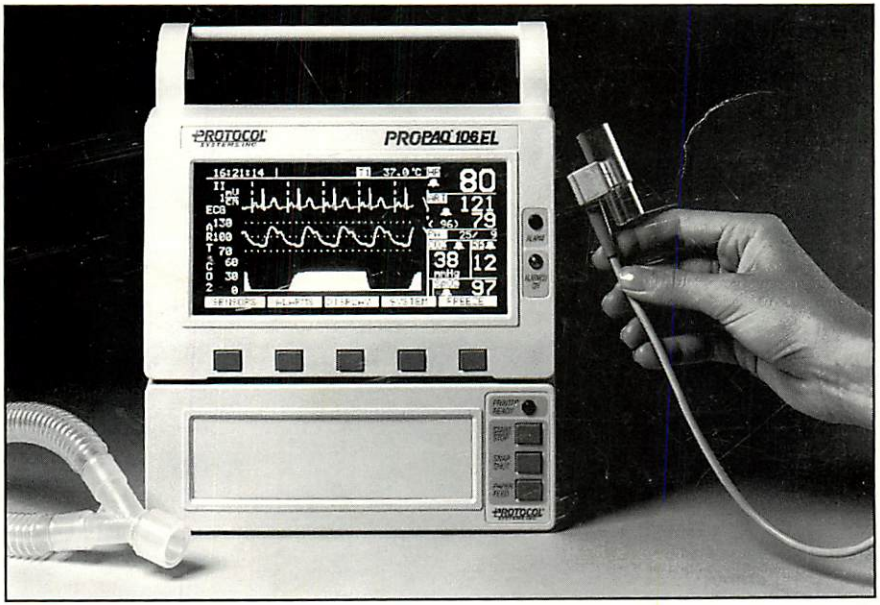
PROPAQ®

User's Guide



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User's Guide

Models 102, 104, 106, 102EL, 104EL, 106EL
Software Version 8
English Language

IMPORTANT
Check for important User's Guide Updates on the inside back cover of this manual.

GSA Listings:

North American #V797P-3409j International #GS-00F-8088F

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Model 102 LCD: 6515-01-3156196 Model 102 EL: 6515-01-3627449
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Model 106 LCD: 6515-01-3156197 Model 106 EL: 6515-01-3627447
Expansion Module with Printer: 6515-01-3159814
Pulse Oximetry Option: 6515-01-3631219

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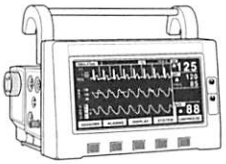

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Safety Summary

This Safety Summary should be read by all Propaq users. It provides information on the safe use and application of the Propaq monitors.

The general safety information in this summary is for both operating and servicing personnel. Specific warnings and cautions will be found throughout the Propaq documentation where they apply. These warnings and cautions are summarized starting on page xxv.

Statement of Intended Use

The Propaq monitors and options are intended to be used in compliance with the instructions in the Propaq documentation and according to accepted hospital and clinical protocols. The Propaq is to be used only with accessories and other parts recommended or supplied by Protocol Systems, Inc. Use of other than recommended or supplied accessories and parts may result in inaccurate patient information and damage to the monitor.

The Propaq is intended for use only on pediatric and adult patients, not on neonates.

Specific intentions of use are also listed in the monitoring sections of Chapter 2 of this book.

General Definitions

NOTE statements are for important general information applicable to the reader. Note statements appear as shown below.

Note Statement

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

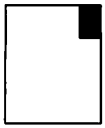
Caution statement.

WARNING statements in the documentation identify conditions or practices that could result in personal injury. WARNING statements appear as shown below.

Warning statement.

> The ">" character separating labels of buttons in the text (such as SENSORS > ECG > SIZE) indicates the sequence of button presses in order to change a setting or access a Propaq function.

FONts **Bold**, *italic*, and ***bold-italic*** characters are used for emphasis or to draw attention to a term. Some terms are *italicized* and defined in sidebar boxes next to the main text. Other term definitions can be found in the **Glossary** (Appendix A).



Edge tabs appear on the right hand pages of this manual allowing you to easily find the chapters you're interested in.

Symbols

The following symbols appear in the Propaq documentation and on Propaq labels.

DANGER: Risk of explosion when used in the presence of flammable anesthetics. (This is on older versions only.)

Type CF, isolated patient connections comply with the allowable risk (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 risk (leakage) current limits for noncardiac body applications, protecting the patient and operator from risk of electric shock.

Protected against water dripping vertically.
(Protection Classification IPX1 per IEC Publication 529.)

DC power input connector for applications not requiring a "high output" power adapter.

DC power input connector for applications requiring a "high output" power adapter.

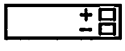
For continued fire protection, use only the specified fuse.

Internal power transformer meets requirements of a short-circuit-proof safety-isolating power transformer (symbol is located on ac power adapter).

Caution: Refer to User's Guide and accompanying documentation.

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

Battery.



Positioning of battery.

Direct current.

Alternating current.

For indoor use only.

Off (power disconnection from the mains).

On (power connection to the mains).

Please consider the following safety points when using the Propaq.

Important Safety Considerations

Please consider the following safety points when using the Propaq.

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

Do not autoclave this product.

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 some power adapter versions is replaceable.) 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 snap fittings and connector, since flexure will eventually cause breakage of strands at these points.

Avoid electrosurgery burns at monitoring sites by ensuring proper connection of the electrosurgery return circuit. If the electrosurgery return electrode is improperly connected, the other patient-connected monitoring electrodes and transducers, particularly ECG electrodes and temperature probes, will serve as return paths for the high-frequency energy. This is especially true for older electrosurgery units which have the return circuit deliberately earth grounded. For improved safety, never deliberately ground the return circuit of an isolated-output electrosurgery unit. If necessary, operate the monitor only on battery power to prevent a return to earth ground through the monitor.

To ensure 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. During defibrillation, always avoid contact with any accessories, such as cables and sensors, connected to the Propaq's left side panel. 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, at any time.

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.

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

To ensure patient safety, use only accessories recommended or supplied by Protocol Systems, Inc. For a list of those accessories, see the Protocol Products and Accessories book that accompanied this manual (PN 810-0409-00).

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

To ensure conformance to risk (leakage) current requirements when operating from an ac mains power source, use only a Protocol Systems' 503-0002 or 503-0054 series power adapter. Power adapters are for indoor use only.

Pour limiter le courant de fuite conformment aux exigences lorsque l'appareil est branch au secteur, utiliser seulement un bloc d'alimentation de la serie 503-0002, 503-0054. Pour utilisation a l'interieur seulement.

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

The Propaq should only be serviced by a Protocol Systems service person while under warranty. A Propaq Service Manual is available from Protocol Systems to aid the biomedical engineer during post-warranty period service.

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

Summary of Cautions

CAUTION

Page 2-4. To protect the Propaq from damage during defibrillation, for accurate ECG information, for protection against noise and other interference, and to avoid excessive recovery time following defibrillation, use only ECG electrodes and cables (namely, ones with internal current-limiting resistors) specified or supplied by Protocol Systems, and follow recommended application procedures. ECG electrodes must be of similar metal to prevent excessive polarization. See the Products and Accessories book for part numbers and ordering information of ECG cables and other accessories.

Page 2-30. If the ZERO key (either P1 or P2) is pressed after an invasive pressure channel has been successfully zeroed and is currently monitoring a pressure waveform, the message ZERO REJECTED will display in the invasive pressure numerics window. This message will preempt the valid invasive pressure numerics that were displayed in this zone prior to the unintentional ZERO key press and will continue to preempt the numerics until the CANCEL key in the Invasive Pressure Menu is pressed. In addition, if the invasive pressure channel enters an alarm condition while the ZERO REJECTED message is overriding the invasive pressure numerics, no invasive pressure numerics will flash between inverse and normal to identify which patient channel is in alarm.

CAUTION

Page 2-78. The Mainstream CO2 option is not recommended for use during magnetic resonance imaging (MRI) procedures. The magnetic fields involved will permanently damage the CO2 sensor.

Page 2-83. If the sensor does not easily slide onto the adapter in the next step, do not attempt to force these components together. They fit together in only one way.

Page 5-4. Do not autoclave this product or its accessories.

Page 5-9. Leaving the monitor's lead-acid batteries in a completely discharged state may result in permanent battery damage. The batteries should be kept fully charged.

Page 5-12. Use only low-debris printer paper specified by Protocol Systems. Use of other paper will cause unclear printing of patient data, damage to printing head, and eventual printer failure. Store all paper (including a monitor loaded with paper) in an environment that meets the paper storage specifications listed in Table B-12 on page B–24. Failure to properly store paper can result in paper discoloration and damage to the printer.

Page 6-21. Use of other than Protocol power adapters with the appropriate plug rated for your ac mains can damage the Propaq monitor and may require fuse replacement in the power adapter. Do not autoclave the power adapter. Do not operate the power adapter with a damaged mains power cord or plug. Verify that the "Universal Power Adapter" is set for the proper mains voltage (see page 6-24) prior to plugging it into the Propaq. Inspect the adapter power cords periodically for fraying or other damage, and replace the adapter or the mains power cord as necessary. (The power adapter is not a serviceable part; however, the detachable mains power cord is separately replaceable.)

CAUTION

Page 6-25. Replace each fuse only with the specified type as listed in Table 6-3 on page 6-23.

Page 6-28. Spare fuses are contained in housings above the fuses in the carrier as shown in Figure 6-16. Between the fuses is a small printed-circuit board (PCB) that sets the power adapter to the desired ac mains voltage. This PCB may slide out of the carrier when handling the housing. The PCB is easily replaced in the following steps.

Page 6-29. Be sure that the window shows the voltage setting for your ac mains source (100-120 Volts or 200-240 Volts). Do not install the carrier unless the correct voltage setting appears in the window.

Page 6-29. Do not plug the dc power cable into the Propaq until you have verified the power adapter operation in the next steps.

Page 6-31. Replace each fuse only with the specified type as listed in Table 6-3 on page 6-23.

Page 6-32. Do not plug the power adapter cord into the Propaq until you have verified the power adapter in the next step.

Summary of Warnings

WARNING

Page 1-11. Safe interconnection between the Propaq and another device must be in accordance with applicable safety recommendations. In the United States of America, the Association for the Advancement of Medical Instrumentation (AAMI) specifies safe interconnection requirements.

Page 1-14. Connecting to other networks (for example, telephone systems that use the same type of connector) may damage the Propaq or present a hazard to the patient.

Page 2-3. High-intensity radio frequency (RF) energy from external sources, such as an improperly connected electrosurgical unit, can induce heat into electrodes and cables which can cause burns on the patient. Reading errors and damage to equipment may also result. This hazard can be reduced by (1) avoiding the use of small ECG electrodes, (2) selecting ECG electrode attachment points remote from the expected RF paths, (3) using electrosurgical return electrodes with the largest practical contact area, and (4) assuring proper application of the electrosurgical return electrode to the patient.

Page 2-14. Pacemaker signals can differ from one pacemaker to the next. The Association for Advancement of Medical Instrumentation (USA) cautions that "in some devices, rate meters may continue to count the pacemaker rate during occurrences of cardiac arrest or some arrhythmias. Do not rely entirely upon rate meter alarms. All pacemaker patients should be kept under close or constant observation."

Page 2-21. If electrocautery is going to be applied, always avoid using any transducer with a conductive (metal) case that is electrically connected to its cable shield. Using a conductive transducer case with such a shield connection risks high-frequency burns at the ECG electrodes if the transducer case becomes earth grounded.

WARNING

Page 2-41. The Propaq should never be used to monitor NIBP on one patient while simultaneously monitoring ECG on another patient.

Page 2-41. Propaq cuff pressure levels and inflation rates could injure neonates. Do not use on neonates.

Page 2-42. If a noninvasive blood pressure measurement is suspect, repeat the measurement. If you are still uncertain about the reading, use another method.

Page 2-42. Do not attempt to take cuff pressures on patients during cardiopulmonary bypass.

Page 2-61. A metal-jacketed temperature probe that contacts conductive objects during electrocautery may increase the possibility of RF burns at the temperature probe site or at the ECG electrodes, especially if the object the probe contacts is earth grounded. During application of the probe, be sure that it is not allowed to touch conductive objects. During electrocautery be sure that the probe does not contact conductive objects and is not in contact with clinical personnel.

Page 2-68. Sensors exposed to ambient light while not applied to a patient can exhibit semi-normal saturation readings. Be sure the sensor is securely placed on the patient and check its application often to ensure accurate readings.

Page 2-81. Do not attempt to verify operation of the CO2 sensor by blowing through it directly. Always blow through an attached airway adapter. Otherwise, a small amount of CO2 from your breath may enter the CO2 sensor housing and cause a small shift in the measured CO2 values. It may take 3-24 hours for the sensor to return to proper calibration.

WARNING

Page 2-81. Protocol airway adapters are for single-patient use only. Replace the adapter with every new patient or if it becomes occluded. When using the CO2 Option in critical care, replace the adapter every 24 hours or if it becomes occluded. Prior to using an airway adapter, always inspect it for inadvertently lodged obstructions and for window integrity. After attaching the sensor to the adapter, always check the adapter again for proper placement of the sensor and for window integrity.

Page 2-82. Always gently attach the sensor to the airway adapter away from the patient, and take care not to damage the glass windows.

Page 2-84. When attaching the airway adapter in the next steps, position the adapter so that the sensor is on top as shown in Figure 2-41 to avoid fluid collection in the sensor airway slot. Any concentration of fluids here can cause inaccurate CO2 readings.

