K 1%	25.0000		R1005
201-4751-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 4.75K 1%	25.0000		R1008
201-4751-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 4.75K 1%	25.0000		R1009
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R1012
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R1013
201-0000-00	RES,SMD,0 OHM,1206	3.0000		R1021
201-4752-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 47.5K 1%	15.0000		R1101
201-4752-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 47.5K 1%	15.0000		R1102
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R1103
201-5110-00 A	RESISTOR, SURFACE MOUNT, 1206 PKG, 511 OHM 1%	6.0000		R1105
201-1623-00	RESISTOR, SMT, 162.0K,1206 PKG,SCREENED, 1%	10.0000		R1106
201-1623-00	RESISTOR, SMT, 162.0K,1206 PKG,SCREENED, 1%	10.0000		R1107
201-5110-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 511 OHM 1%	6.0000		R1108

PART NUMBER & REV.	DESCRIPTION	QPA	B DWG DSG	REF DESG
201-1782-00 A	RES,SMD,17.8K,1%,1206,+/-100 PPM/DEGREE C	1.0000		R1109
201-2212-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 22.1K +/-1%	18.0000		R1110
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R1111
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R1112
201-5110-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 511 OHM 1%	6.0000		R1114
201-2740-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 274 OHM 1%	4.0000		R1115
201-2740-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 274 OHM 1%	4.0000		R1116
201-825Z-00	RESISTOR, SMT, 1206 PKG, 82.5 OHM 1%	5.0000		R1130
201-1003-00	RESISTOR, SURFACE MOUNT, 1206 PKG, 100K, 1%	34.0000		R1131
201-3402-00	RESISTOR, SMT, 1206,PKG, 34.0K 1%	2.0000		R1132
228-0001-00 A	RESISTOR, VARIABLE, SURFACE MOUNT, 2K +/-25% .2W	1.0000		RP301
228-0002-00 A	RES,VAR,SMD,50K,25%,0.2 OW	3.0000		RP400
228-0002-00	RES,VAR,SMD,50K,25%,0.2 OW	3.0000		RP401
228-0002-00	RES,VAR,SMD,50K,25%,0.2 OW	3.0000		RP402
225-0004-00 A	RES,POT,3/8" SINGLE TURN,2K OHM,.5W,10%	1.0000		RP601
360-0008-00 B	TRANSFORMER,SWITCHING, EL MAIN PCB	1.0000		T601
503-0022-00 A	TEST TERMINAL	10.0000		TP400
503-0022-00	TEST TERMINAL	10.0000		TP402
503-0022-00	TEST TERMINAL	10.0000		TP601
503-0022-00	TEST TERMINAL	10.0000		TP606
503-0022-00	TEST TERMINAL	10.0000		TP610
503-0022-00	TEST TERMINAL	10.0000		TP700
503-0022-00	TEST TERMINAL	10.0000		TP701
503-0022-00	TEST TERMINAL	10.0000		TP800
503-0022-00	TEST TERMINAL	10.0000		TP1000
503-0022-00	TEST TERMINAL	10.0000		TP1001
482-4052-03 A	IC, SMT, 4052 ANALOG MULTIPLEXER/DEMULTI, SOIC	2.0000		U200