Page 2-85. Always double check to ensure that there are no leaks in the breathing circuit at any point of connection.

Page 2-89. To ensure patient safety, it is recommended that the Breath Rate alarm limits always be turned on and set appropriately.

Page 3-10. Suspending an alarm tone also suspends all alarm monitoring for 90 seconds or until the RESUME button is pressed.

Page 3-17. Suspending an alarm tone also suspends all alarm monitoring for 90 seconds or until the RESUME button is pressed.

Page 5-8. The monitor may not meet its performance specifications if stored or used outside the specified temperature and humidity ranges listed in the specification tables in Table B-10 on page B–21.

WARNING

Page 6-6. If you connect the 1290A or other 40 microV/V/mmHg transducer and then press any button as instructed by the equipment alert window, but do not disconnect the transducer from the Propaq, the equipment alert will not occur again. Using such a transducer connected to the Propaq will provide no pressure readings for that channel and may cause erroneous readings to be provided by the other pressure channel even if a compatible transducer is connected to the other channel. Disconnect the incompatible transducer and use a compatible transducer.

Page 6-8. The instructions in this booklet provide general guidelines for the use of the Defib Synchronization feature for performing synchronized cardioversion. These instructions are not intended to replace existing hospital procedures and protocols relative to the provision of cardiac electrical therapy and the operation of the specific models of the defibrillators. Use all safety standards and clinical protocols as defined by your institution.

Page 6-9. Use only the correct Protocol part with the LIFEPAK 5 or LIFEPAK 6s. Use of any other cable will result in incorrect operation. Refer to Table 2, "Defibrillator Synchronization Cables/Interface," on page 6-8, or in the Products & Accessories Book.

Page 6-14. The R-wave amplitude must be at least 0.5 mV (5 mm tall when the Propaq ECG sensitivity—SIZE button—is set to 1.0 mV/cm) to guarantee that the defibrillator sync pulse will occur no later than 30 milliseconds after the peak of an R-wave. Reposition the patient electrodes or change the Propaq lead selection as necessary to ensure sufficient ECG waveform amplitude.

Page 6-16. If the R-wave synchronization markers do not appear to be nearly simultaneous with the R-waves on the Propaq display, do not proceed with synchronized cardioversion.

WARNING

Page 6-17. You must press the LIFEPAK 5's SYNC button and check for appropriate synchronization markers on the Propaq before each cardioversion.

Page 6-18. The R-wave amplitude must be at least 0.5 mV (5 mm tall when the Propaq ECG sensitivity—SIZE button—is set to 1.0 mV/cm) to guarantee that the defibrillator sync pulse will occur no later than 30 milliseconds after the peak of an R-wave. Reposition the patient electrodes or change the Propaq's lead selection as necessary to ensure sufficient ECG waveform amplitude.

Page 6-20. If the R-wave synchronization markers do not appear to be nearly simultaneous with the R-waves on the Propaq display, do not proceed with synchronized cardioversion.

Page 6-20. You must press the LIFEPAK 6s SYNC button and check for appropriate synchronization markers on the Propaq before each cardioversion.

Page 6-22. Explosion risk. Do not operate this product in the presence of flammable anesthetics. This product must only be operated in strict conformance with local fire prevention regulations. Place the power adapter where it cannot fall and harm someone.

Page 6-25. Only qualified service personnel should replace the fuses.

Page 6-30. Only qualified service personnel should replace the fuses.

Page C-10. Do not attempt to verify operation of the CO2 sensor by blowing through it directly. Always blow through an attached airway adapter. Otherwise, a small amount of CO2 from your breath may enter the CO2 sensor housing and cause a small shift in the measured CO2 values. It may take 3-24 hours for the sensor to return to proper calibration.

Propaq Documentation

The Propaq documentation consists of documents for the clinician, the biomedical technician, and the department head or purchaser of accessories for the Propaq monitors.

The *Propaq User's Guide* (this book) contains important safety and other detailed information for the clinician. In addition, each institution may have specific requirements and policies that must be followed, which are not contained in the User's Guide. The User's Guide describes the Propaq with the software version number listed on the cover and title page. (The software version indicates the internal Propaq programming and appears when the Propaq is turned on, for example, 8.00.00.) More information is provided in the following section "About This User's Guide."

The *Propaq Service Manual* contains information on how to properly maintain the Propaq through routine calibration, inspection, and maintenance. It also describes how to change batteries, how to make minor repairs, such as unclogging air lines, and provides technical information for the repair technician. The Propaq's Service Menu is also described in detail in this manual. This manual is available from Protocol Systems, Inc.

The Protocol Systems, Inc. *Products & Accessories* book (Part Number 810-0409-00) provides a comprehensive, up-to-date list of accessories recommended for the Propaq monitors and options. You should refer to the *Products & Accessories* book any time you want to purchase accessories. If an accessory you are interested in is not listed in this booklet, call Protocol Systems Customer Service at (503) 526-8500, or toll-free in the continental United States at (800) 289-2500.

About This User's Guide

This User's Guide provides descriptions and operating information for the Propaq series of ultraportable vital signs monitors—a family of lightweight, versatile patient monitors that allow easy, accurate measurement of patient vital signs. The Propaq monitors are manufactured by Protocol Systems, Inc. of Beaverton, Oregon U.S.A.

This User's Guide covers Propaqs with software version 8. The software version appears on the Propaq display when the monitor is turned on, for example, 8.00.00.

As the Propaq is enhanced with new features, periodic updates are published to keep the User's Guide up-to-date. These updates can be stored in the envelope located on the inside back cover of this book.

Statement of Expectations of the Reader

This User's Guide was written for the clinician. Although this User's Guide may show you some medical monitoring techniques, Protocol Systems expects that you are a trained clinician who knows how to take and interpret a patient's vital signs.

General Manual Organization

You should read the Safety Summary at the beginning of the book before continuing any further. The Safety Summary provides information on safe operation and application of the Propaq monitor.

This User's Guide provides all the operating information for the Propaq models 102, 104, 106, 102EL, 104EL, and 106EL, including all available options at the time of this manual's printing. On the starting page of each chapter is listed the table of contents for the chapter. Each right-hand page within a chapter is printed with an edge tab so you can quickly locate the chapter you are interested in. Here are brief descriptions of the chapters in this book.

1 Getting Started

Refer to this chapter for general information on the Propaq monitors and options, for introductory information on using the Propaq, and for information on using the Propaq's in-service training mode. An easy-to-use menu reference can be found in this chapter.

2 Patient Monitoring

Refer to this chapter for all information on monitoring patients with the Propaq. This chapter contains sections on ECG, invasive pressure, noninvasive blood pressure (cuff), temperature, pulse oximetry (SpO_2), and CO_2 monitoring. Included are intended use of each monitoring channel, preparation and setup, how patient information is displayed, and other important operating details, including printing.

3 Alarms and Limits

Refer to this chapter for all information on Propaq alarms. In this chapter you will find what kind of alarms the Propaq indicates and how to respond to them, how to set alarm limits, and how to print patient information when an alarm occurs.

4 Trends

Refer to this chapter for how to view and print trended patient information.

5 Care and Maintenance

Refer to this chapter for general maintenance information, such as changing the printer paper, cleaning, and Propaq care. Recommended service intervals are also listed in Chapter 5. For more detailed service information, see the *Propaq Service Manual.*

6 Additional Features

Refer to this chapter for information on additional Propaq options and capabilities, including the Hewlett-Packard Connector-Compatible side panel option, a new higher-output power adapter, and the Defibrillation Synchronization Connector.

Appendices

The Appendices provide Propaq information not required for operation but helpful to many users, including a glossary, specifications, and a pre-service checkout that should be performed by a qualified service person.

Index

This alphabetical index will help you quickly locate information.

Disclaimers

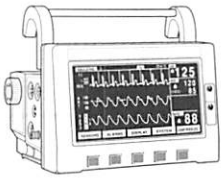
PROTOCOL SYSTEMS, INC. cautions the reader of this manual:

- ❑ This manual may, wholly or partially, be subject to change without notice.
- ❑ All rights are reserved: No one is permitted to reproduce or duplicate, in any form, the whole or part of this manual without Protocol's permission.
- ❑ Protocol will not be responsible for any damage to the user that may result from accidents during operation of this unit.
- ❑ Protocol assumes no responsibility for usage not in accordance with this manual resulting in illegal or improper use of the unit.

Active Documents

The following table lists the active Propaq documents, including change information updates, if any. As changes are made to the Propaq, updates are included with the manual as necessary. Updated pages are included within this manual, or update booklets are stored in the envelope on the inside back cover of this book.

Document Title and Part Number	Date of Issue	Comments
Propaq User's Guide, Software Version 8, PN 810-0408-00, Rev A	April, 1993	Original Issue of Software Version 8 Propaq User's Guide.
Propaq User's Guide, Software Version 8, PN 810-0408-00, Rev B	May, 1993	Updated Specifications Table B-5, page B-14: CO_2 measurement and display ranges.
Propaq User's Guide, Software Version 8, PN 810-0408-00, Rev C	June, 1993	Added envelope to inside back cover.



1

Getting Started

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Introducing the Propaq

Propaq Models

Propaq monitors are durable, lightweight, portable patient monitors for use in many monitoring applications, such as

- ❑ pre-hospital care/transport
- ❑ intra-hospital patient transport
- ❑ post-anesthesia monitoring
- ❑ outpatient and low-risk surgical procedures
- ❑ emergency medical services
- ❑ monitoring during and after special procedures such as endoscopy and catheterization, where critically ill patients require continuous monitoring
- ❑ step-down care
- ❑ field hospital use
- ❑ central station monitoring with the Acuity™ Monitoring System from Protocol Systems

Three models of Propaq monitors with two different display types meet the monitoring needs required for high-quality patient care for both transport and bedside. Monitored vital signs include ECG, noninvasive blood pressure (cuff), invasive pressure, temperature, pulse oximetry (SpO_2), CO_2 ($ETCO_2$ and $INCO_2$), and Breath Rate. Table 1-1 on page 1-4 lists the Propaq models available.

Weighing as little as six pounds, the Propaq can easily be carried, or it can be hung on a bed rail for patient transport. Extremely low-power operation allows some Propaq models to operate for up to 30 hours on one battery charge.

Table 1-1: Propaq Models

Vital Sign	102 & 102EL	104 & 104EL	106 & 106EL
ECG	1 Channel: 3-Lead	1 Channel: 3-Lead	1 Channel: 3-Lead
Noninvasive Blood Pressure (Cuff)	1 Channel	1 Channel	1 Channel
Invasive Pressure	None	1 Channel	2 Channels
Temperature	2 Channels: YSI™ and Electromedics™	2 Channels: YSI™ and Electromedics™	1 Channel: YSI™
NELLCOR-compatible Pulse Oximetry	Optional	Optional	Optional
Mainstream CO_2 ($ETCO_2$ and $INCO_2$) and Breath Rate	Optional	Optional	Optional
Printer	Optional	Optional	Optional
HP Connector-Compatible Side Panel	Optional	Optional	Optional

For fixed-site operation and recharging from ac mains, an ac power adapter plugs into the monitor. Only a Protocol Systems ac power adapter should be used to ensure protection against risk (leakage) current hazards. See **Battery Operation** on page 1-14. The Propaq can also be powered and recharged from a 12-28 Volt dc source, making it ideal for emergency vehicle or field medical applications.

Protocol Systems provides many necessary accessories for patient monitoring including three-lead ECG cables and various sizes of blood pressure cuffs for the Propaq. The monitor is also compatible with popular Yellow Springs Instrument Company (YSI™) and Electromedics™ temperature probes. Propaq invasive blood pressure channels require 5 μV/V/mmHg strain-gauge transducers available from several transducer manufacturers. See the appropriate vital sign section in Chapter 2 for more information on applicable available accessories.

Other accessories are also available. See the Protocol *Products & Accessories* book (Part Number 810-0409-00) for a list of accessories and information on ordering.

EL or LCD Display

The Propaq Electroluminescent (EL) Display is excellent for bedside applications where viewing the Propaq display from a longer distance is required. See Figure 1-1. The EL display increases both the contrast and viewing angle of the monitor. The Liquid Crystal Display (LCD) Propaq operates longer on a battery charge, provides excellent viewing at close distances, and is more visible than the EL display model in direct sunlight.

Propaqs with an EL display also provide electrosurgery interference suppression (ESIS) on all channels. Propaqs with an LCD display have ESIS on ECG, temp, SpO_2, and CO_2, but not on IBP and cuff.

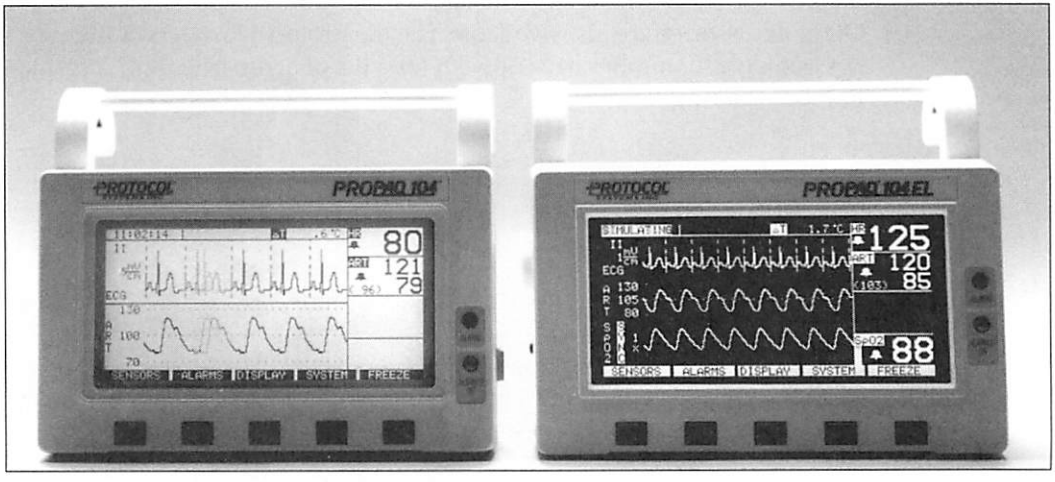


Figure 1-1. Propaqs with LCD and EL displays

The Propaq can be configured with either an LCD (left) or EL (right) display.

Expansion Module

The lightweight Propaq Expansion Module attaches to the monitor and provides immediate expandability of monitoring capabilities. The Expansion Module with Printer (EMP) shown in Figure 1-2 provides a lightweight 3-channel recorder. The Expansion Module can also be fitted with a NELLCOR-compatible pulse oximetry (SpO_2) option (Figure 1-3 on page 1-8) and a Mainstream CO_2 option (Figure 1-4 on page 1-9).

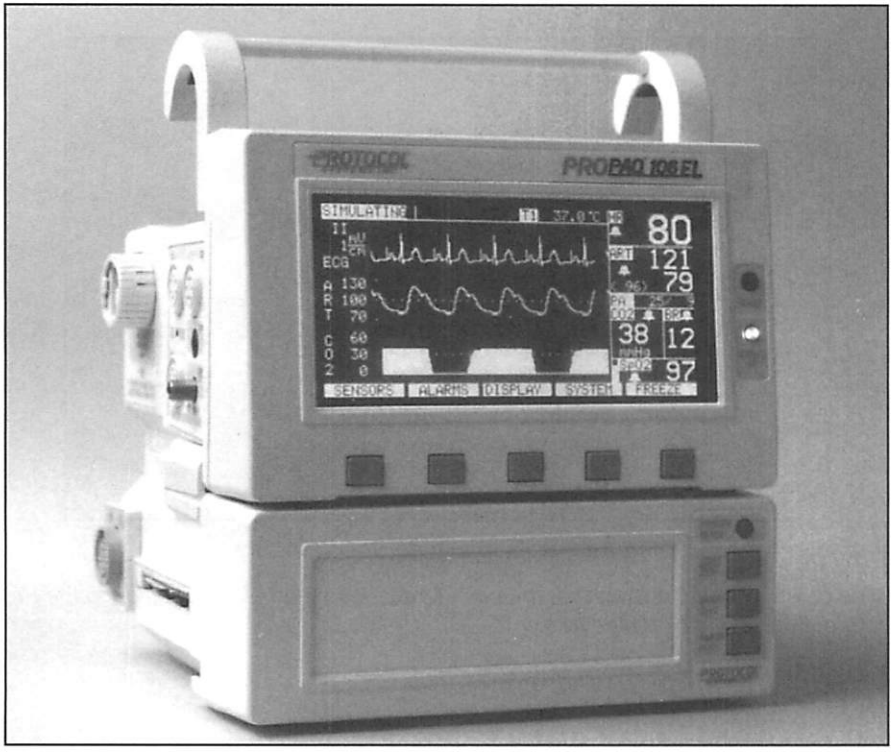


Figure 1-2. Propaq with Expansion Module

The Propaq with Expansion Module can be configured with a printer, an SpO_2 channel, and a CO_2 channel.

Propaq Pulse Oximetry Option (SpO_2)

The Propaq Pulse Oximetry option (SpO_2) can be installed in the Expansion Module or added to any Propaq monitor as an option that attaches to the rear of the monitor. See Figure 1-3. The SpO_2 option was designed to match the performance of a NELLCOR N-200 Pulse Oximeter. This device can be used only with NELLCOR oxygen transducers. For further information on Pulse Oximetry, read the Pulse Oximetry Monitoring information in Chapter 2.

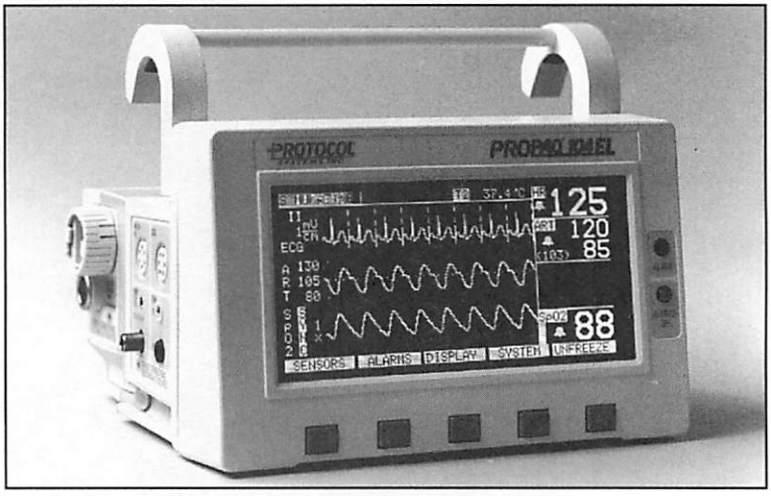


Figure 1-3. Propaq with SpO_2 module

The pulse oximetry channel can be configured as a stand-alone addition to the Propaq without the Expansion Module.

Mainstream CO_2 Option

The Propaq Mainstream CO_2 option provides carbon dioxide monitoring directly in the breathing circuit of a ventilator using proprietary technology. The Mainstream CO_2 option is installed in the Expansion Module and is configured with the Pulse Oximetry option (Figure 1-4).

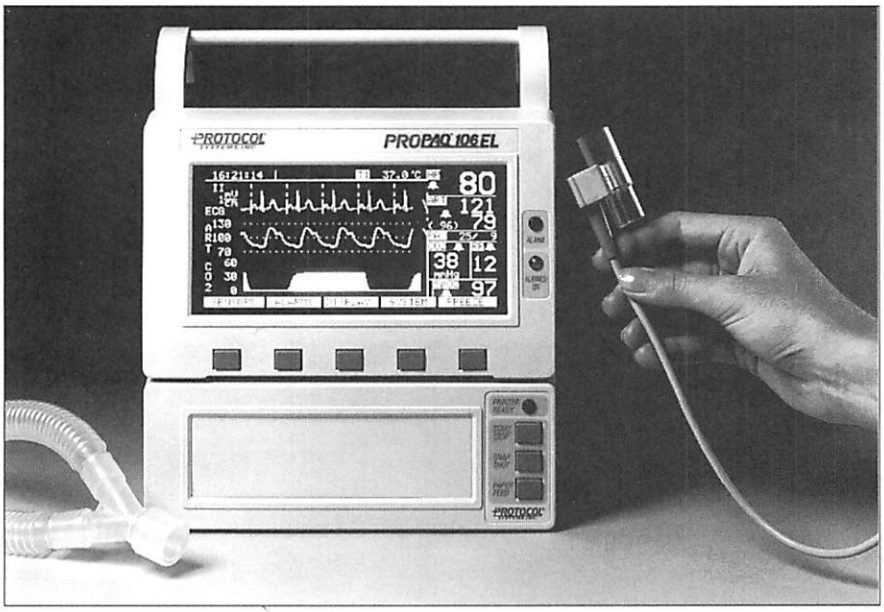


Figure 1-4. Expansion Module with CO_2 option

The Propaq Mainstream CO_2 option is installed in the Expansion Module and configured with pulse oximetry and printer (optional).

Using the Propaq

The rest of this chapter helps you become more familiar with the Propaq. The more you know about it, the more effectively you can use the monitor to provide the high-quality patient care you strive for.

This section briefly describes the Propaq's external controls, indicators, and connectors, shows you where information is displayed on the Propaq, and introduces you to the Propaq's menus. The accompanying figures provide a reference for you so you don't need the monitor while reading the information.

System Controls (Right Side Panel)

Refer to Figure 1-5 on page 1-12.

Propaq right side panels differ depending on the options ordered with the Propaq. Optional right side panels are shown in Chapter 6.

WARNING

Safe interconnection between the Propaq and another device must be in accordance with applicable safety recommendations. In the United States of America, the Association for the Advancement of Medical Instrumentation (AAMI) specifies safe interconnection requirements.

POWER INPUT Connector
This receptacle accepts Protocol Systems' 503-0002-XX ac power adapter, which must be used for ac mains operation and battery charging.

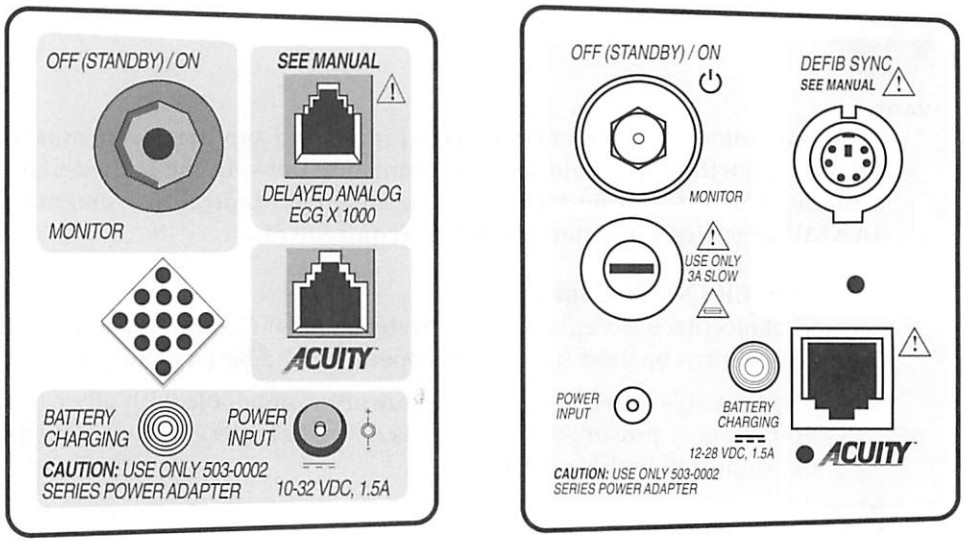
The Propaq's power requirements are also compatible with other 12-28 volt, dc-only power sources, such as a vehicle battery system, which can be connected to this receptacle.

Some countries restrict usage of the Propaq from such external power sources and certain regulating agencies do not test the monitor for such applications.

An alternative high-output power adapter with a unique connector is available and is required for the Mainstream CO_2 option. Refer to Chapter 6 for more information about this power adapter.

BATTERY CHARGING Light

This green light turns on when a power source (ac power adapter or external dc source) is connected and the battery is charging. Although the monitor may be turned off, battery charging continues when an external power source is connected.



With Delayed Analog

With Defib Sync

Figure 1-5. The Propaq's right side panel

The Propaq's right side panel contains the system controls and connectors. Different right side panels are available depending on the options purchased. Optional panels are described in Chapter 6.

INPUT FUSE

The input fuse, which protects the Propaq against power surges, is a 3 Ampere, Slow-Blow fuse, externally replaceable by your qualified service personal. See Chapter 5 for detailed instructions for replacing the fuse.

OFF (STANDBY)/ON Switch

This switch turns the monitor on and off. The switch is recessed to prevent accidentally turning off the monitor, which would result in losing patient data.

startup window—the window that first appears when you turn on the Propaq. This window contains Propaq information including the software version number.

When you first turn on the monitor, information about the Propaq is shown on the screen. This is the *startup window*. While the startup window is displayed, the monitor checks its own electronics to be sure they properly function.

If the monitor detects a problem in its electronics, an error message window appears containing an error number and what to do (Figure 1-6). Report such errors to Protocol Systems.

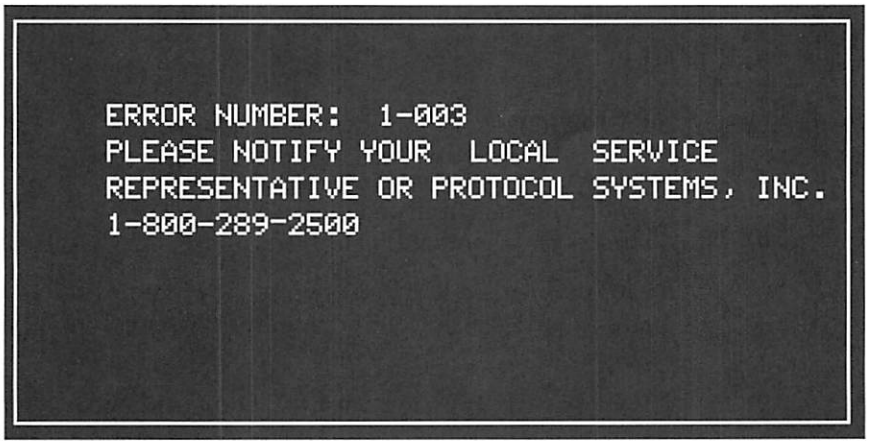


Figure 1-6. Propaq Error Message Window

If an error window such as this one appears while the Propaq is turning on, your biomedical service person should be notified immediately.

ACUITY™ Connector
Allows connection to the Acuity™ Central Station Monitoring System. This connector is intended only for connection to the Acuity System network.