PART NUMBER & REV.	DESCRIPTION.....	QPA.....	B	DWG REF.... DSG DESG
482-4052-03	IC, SMT, 4052 ANALOG MULTIPLEXER/DEMULTI, SOIC	2.0000		U201
470-0002-03 B	IC, SMT, TL064, OP AMP, LOW INPUT OFFSET	4.0000		U203
470-0003-03 A	TLC27M4ACD,QUAD CMOS OP-AMP,MEDIUM POWER	3.0000		U204
470-0003-03	TLC27M4ACD,QUAD CMOS OP-AMP,MEDIUM POWER	3.0000		U205
483-4016-03 A	IC,SMD,74HC4016,QUAD FET SWITCH,SO-14	2.0000		U300
470-0002-03	IC, SMT, TL064, OP AMP, LOW INPUT OFFSET	4.0000		U301
482-4053-03 A	IC, SMT, 4053B TRIPLE 2 CHANNEL ANALOG MULTI/DEMULTIPLEXER	1.0000		U302
470-0002-03	IC, SMT, TL064, OP AMP, LOW INPUT OFFSET	4.0000		U303
483-4016-03	IC,SMD,74HC4016,QUAD FET SWITCH,SO-14	2.0000		U304
470-0001-03 A	IC, OP-AMP,TLC27L4, QUAD CMOS, LOW POWER	1.0000		U401
470-0014-03 A	IC,SMD,TLC27L9CD,OP AMP,LOW OFFSET,LOW POWER	1.0000		U402
482-4051-03 A	4051 ANALOG MULTIPLEXER, SINGLE 8 CHANNEL	1.0000		U501
474-0002-04 A	IC, TO220 PKG, SWITCHING REG,LT1070, 5A HIGH EFF	1.0000		U602
472-0001-03 A	IC, SMT, VOLTAGE REG,LP2951,ADJUSTABLE MICROPOWER	1.0000		U603
470-0002-03	IC, SMT, TL064, OP AMP, LOW INPUT OFFSET	4.0000		U604
400-0008-03 A	IC,SMT,,QUAD 2 INPUT AND GATE,74HC08	1.0000		U605
322-0003-00 B	PHOTOCOUPLER,NEC PS2501-1	1.0000		U606
322-0006-00 A	PHOTOCOUPLER,PC900V,SHARP	2.0000	1	U607
322-0006-00	PHOTOCOUPLER,PC900V,SHARP	2.0000		U608
502-0009-00 A	OSCILLATOR,DUAL,CRYSTAL,CLOCK,18.432MHZ/10.75	1.0000		U700
400-4040-03 A	COUNTER, 12 BIT BINARY ASYCHRONOUS	1.0000		U703
440-8031-02 A	IC, SMT, 80C31, 8 BIT MICROCONTROLLER, PLCC	2.0000		U704
400-0373-03 A	IC,SMD,74HC373,OCTAL D-TYPE TRANSPARENT LA	2.0000		U705
610-0006-00 A	SOCKET, 32 PIN PLCC	2.0000		U706

PART NUMBER & REV.	DESCRIPTION	QPA	B	DWG REF DSG DESG
	THRU-HOLE			
400-0014-03 A	IC,INVERTER,HEX,,SCHMIT T-TRIGGER,74HC14	2.0000		U708
400-0138-03 A	IC,SMT,74CH138,3 TO 8 LINE DECODER,SOIC16	1.0000		U712
441-0002-02 A	IC, SMT, 82050, ASYCHRONOUS COMMUNICATIONS CONTROLLER, PLCC	1.0000		U714
430-0005-03 A	IC,SMD,256K BIT SRAM,LOW STANDBY CURRENT	1.0000		U716
441-0005-03 A	IC,SMD,DS1210,NONVOLATILE CONTROLLER CHIP	1.0000		U717
400-0000-03 A	IC, SMT, 74HC00, QUAD 2-INPUT POSITIVE NAND GATE, SO14 PKG	2.0000		U719
400-0011-03 A	IC,SMD,74HC11,TRIPLE 3 INPUT POSITIVE & GATE	1.0000		U720
441-0001-03 A	IC, SMT, 61830B, DISPLAY CONTROLLER, DOT MATRIX LCD GRAPHIC	1.0000		U800
430-0002-03 C	IC,SMT,5565,8KX8 STATIC RAM,200NS	2.0000	1	U801
400-T377-03 A	IC, SMT, 74HCT377, OCTAL D-TYPE FLIP-FLOP (TTL LEVEL), SOIC 20L WIDE PKG	2.0000		U803
400-0123-03 A	IC, SMT, 74HC123A, DUAL TRIGGERABLE MONOSTABLE MULTIVIB, SOIC16	1.0000		U804
442-0001-03 A	IC, SMT, MSM6242, DIRECT BUS CONNECTED REAL TIME CLOCK, SOIC	1.0000		U805
400-0000-03	IC, SMT, 74HC00, QUAD 2-INPUT POSITIVE NAND GATE, SO14 PKG	2.0000		U806
400-0393-03 A	IC, SMT, 74HC393, DUAL 4-BIT BINARY COUNTER, SOIC	1.0000		U807
433-0180-03 A	EEPROM,93C46,1024 BIT,8 PIN,SOIC	1.0000		U810
480-0001-02 A	IC, SMT, AD7528, DAC, CMOS DUAL 8BIT BUFFERED MULT	1.0000		U900
470-0003-03	TLC27M4ACD,QUAD CMOS OP-AMP,MEDIUM POWER	3.0000		U902
473-0003-03 A	IC,TL431AD,PROGRAMMABLE PRECISION REFERENCE	1.0000		U903
470-0015-03 A	IC,SMD,OP-AMP,TL031,LOW POWER/LOW OFFSET	1.0000		U906
440-8031-02	IC, SMT, 80C31, 8 BIT MICROCONTROLLER, PLCC	2.0000		U1000