WARNING

Connecting to other networks (for example, telephone systems that use the same type of connector) may damage the Propaq or present a hazard to the patient.

Battery Operation

The Propaq's application is greatly enhanced by its ability to operate for extended periods from an internal battery. This makes the Propaq ideal for patient transport and field medical use.

It is recommended that you operate the monitor from the battery if the mains ground (earth) conductor of the power cord or power receptacle is suspect.

The Propaq can operate from 4 to 30 hours on one battery charge. The actual operating time depends on several factors, including how often you take noninvasive blood pressure measurements (cuff), how often you use the printer, whether or not the CO_2 channel is active, and whether the display backlight (applies only to LCD types) is turned on or off.

In applications where the Propaq must operate on battery power for extended periods, turning off the backlight in LCD models will extend the operation. In all Propaqs, limiting the number of cuff measurements you take will extend the operation.

To the Propaq, its battery voltage is a critical operating factor. The monitor's ultrasmart capabilities let you know when its battery voltage begins to get low. When the battery voltage is too low to successfully take cuff measurements, the Propaq turns off the cuff channel and lets you know the cuff channel is no longer available.

The lifetime usage of the battery (battery life) may be shortened if the battery is not cared for properly. For prolonged storage of the Propaq, a qualified service person should remove the battery. Battery life may be prolonged by following a few simple guidelines:

- ❑ Keep the ac power adapter plugged into the monitor and an ac mains source whenever possible and when not in use.
- ❑ If the LOW BATT message appears, connect the charger as soon as possible.
- ❑ In the LCD models, turn off the backlight whenever possible.

For more information about battery operation and storage, see **Extended Storage Precautions** on page 5-8 and see **Battery Care** on page 5-9.

Alarm Lights

Alarms and limits operation is thoroughly described in Chapter 3. Refer to Figure 1-7 for the following descriptions.

ALARM Light
When an alarm limit is violated, the ***ALARM*** light turns on and an alarm tone sounds. The ***ALARM*** light can also indicate other alarm conditions. Refer to Table 3-1 on page 3-7 for more information.

ALARM(S) OFF Light
When any alarm limit is turned off, the ***ALARM(S) OFF*** light turns on. The ***ALARM(S) OFF*** light can also indicate other alarm conditions. Refer to Table 3-1 on page 3-7 for more information.

Figure 1-7. Propaq alarm lights

The alarm lights indicate both active alarm and suspended alarm conditions.

Patient Connections

Patient connections and monitoring with the Propaq patient channels are thoroughly described in Chapter 2. Refer to Figure 1-8 on page 1-18 while reading the following brief descriptions of the Propaq left side panels.

The three different left side panels differ depending on the Propaq model. All models have ECG, cuff, and at least one temperature connector. The Propaq 104 left side panel includes an invasive pressure connector, and the Propaq 106 includes an additional invasive pressure connector.

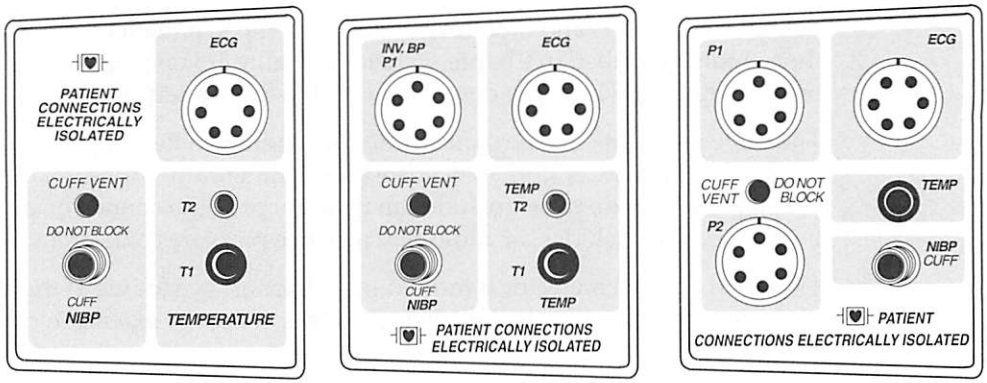
The SpO_2 option connector is located in an Expansion Module at the rear of the monitor. It connects directly to a Nellcor sensor or extension cable.

The Mainstream CO_2 option connector is located on the left side of the Expansion Module below the SpO_2 connector.

Besides the standard patient connectors for ECG, cuff, invasive pressure, and temperature, the Propaq can be provided with a Hewlett-Packard connector-compatible side panel to allow you to use accessories compatible with the Hewlett-Packard Component Monitoring System. See **HP-Connectors** on page 6-3 for more information.

Details about each of the connectors and compatible accessories are provided in the particular vital sign parameter sections in Chapter 2.

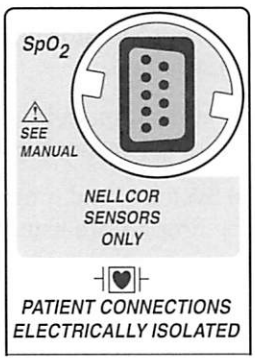
Accessories available from Protocol Systems, and other manufacturer's accessories that can be used with the Propaq, are listed in the *Products & Accessories* book.



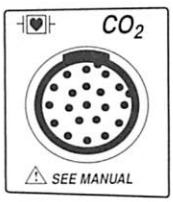
102 Patient Connections

104 Patient Connections

106 Patient Connections



SpO_2 Patient Connection



CO_2 Connector

Figure 1-8. Propaq left side panels

The Propaq left side panels contain all the patient connections. Hewlett-Packard Connector-Compatible side panels are described in Chapter 6.

Propaq Display

Your Propaq has either a liquid crystal display (LCD) or an electroluminescent (EL) display.

The display shows waveforms, vital sign numeric values, Propaq status, and alarm information in different windows as shown in Figure 1-9. Different vital sign numeric values (such as heart rate and blood pressures) have upper and lower range limits. If the Propaq detects a vital sign value outside of the Propaq's measurable range, the monitor displays --- (below the range) or +++ (above the range) instead of the vital sign value. For example, the heart rate counter range is 25 to 250 beats per minute (bpm). A heart rate above 250 bpm appears as +++.

Waveform/Status Window Area

You can select up to three waveforms to be shown on the Propaq. When only one waveform is selected, a trend window automatically appears below the waveform as shown in Figure 1-9. While changing Propaq settings, a status window may appear below the waveform as shown in Figure 1-10 on page 1-20.

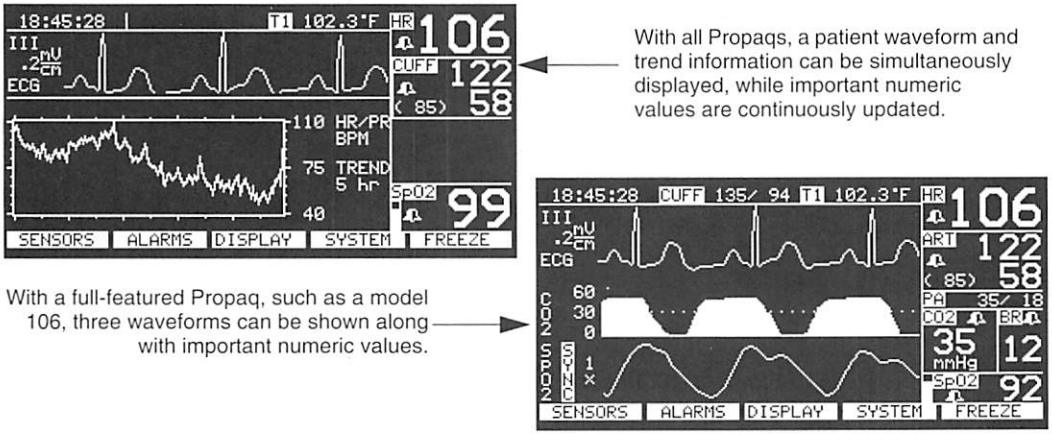


Figure 1-9. The Propaq display shows all the patient information

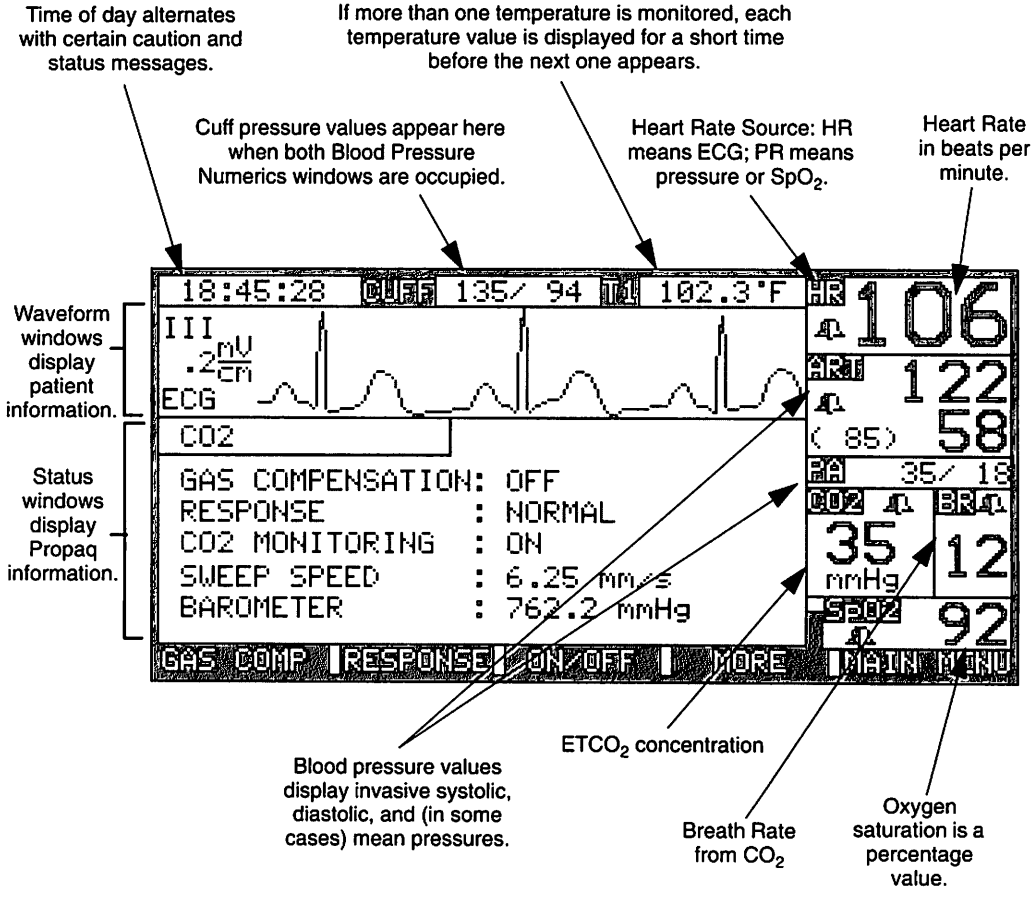


Figure 1-10. Propaq monitoring all vital signs

This LCD display shows a fully-loaded Propaq monitoring all vital signs. Other examples are shown in Figure 1-11 on page 1-23 and Figure 1-12 on page 1-24.

Frozen Waveforms
Waveforms can be unfrozen or frozen. Waveforms that are unfrozen always show the latest information about the patient being monitored. These waveforms are continuously updated from left to right, with an invisible erase bar showing the separation between the oldest and newest information. When you freeze a waveform, the Propaq continues to monitor the patient, watching for alarm conditions. If only one or two waveforms are displayed and you freeze the display, the frozen waveform(s) are shown along with an unfrozen waveform so you can continue to monitor the patient's active waveform.

Status Windows
When a status window appears in the lower two-thirds of the display (as shown in Figure 1-10 on page 1-20), information about monitoring functions is shown. Although some waveforms are not displayed during this time, ECG (if it is monitored) is always displayed, and the monitor continues to update and display the heart rate, pressure values, and other numerics so that you can always see the patient's current condition. When the status window is removed, the prior waveform(s) reappear.

Time of Day/Caution and Status Messages
The time of day appears in a twenty-four hour clock format with 00:00:00 being midnight and 12:00:00 being noon. The clock is set using the System Menu functions.

Certain caution and status messages alternate with the time of day (others appear in the corresponding numerics window). Table 1-2 on page 1-25 lists possible messages that appear in the Time of Day window, the conditions that cause them, and possible corrections.

Cuff Measurement
The most recent cuff measurement is displayed as systolic over diastolic. The mean value is not shown on the display, but it is shown in the Cuff Status window and in other cuff display areas, such as in a blood pressure window below heart rate that is not used for invasive pressure display (Figure 1-9). A detected problem with the cuff channel causes the message CUFF FAULT to appear in place of the cuff measurement. An equipment alert also occurs providing more information about the fault.

Temperature Numerics
If two temperatures are monitored, each temperature value (T1, T2, and ΔT) is displayed for a short time, circulating through all of the temperature measurements every few seconds. Temperature can be shown in either Celsius or Fahrenheit (only Celsius in some non-U.S. models). In models that display either unit, you can change the unit using the System Menu functions. A detected problem with a temperature channel causes a temperature message (T1 FAULT or T2 FAULT) to appear in place of the temperature measurement. An equipment alert also occurs providing more information about the fault.

Heart Rate Source
Heart rate (Figure 1-10) can be derived from ECG, invasive pressure, pulse oximetry, or noninvasive pressure. The letters HR (heart rate) in this area indicate a rate derived from ECG (an electrical heart signal); the letters PR (pulse rate) in this area indicate a rate derived from blood pulsing through the circulatory system, such as from a pressure source or from SpO_2.