PART NUMBER & REV.	DESCRIPTION.....	QPA.....	B	DWG REF.... DSG DESG
400-0373-03	IC,SMD,74HC373,OCTAL D-TYPE TRANSPARENT LA	2.0000		U1002
610-0006-00	SOCKET, 32 PIN PLCC THRU-HOLE	2.0000		U1003
430-0002-03	IC,SMT,5565,8KX8 STATIC RAM,200NS	2.0000		U1004
400-T377-03	IC, SMT, 74HCT377, OCTAL D-TYPE FLIP-FLOP (TTL LEVEL), SOIC 20L WIDE PKG	2.0000		U1006
481-0001-02 A	IC,A TO D,TLC1541,10 BIT SERIAL CONTROL AND ELEVEN INPUTS, PLCC	1.0000		U1007
306-0003-03 A	DIODE ARRAY,MMAD1108,SOIC16 PKG	2.0000		U1008
306-0003-03	DIODE ARRAY,MMAD1108,SOIC16 PKG	2.0000		U1009
400-0014-03	IC,INVERTER,HEX,,SCHMIT T-TRIGGER,74HC14	2.0000		U1010
442-0005-03 A	IC,SMD,LT1032,QUAD LOW POWER LINE DRIVER	1.0000		U1101
442-0004-03 A	IC,SMD,LTC485,LOW POWER RS485 TRANSCIEVER	2.0000		U1102
442-0004-03	IC,SMD,LTC485,LOW POWER RS485 TRANSCIEVER	2.0000		U1103
470-0011-03 A	IC,SMD,OP-AMP,TL032,LOW POWER/LOW OFFSET	1.0000		U1104
502-0004-00 A	CRYSTAL, SMD, 32.768KHZ	1.0000		X800
502-0005-00 A	CRYSTAL,SMD,10.752,MHZ	1.0000		X1000

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Appendix A

Buildable Test Equipment

This appendix contains information that allows the service technician to build the following special test fixtures required for calibration and testing.

- Electromedics 37° C Temperature Simulator
- Power Supply Connectors
- Battery Substitution Plugs
- Battery Temperature Sensor Substitution Plug
- RS-423 Loopback Test Fixture

The parts to build these fixtures are available from either the part manufacturer or from Protocol Systems, Inc. where Protocol's part number is listed. Contact Protocol Systems for information on ordering these parts.