When the Propaq is turned on, it automatically selects the first available patient channel as the rate source according to the following priorities: ECG (first choice), P1 (second choice), SpO_2 (third choice, if present), P2 (fourth choice, Propaq 106 only); and cuff (only when all of the previous sources are unavailable).

The heart rate source can be changed using the Display Menu. Cuff, however, cannot manually be selected as a heart rate source.

Heart Rate
The heart rate (Figure 1-10) is determined from the selected heart rate source. Rate is determined by counting the number of QRS events or blood pulses over a period of time and converting the value to beats per minute (bpm). The Propaq can count from 25 to 250 (bpm).

Auto Configure Numerics (Invasive Pressures, Cuff, SpO_2, and CO_2)
The numeric display area below the heart rate automatically changes to allow the best possible view of all numerics for vitals signs being monitored. When few vital signs are monitored (for example, ECG, SpO_2, CO_2, and breath rate), all the numerics are prominently displayed. As more vital signs are monitored, the numeric displays change size to allow some numerics to be more prominent than others. Examples of display formats are shown in Figure 1-11 and Figure 1-12.

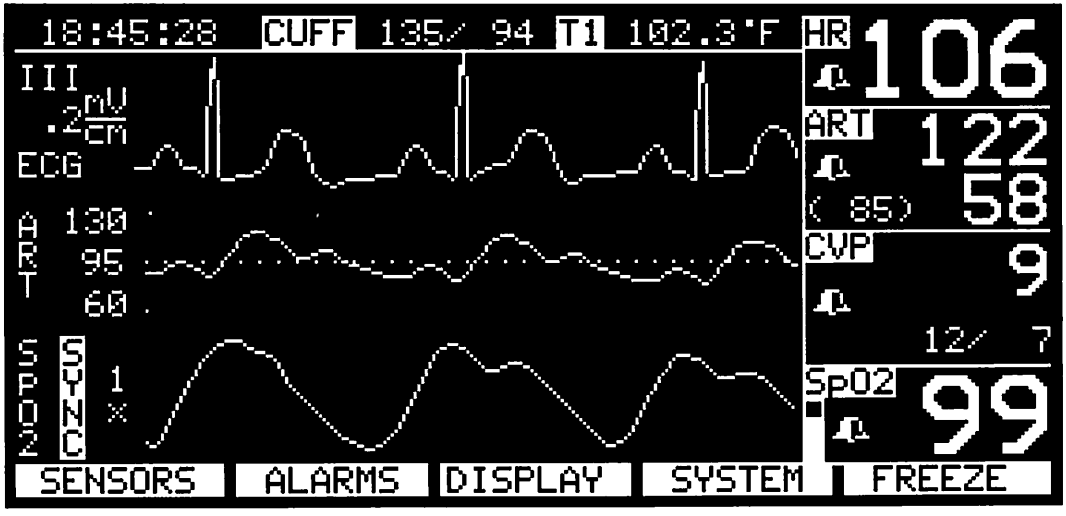


Figure 1-11. EL display showing two invasive pressures

This EL display shows two invasive pressures being monitored with pulse oximetry. CO_2 is not monitored. Notice the larger numerics for SpO_2 as compared to Figure 1-10.

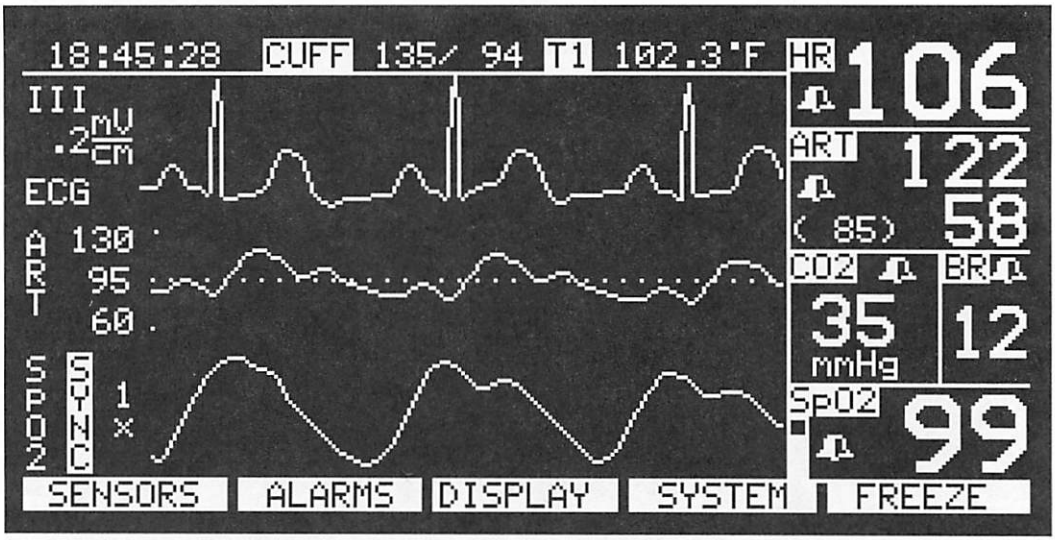


Figure 1-12. EL display showing one invasive pressure

Table 1-2: Caution and Status Messages that Alternate with Time of Day

Message	Condition	Possible Correction
LOW BATT	Low battery voltage.	Plug the Propaq into ac mains using the power adapter to recharge the battery.
ECG FAULT	Faulty ECG lead connections.	Check all ECG lead wires, electrodes, and cable.
PRNT FAULT	Problem with the printer.	Check the printer paper, paper door, and general functionality of printer.
SIMULATING	In-service mode is activated; simulated patient data is being displayed and saved in trend memory.	To deactivate, turn Propaq off and then on. See **Learning the Propaq** on page 1-66.
ON NETWORK [a]	The network is active.	Not applicable.

a. Only on models with the Acuity Network option and when connected to the network.

Table 1-3: Caution and Status Messages in Numerics Zones

Message	Condition	Possible Correction
P1 (or P2) FAULT	Faulty P1 (or P2) pressure transducer or connector.	See Invasive Pressure Messages.
T1 (or T2) FAULT	Faulty T1 (or T2) probe, or temperature is out of range.	See Temperature Messages.
CUFF FAULT	Various possible cuff problems.	See Cuff Messages.
SpO_2 SRCH	SpO_2 does not detect pulses.	See SpO_2 Messages.
CO_2 FAULT	Various possible CO_2 problems.	See CO_2 Messages.

Pushbuttons

Except for the Off (Standby)/On switch, the pushbuttons are the only operator controls you use to control the Propaq. What each button does is identified by a pushbutton label displayed above each button as shown in Figure 1-13. The five labels above the buttons make up a menu. There are several menus, allowing only five buttons to perform many Propaq functions, which keeps the operation of the Propaq monitors simple and efficient. Each Propaq menu function is described in the **Propaq Menu Reference** on page 1-32.

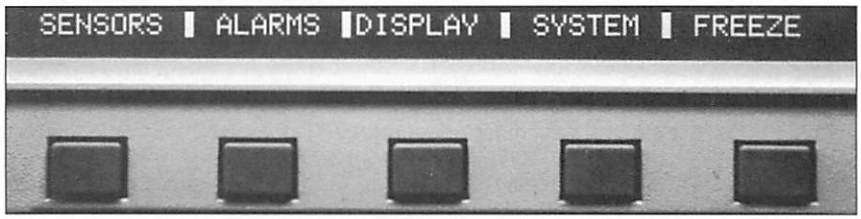


Figure 1-13. Propaq pushbuttons and menu labels

Pushbuttons and the menu labels above the pushbuttons make the Propaq easy to operate

Propaq Menus

A menu in the Propaq is the row of labels displayed above the pushbuttons (as shown in Figure 1-13). Using the Propaq menus, you can control the Propaq with ease.

For example, to turn on and automatically set all alarm limits of monitored vital signs, you simply press the ALARMS button, and then the STAT SET button, which automatically appears when you press ALARMS (see Figure 1-14).

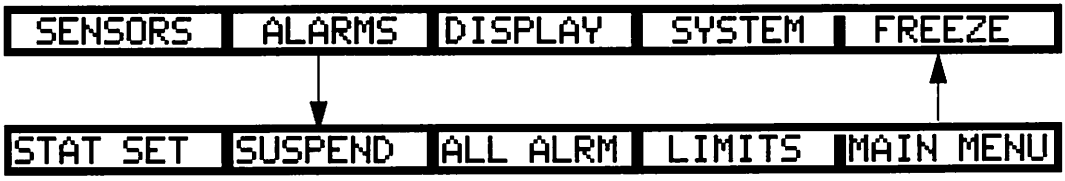


Figure 1-14. The Alarms Menu

By pressing ALARMS, the next menu automatically appears. You press STAT SET in this menu to automatically set all alarms for all monitored vital signs.

As shown in the figure, when you press a button in the Main Menu (and in other menus), a new menu appears, which means with only five buttons you have complete control over the Propaq.

Sometimes only the menu label of the pressed button changes. For example, when you press the FREEZE button to freeze all waveforms, the FREEZE menu label changes to UNFREEZE (Figure 1-15 on page 1-28). Pressing the UNFREEZE button unfreezes the waveforms. The SUSPEND button in the Alarms Menu changes to RESUME in the same way when you suspend alarms.

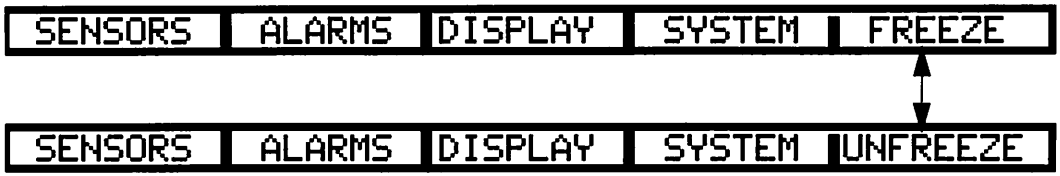


Figure 1-15. The Main Menu with FREEZE/UNFREEZE buttons

There are several different menus in the Propaq. How many vital signs the Propaq monitors determines the number of menus for that particular model. There are menus for each patient channel in the Propaq (Sensors Menu), for the alarm system (Alarms Menu), for the display (Display Menu), and for other system functions, such as setting the time and date (System Menu). All menus are logically arranged so that with a few presses of the pushbuttons, the monitor is easily controlled.

MAIN MENU and MORE Buttons. Two very important buttons are the MAIN MENU and MORE buttons. MAIN MENU always makes the Propaq display the Main Menu, which is shown in Figure 1-16. This is the menu shown when you first turn on the Propaq. You always start selecting functions from the Main Menu.

The MORE button shows you more menu selections. The MORE button is always the fourth button from the left. Some menus don't have a MORE button, but many do.

Figure 1-16 shows the menu structure (menu tree) for the Propaq.

A Propaq menu reference following the menu tree lists the functions of each button in the Propaq. Depending on your model of Propaq, you may not have all the functions listed in the reference.

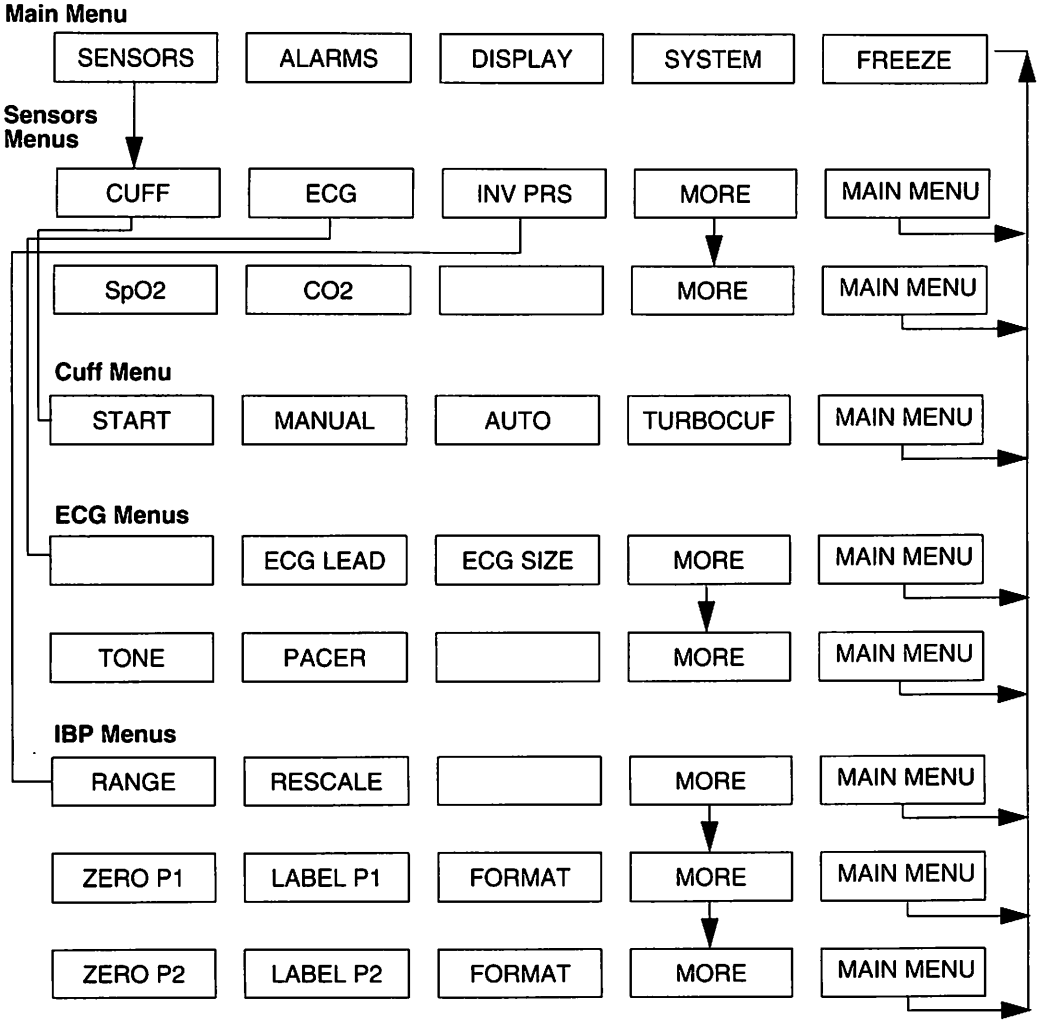
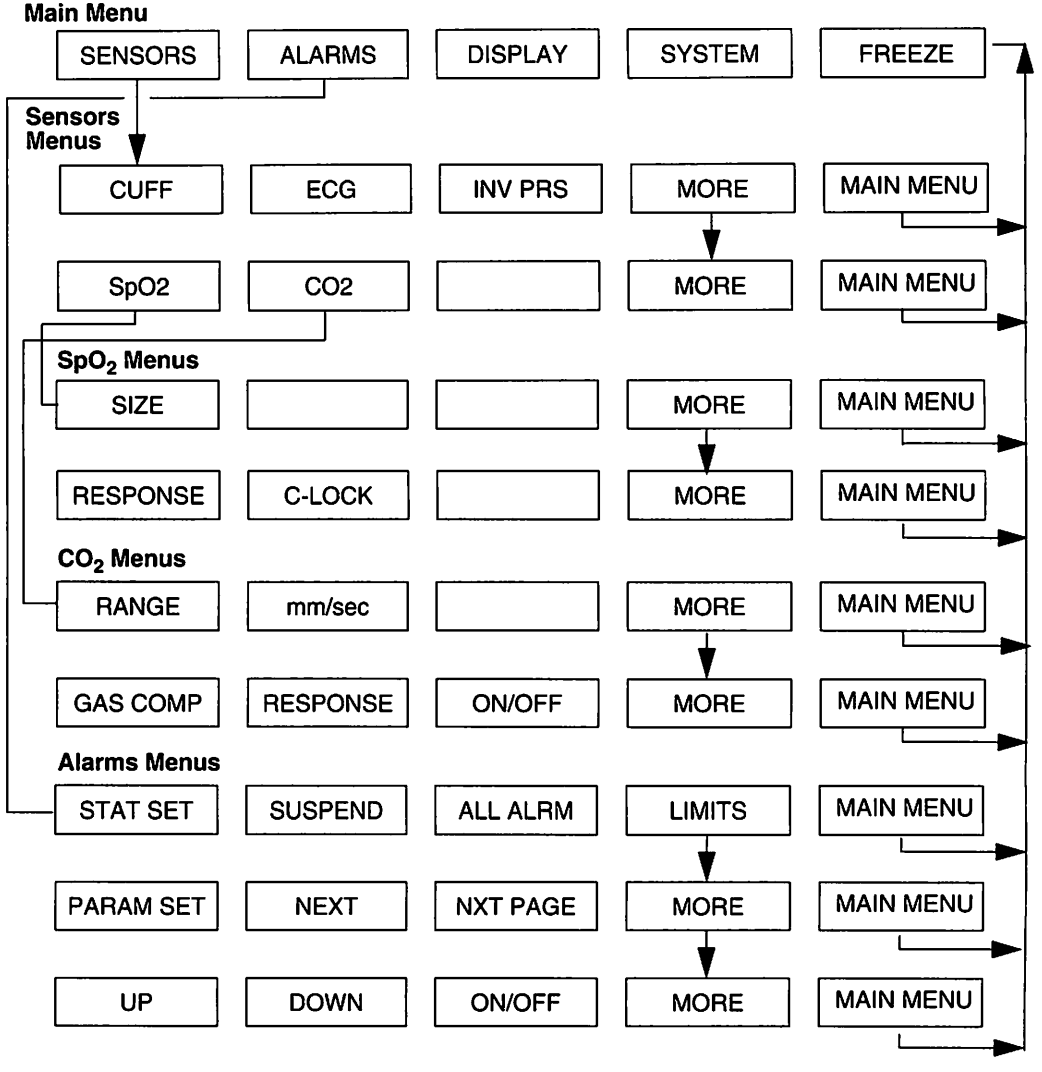
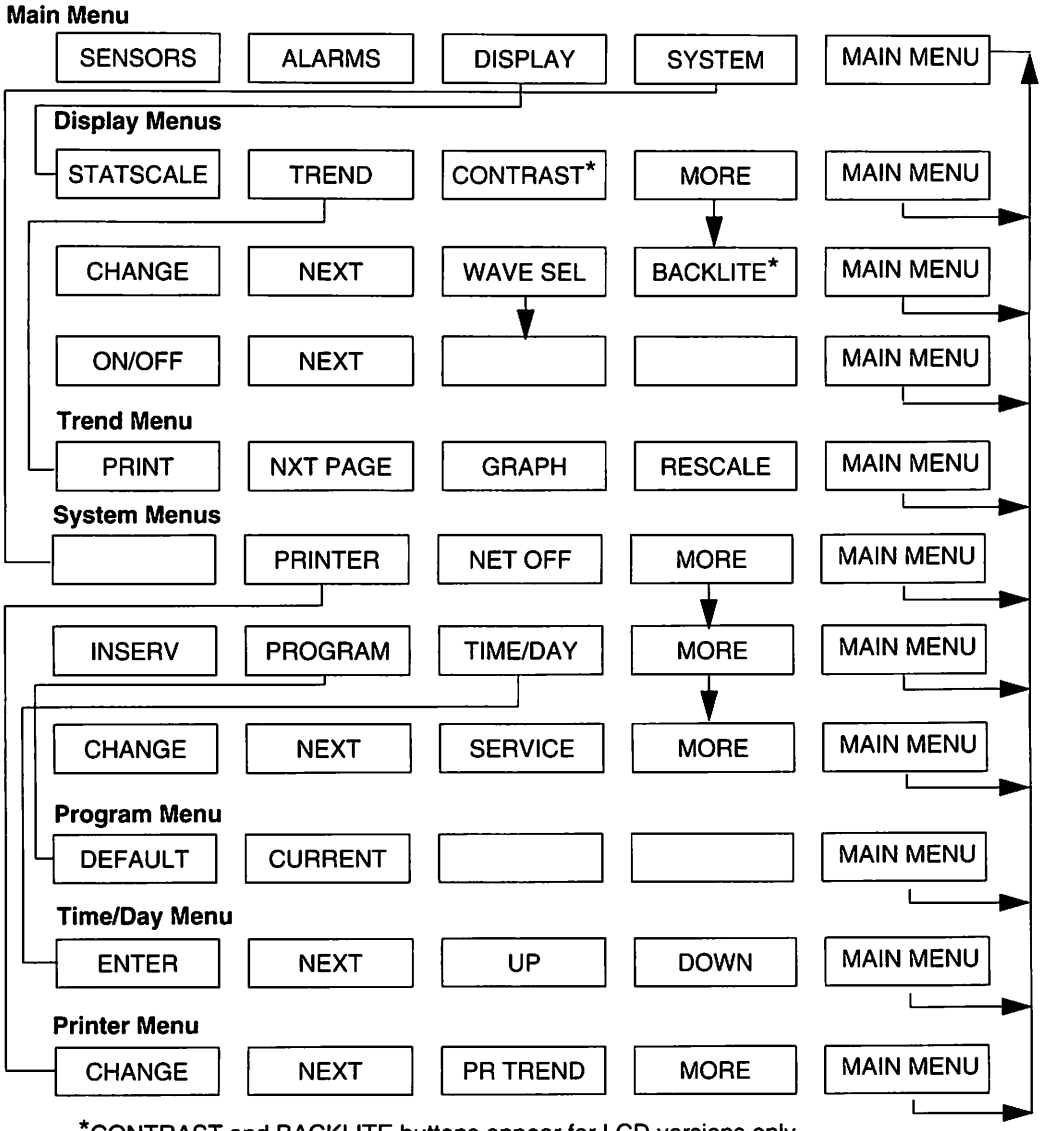


Figure 1-16. Menu tree showing the Propaq menus

By pressing one of the buttons, you reach another menu with more functions. The figure, continued on the following two pages, shows more menus. The MAIN MENU button always returns to the Main Menu


Main Menu
SENSORS
ALARMS
DISPLAY
SYSTEM
FREEZE
Sensors Menus
CUFF
ECG
INV PRS
MORE
MAIN MENU
SpO2
CO2
MORE
MAIN MENU
SpO2 Menus
SIZE
MORE
MAIN MENU
RESPONSE
C-LOCK
MORE
MAIN MENU
CO2 Menus
RANGE
mm/sec
MORE
MAIN MENU
GAS COMP
RESPONSE
ON/OFF
MORE
MAIN MENU
Alarms Menus
STAT SET
SUSPEND
ALL ALRM
LIMITS
MAIN MENU
PARAM SET
NEXT
NXT PAGE
MORE
MAIN MENU
UP
DOWN
ON/OFF
MORE
MAIN MENU



*CONTRAST and BACKLITE buttons appear for LCD versions only.
In EL versions, CONTRAST is WAVE SEL; BACKLITE has no counterpart.

Propaq Menu Reference

Table 1-4: Propaq Menus

Menu	Press the button with the label	Functions Controlled
Main Menu	MAIN MENU	Allows access to all other menus. If you can't find a desired function, always press the MAIN MENU button to return to the Main Menu so you can start over.
Sensors Menu	SENSORS	Allows selection of all patient parameter menus: cuff, ECG, invasive pressure (INV PRS), pulse oximetry (SpO_2), and CO_2
Alarms Menu	ALARMS	Allows control of the alarm system and adjustment of alarm limits.
Display Menu	DISPLAY	Allows control over aspects of the display including which waveforms you select for display, contrast (LCD version only), the backlight mode (LCD version only), sweep speed, trend data, alarm tone volume, and the heart rate source and tone.
System Menu	SYSTEM	Allows control over the general set up of the monitor, such as temperature units in °F or °C, ECG filter, time, programming, and other settings. The System Menu also allows activation of several internal tests for service. The *Propaq Service Manual* describes how to use the service features. The Printer Menu (if a printer is installed) is controlled through the System Menu.

To get to the Cuff Menu, press SENSORS and then CUFF.

Table 1-5: Cuff Menu Reference

Button Label	Function
START/CANCEL	Starts and stops cuff measurements
MANUAL	Sets cuff measurements to manual mode. Measurements are started by pressing START.
AUTO/INTERVAL	Sets cuff measurements to automatic mode. The button label changes to INTERVAL. Pressing INTERVAL selects the interval at which cuff measurements are automatically taken.
TURBOCUF	Automatically starts cuff measurements and continues to take as many measurements as possible within five minutes.

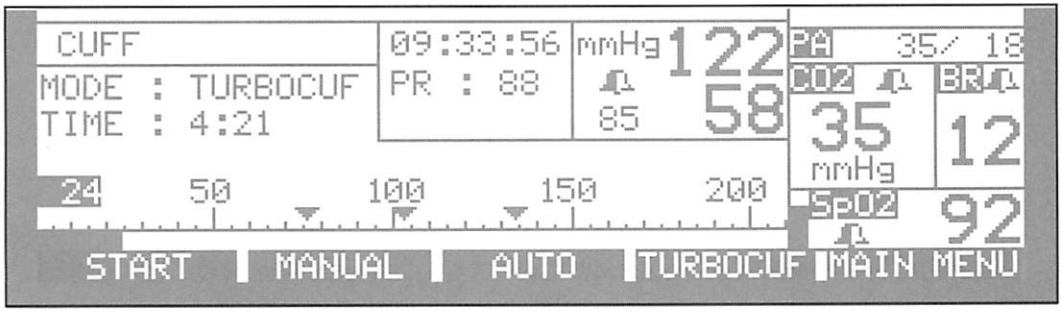


Figure 1-17. Cuff Status Window

The cuff status window shows the last measurement, including time and pulse rate, and the current activity of any measurement being taken

To get to the ECG Menus, press SENSORS and then ECG. Refer to Figure 1-18 on page 1-35.

Table 1-6: ECG Menu Reference

Button Label	Function
LEAD	Selects the ECG monitoring lead; lead selections are I, II, and III. The selected lead is shown to the left of the waveform.
SIZE	Selects the ECG waveform size; sizes are shown in millivolts per centimeter (mV/cm) to the left of the waveform.
HR/PR TONE	Sets the heart beat tone loudness to LOW, MEDIUM, or HIGH.
PACER	Turns on and off the pacer indicator in the ECG waveform. When turned on, a dashed line (pacer indicator) appears in the ECG waveform each time a pacer signal is detected. Pacer signals (spikes) are always displayed when present in the ECG signal whether or not PACER is ON. Before searching for a QRS complex, the ECG processing algorithm always strips out a brief interval of ECG data following detection of a signal that meets the definition of a pacer pulse. This also occurs whether or not PACER is ON.