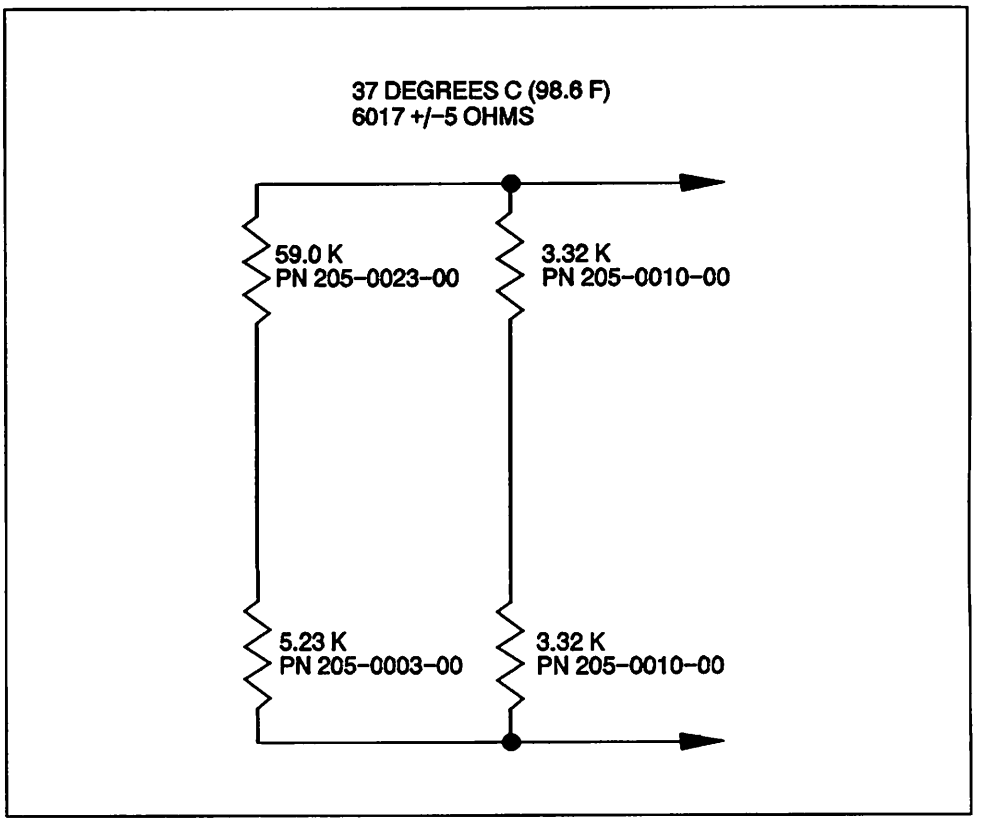

Fig. A-1. Electromedics 37°C Temperature Simulator Schematic

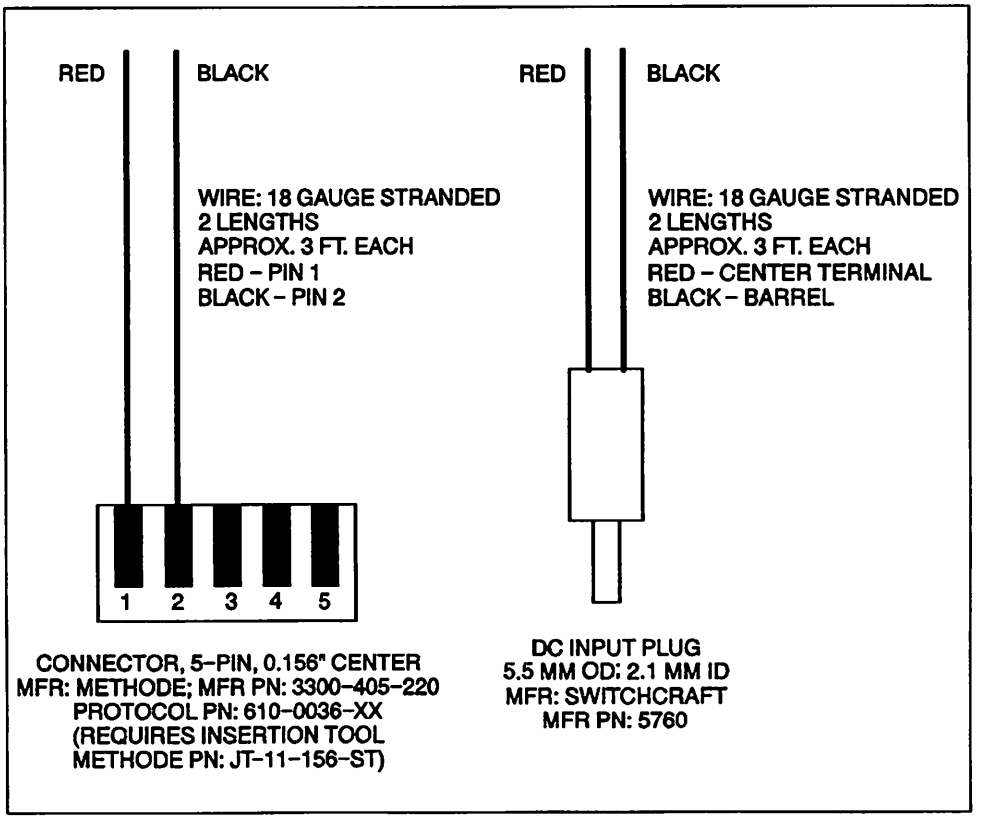

Fig. A-2. Power Supply Adapter Cable Schematic

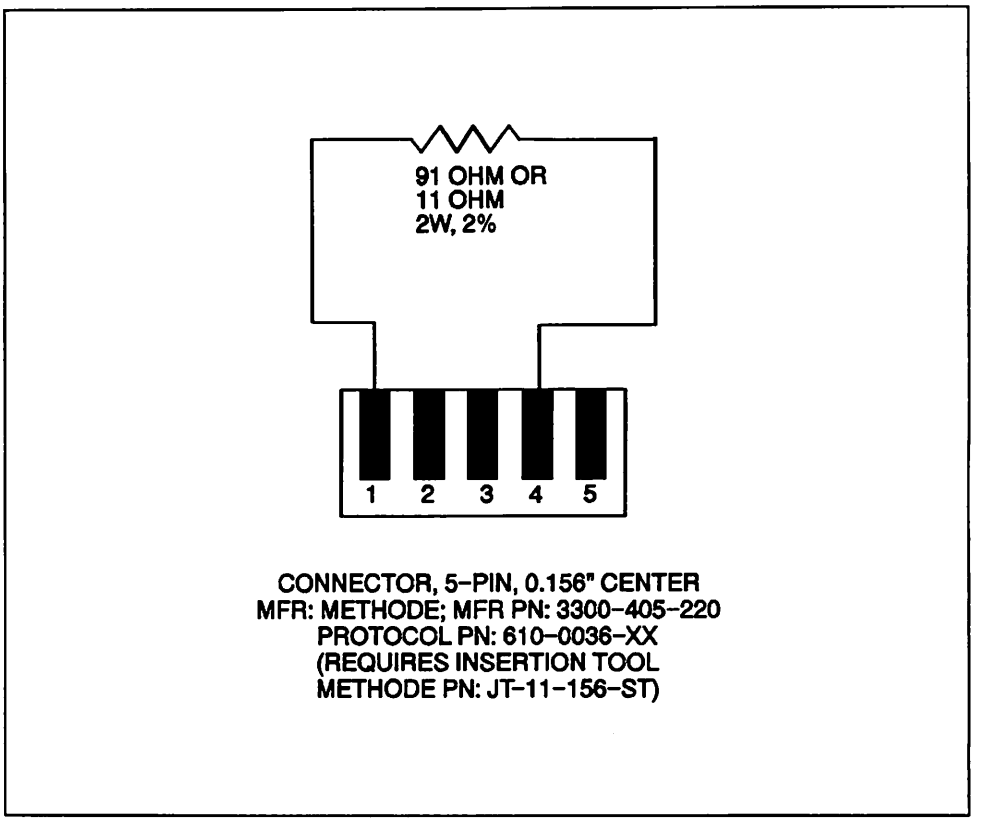

Fig. A-3. Battery Substitution Plugs Schematic

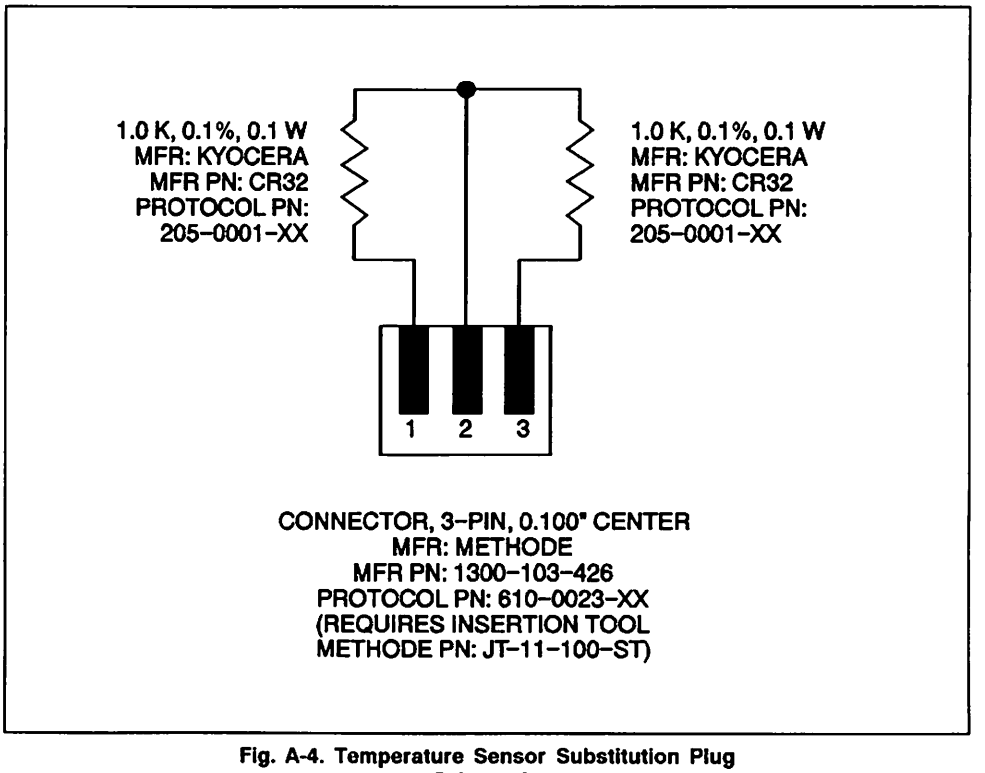

Fig. A-4. Temperature Sensor Substitution Plug Schematic