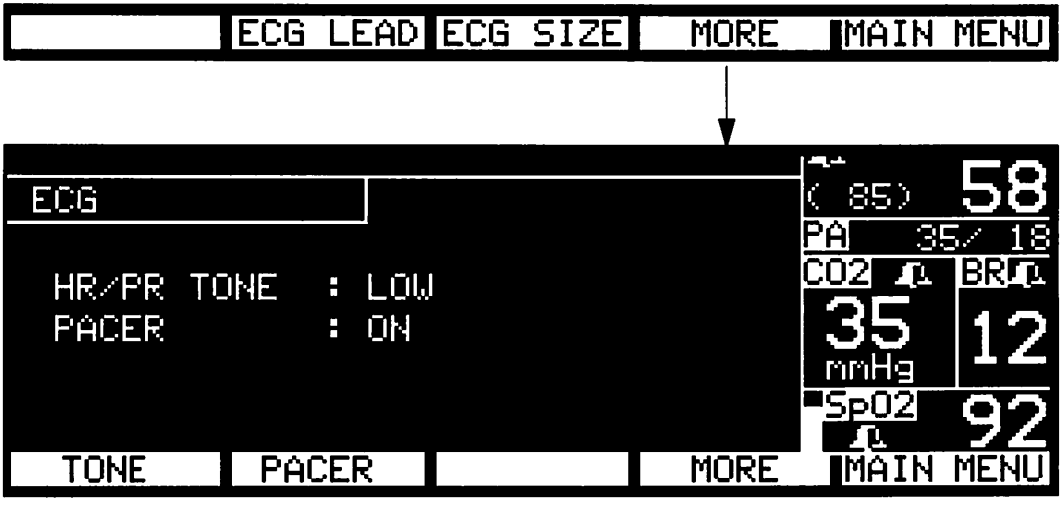


Figure 1-18. ECG Status Window

The ECG status window shows the current settings. The status window appears when you press the MORE button in the first ECG Menu.

To get to the Invasive Pressure Menus, press SENSORS and then INV PRS. Refer to Figure 1-19.

Table 1-7: Invasive Pressure Menu Reference

Button Label	Function
RANGE	Sets the display to range mode. In range mode, all invasive pressure waveforms being monitored are displayed against the same scale.
RESCALE	Sets the display to rescale mode. In rescale mode, each invasive pressure waveform is displayed against its own scale. Each time the button is pressed, the scale is automatically selected based on the current waveform size.
ZERO/CANCEL	Zeroes the selected pressure channel, or cancels the zeroing in process.
LABEL	Selects a label for the pressure channel. See **How Invasive Pressure is Displayed** on page 2-32.
FORMAT	Selects the format in which the IBP numerics are displayed. See **How Invasive Pressure is Displayed** on page 2-32.

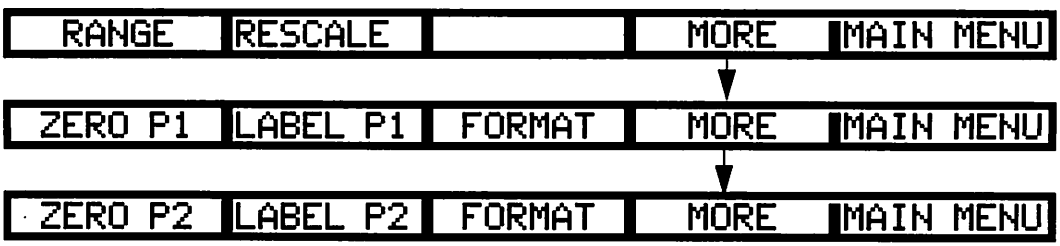


Figure 1-19. Invasive Pressure Menus

There is no status window for invasive pressure channel settings. These menus appear only when invasive pressure channels are included (Propaq 104 and 106).

To get to the SpO_2 Menus, press SENSORS, then MORE, and then SpO_2. If the Propaq does not have both invasive pressure and CO_2 monitoring, you don't need to press MORE.

Table 1-8: SpO_2 Menu Reference

Button Label	Function
SIZE	Selects the SpO_2 waveform size. Waveform sizes are X1, X2, X4, and X8.
RESPONSE	Sets the response of the pulse oximetry channel. See **Preparation** on page 2-69.
C-LOCK	Turns on and off the C-LOCK function. See **Preparation** on page 2-69.

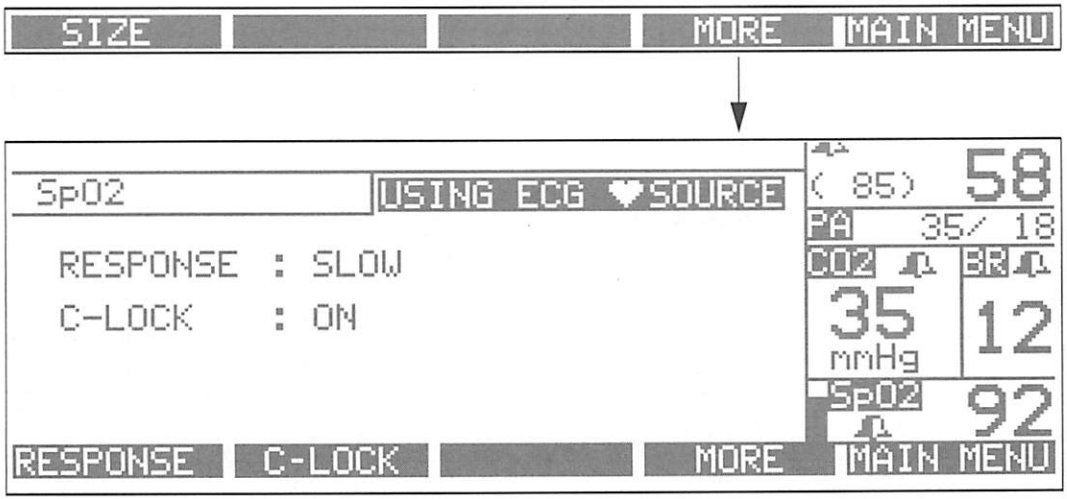


Figure 1-20. SpO_2 Status Window

The SpO_2 status window appears when you press the MORE button in the first menu and shows the current pulse oximetry settings. It is recommended to always keep C-LOCK turned on when monitoring ECG and SpO_2.

To get to the CO_2 Menus, press SENSORS, then MORE, and then CO_2. Refer to Figure 1-21.

Table 1-9: CO_2 Menu Reference

Button Label	Function
mm/sec	Sets the display sweep speed for CO_2; sweep speed selections are 12.5, 6.25, and 3.13 millimeters/second (mm/sec).
RANGE	Selects the CO_2 waveform scale (range). Selections are based on the display units (mmHg, kPa, or percent).
GAS COMP	Selects the measurement compensation for CO_2 measurements when certain gases are being administered.
RESPONSE	Sets the response of the CO_2 measurement.
ON/OFF	Turns CO_2/Breath Rate monitoring On or Off.

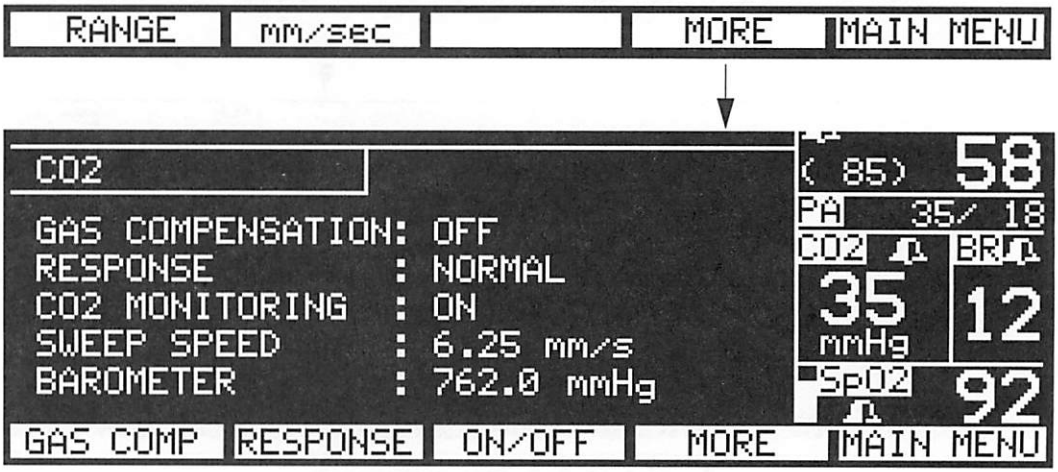


Figure 1-21. The CO_2 Status Window

The CO_2 status window appears when you press MORE in the first menu and shows the current CO_2 settings.

To get to the Alarms Menus, press ALARMS on the Main Menu. Refer to Figure 1-22 and Figure 1-23 on page 1-40 as necessary.

note...

Alarm tone volume is controlled under the Display Menu. See page 3-5.

Table 1-10: Alarms Menu Reference

Button Label	Function
STAT SET	Automatically sets alarm limits for all monitored vital signs.
SUSPEND/RESUME	Suspends the alarm tone and all alarms for 90 seconds, or resumes any suspended alarms. Once alarms are suspended, additional alarm limit violations are not indicated until 90 seconds have elapsed or you press RESUME.
ALL ALRM	Turns on and off all alarm limits. When turned on, limits are set to their previous setting or their turn-on (default) setting.
LIMITS	Accesses the Alarm Limits Menu for alarm limits setting.
PARAM SET/ PARAM OFF	Automatically sets alarm limits for the selected vital sign, or turns off all limits for the selected vital sign.
NXT PAGE	Selects the next vital sign page for alarm limit setting.
NEXT	Selects the next limit for adjustment of the selected vital sign.
UP	Increases the selected alarm limit value.
DOWN	Decreases the selected alarm limit value.
ON/OFF	Turns on and off the selected alarm limit value.

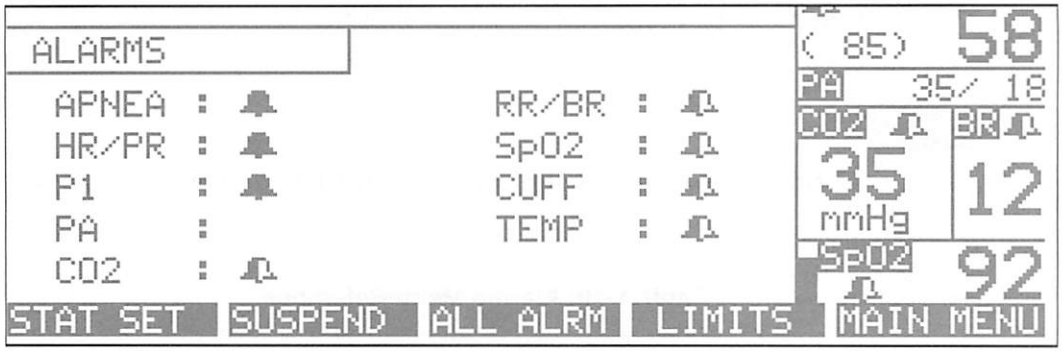


Figure 1-22. Alarms Status Window

The Alarms Status Window shows the current condition of all alarms. A full bell indicates all alarm limits are set for the vital sign. A half bell indicates at least one alarm limit is set. No bell indicates no alarm limits are set.

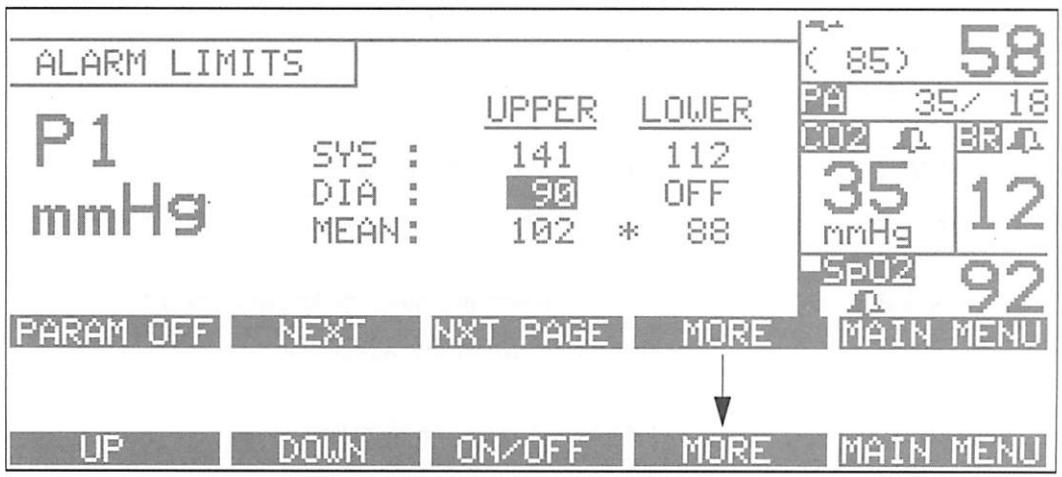


Figure 1-23. Alarm Limits Window

The Alarm Limits Window shows the selected vital sign alarm limit values. An asterisk to the left of a value means the value was violated recently, resulting in alarm. Pressing MORE allows you to adjust the selected limit value using the UP, DOWN, and ON/OFF buttons.

To get to the Display Menus, press DISPLAY on the Main Menu. Refer to Figure 1-24 and Figure 1-25 on page 1-42 for display status and wave select windows.