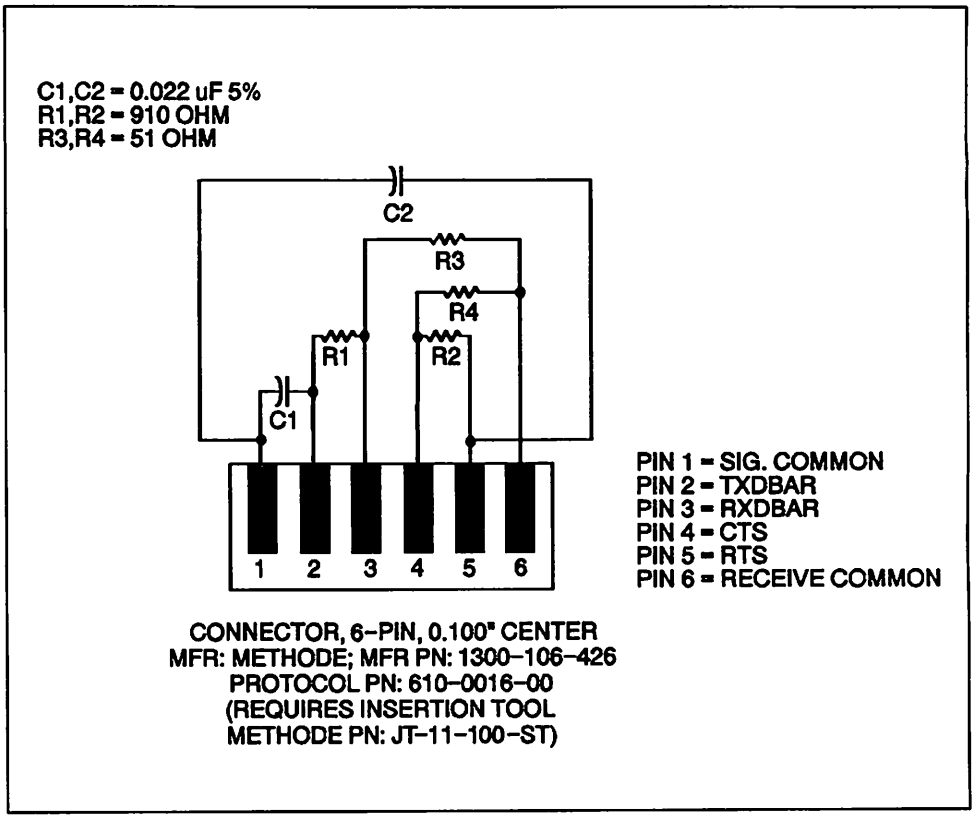

Fig. A-5. RS-423 Loopback Test Fixture

Appendix B

Dynatech/Nevada Patient Simulator Modification

The factory configuration of the Dynatech/Nevada model 214A, 215A, and 217A Patient Simulators is incompatible with the Propaq 104 and 106 when both the ECG and invasive pressure simulator channels are simultaneously connected to the monitor. Erroneous readings result. The patient simulator must be modified as described in this appendix in order to use both simulator channels with the Propaq 104 and 106. If only one simulator channel is used, the modification does not need to be done.

1. Modify the patient simulator's invasive pressure cable as shown in Figure B-1 and Table B-1.

2. Remove jumpers "W1" and "W2" from the patient simulator's "Top PCB" as shown in Figure B-2.

Incompatibilities with other simulators may also cause erroneous readings. Check Propaq readings with the simulator against a known source before using the simulator for calibration.

Table B-1. Modified Dynatech/Nevada Model 215A Cable Wiring

Function	Color	Pin No.	Propaq 104/106
Output (+)	Black	4	C
Output (-)	Red	1	A & E
Exciter (+)	White	3	B
Exciter (-)	Green	5	D
ECG Ref	Blue	2	No Connection

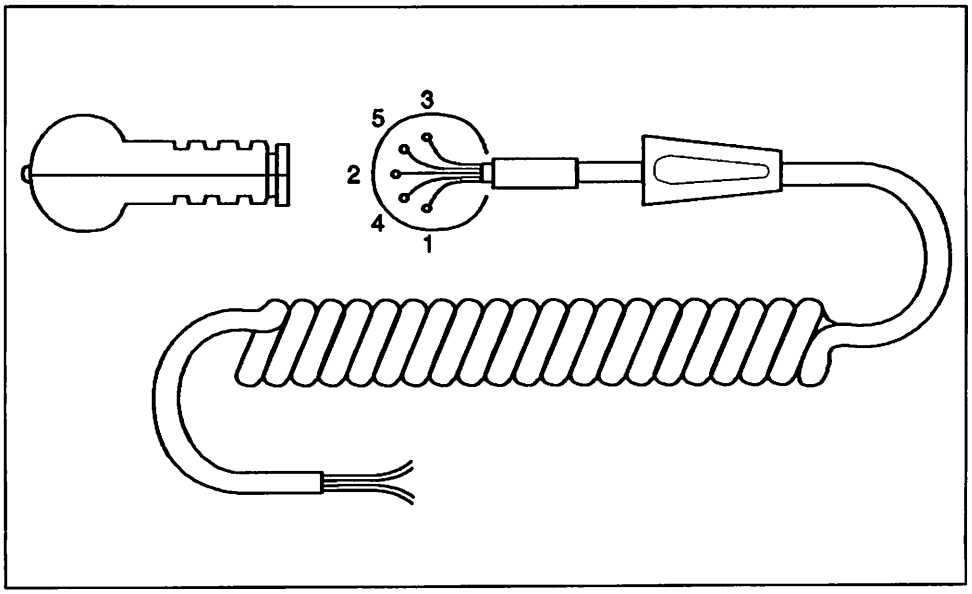

Fig. B-1. Modified Invasive Pressure Model 215A Cable

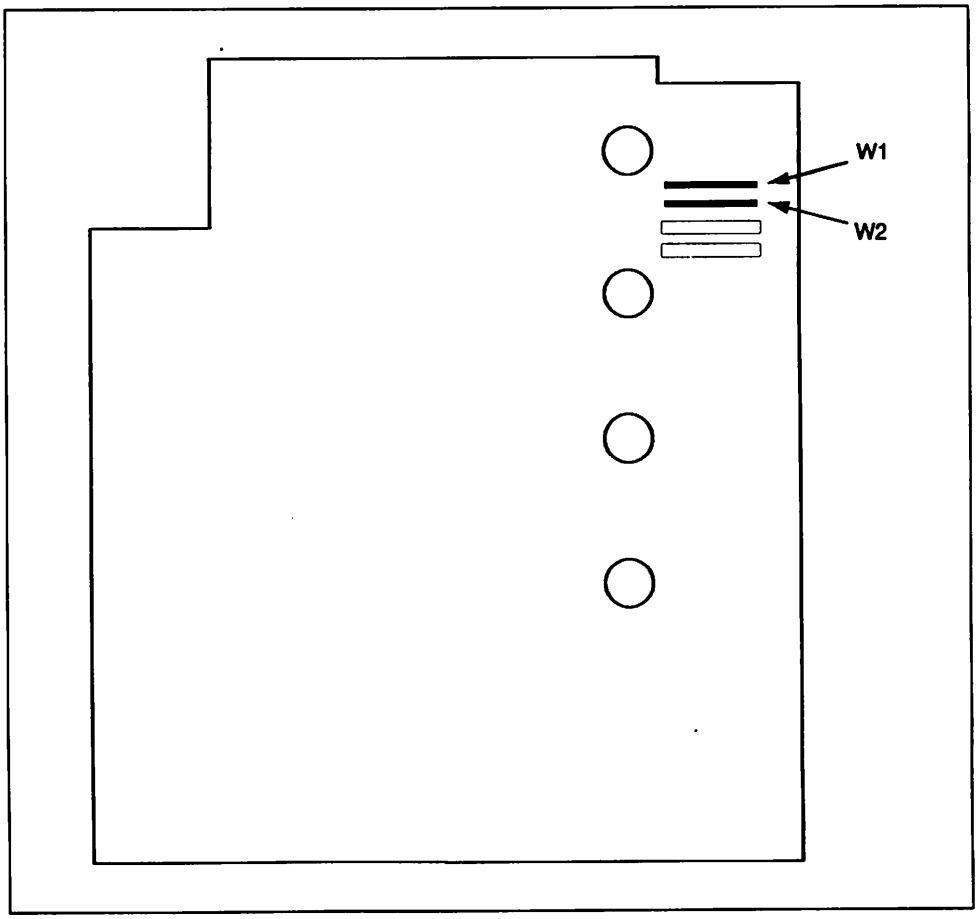

Fig. B-2. Model 215A Top PCB Modification

Appendix C
Software Revision History

Table C-1. Propaq EL Software Revisions

Version	Features/Enhancements
6.01.00	Initial EL Product Release. (Recalled per FDA Z-213/215-2.)
6.10.00	Initial HP patient input connector support. (Recalled per FDA Z-213/215-2.)
6.11.00	Fixed NIBP diastolic computation bug present only in versions 6.01.00 and 6.10.00 Additional features implemented for the 6.11.00 release include: (1) The addition of the SpO2 oxygen saturation value to the Tabular Trend display screen. This was added to more accurately reflect on the display what is printed on the Tabular Trend print strip. (2) Improved Pacer Detection/Display capabilities. With Pacer Display on, if the pacer is of sufficient amplitude and pulse-width, the display and print strip will show the Pacer Display indicator (dashed line) as well as the pacer itself. With Pacer Display off, the pacer will still be shown on the display and the print strip. (3) HP Model 1290C IBP Transducer detection capabilities. (4) HP Model 1290A IBP Transducer rejection capabilities. The 1290A transducer will generate the 'Incompatible Transducer' Equipment Alarm.