Table 1-11: Display Menu Reference

Button Label	Function
STATSCALE	Automatically rescales all waveform scales.
TREND	Allows access to the Trend Menu.
CONTRAST (LCD models only),	Adjusts the screen contrast.
CHANGE	Changes the currently selected display setting.
NEXT	Selects the next setting in the status window.
BACKLITE	BACKLITE turns on and off the backlight (LCD versions). The display automatically turns back on as soon as you press any button or when an alarm occurs. This function increases the operating time of the Propaq when running on the battery.
WAVE SEL	Allows you to turn on and off desired waveforms or cuff numerics for display. See **What You Can Do With In-service Mode** on page 1-71 for how to use the Wave Select menu.
ON/OFF	Turns on and off the selected waveform.
NEXT	Selects the next waveform in the list.

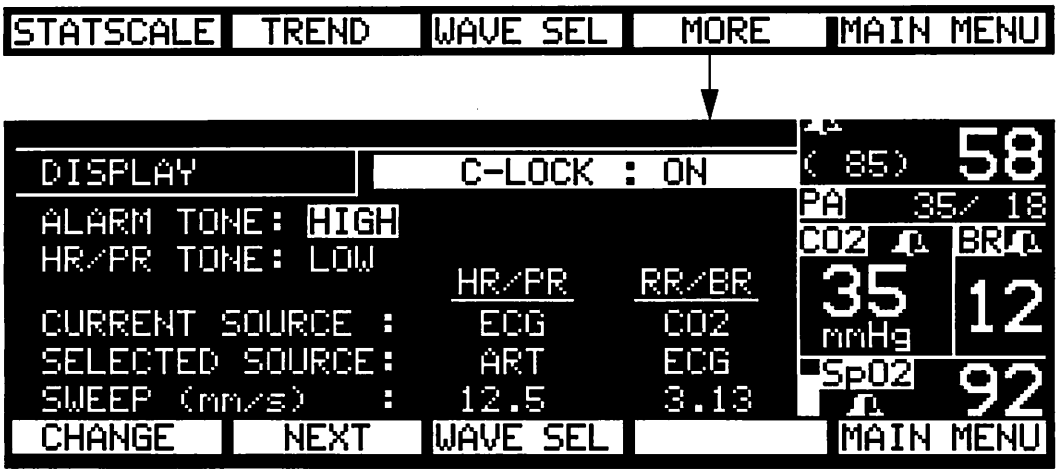


Figure 1-24. Display Status Window

The display status window appears when you press MORE in the first Display Menu and shows the current display settings. Use the CHANGE and NEXT buttons to change the settings.

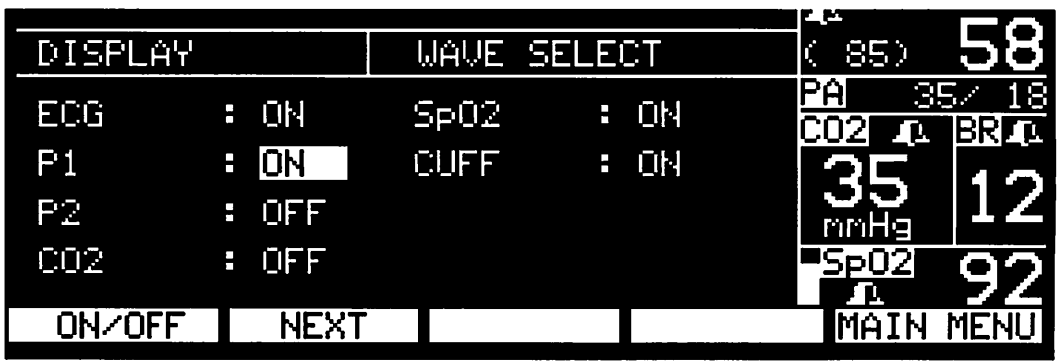


Figure 1-25. Wave Selection Status Window

The wave selection status window appears when you press WAVE SEL and shows which vital signs will appear in the waveform display area. Only the first three items in the list that are turned on will be displayed. CUFF displays the latest measurement numerics in the waveform display area.

To get to the Trend Menu, press DISPLAY and then TREND. Refer to Figure 1-24.

Table 1-12: Trend Menu Reference

Button Label	Function
PRINT	Prints the displayed trend at the displayed scale.
NXT PAGE	Selects the next vital sign trend display.
GRAPH	Selects the scale of the displayed trend graph. If cuff is displayed, the GRAPH button also selects a list of the last five cuff measurements.
RESCALE	Automatically rescales all trend graphs for best viewing in the display.

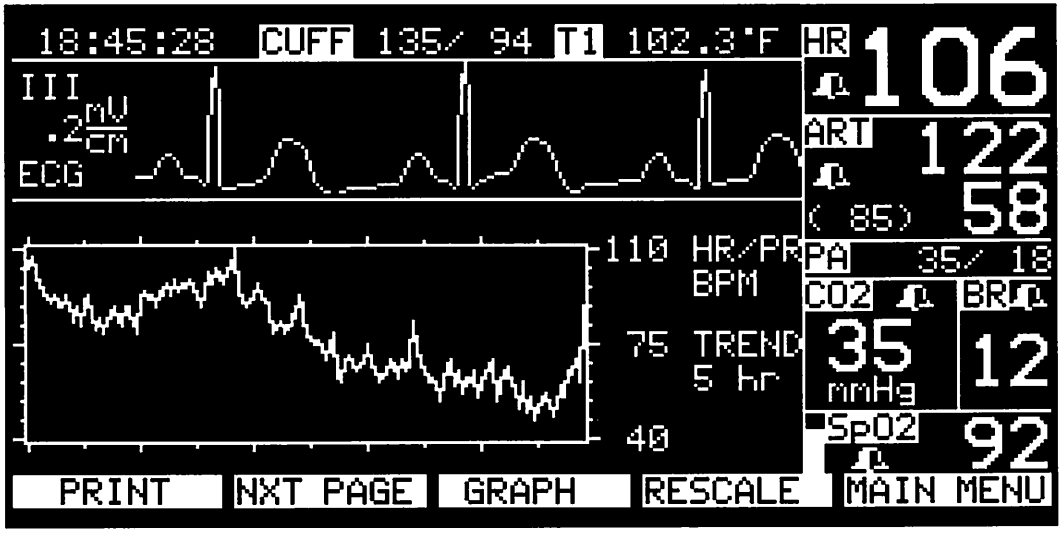


Figure 1-26. Trend Window

The trend window appears when you press TREND in the first Display Menu. Trends are accumulated for eight hours, of which five are displayed, and all eight hours can be printed if a Propaq printer is attached.

To get to the System Menus, press SYSTEM on the Main Menu. Refer to **Preparing for Use** on page 1-57 for more information on the System Menu functions.

Table 1-13: System Menu Reference

Button Label	Function
PRINTER	Allows setting printer functions. See Table 1-14 on page 1-46.
NET OFF (Only on models with the Acuity Network option and when connected to the network)	Notifies the Acuity Central Station that the Propaq is about to be taken off the network. Pressing NET OFF prior to disconnecting the Propaq from the network prevents communication fault messages.
INSERV	Turns on In-service mode. The Propaq displays simulated waveforms and numerics. In-service mode will not turn on if a patient is being monitored or has been monitored since the Propaq was last turned on. NO INSERV is displayed when in-service mode is not allowed. See **Learning the Propaq** on page 1-66.
PROGRAM	Allows setting programming functions. See Table 1-16 on page 1-48.
TIME/DAY	Allows setting the time and day functions. See Table 1-15 on page 1-47.
SERVICE	Allows access to Propaq testing functions. See the *Propaq Service Manual* for more information.
CHANGE	Changes the currently selected setting. See Figure 1-27 on page 1-45.
NEXT	Selects the next setting shown in the status window. See Figure 1-27 on page 1-45.

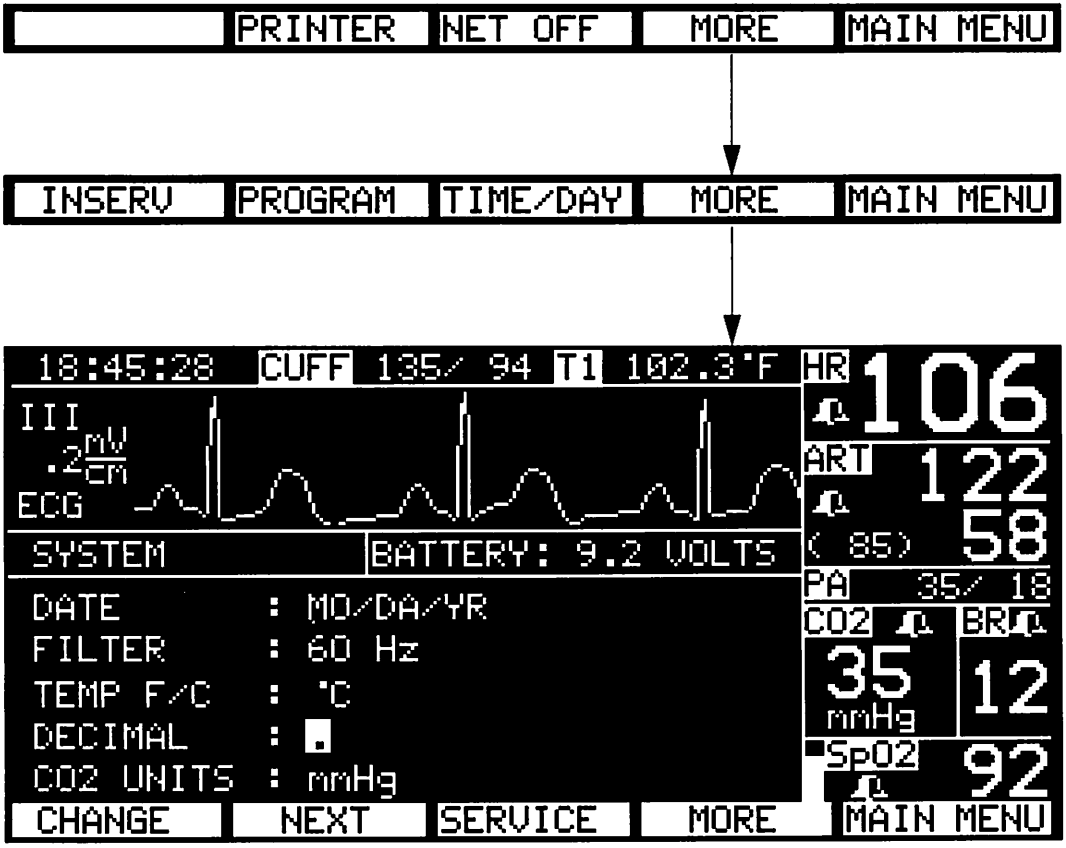


Figure 1-27. System Status Window and Menus

The system status window and accompanying menu allow you to change the date format, filter setting, temperature display units, decimal identifier, and the CO_2 units. The status window only appears when you press the MORE button twice.

To get to the Printer Menu, press SYSTEM and then PRINTER. Refer to **Printer Functions** on page 1-49 for more information on the printer functions.

Table 1-14: Printer Menu Reference

Button Label	Function
CHANGE	Changes the selected functions between ON and OFF.
NEXT	Selects the next function.
PR TREND	Prints all trends turned on in the Printer Trend Select Window.
NXT PAGE	Switches to the next printer status window.

To get to the Time/Day Menu, press SYSTEM, then MORE, and then TIME/DAY. For more information on setting the time and date, see **Setting the Time and Date** on page 1-60.

Table 1-15: Time/Day Menu Reference

Button Label	Function
ENTER	Programs the time and date into the Propaq's memory.
NEXT	Selects the next time/day function for setting.
UP	Increases the selected time or day value.
DOWN	Decreases the selected time or day value.

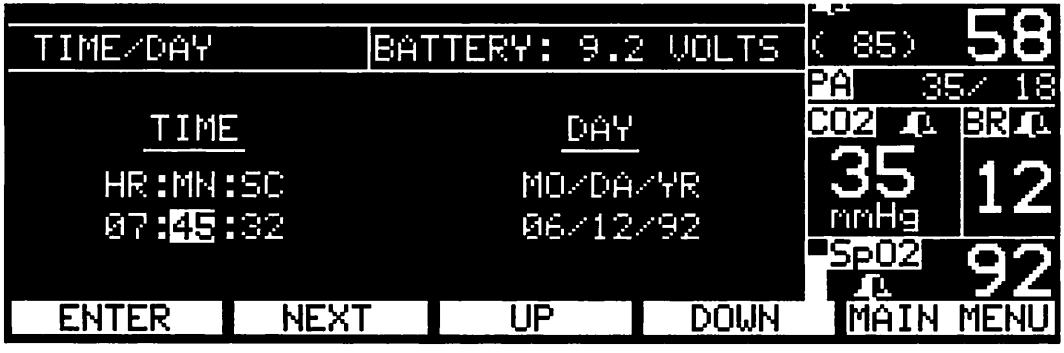


Figure 1-28. Time/Day Status Window

The time/day status window lets you change the time and date of the Propaq. You set the format for the time and date using the third System Menu.

System, More Program, Default, Yes

Main Menu

For more information on setting the date and decimal formats and on programming the Propaq, see **Changing System Settings** on page 1-61 and **Programming the Propaq's Turn-on Settings** on page 1-63.

Table 1-16: Program Menu Reference

Button Label	Function
DEFAULT	Programs the Propaq with the factory settings (see Appendix B).
CURRENT	Programs the Propaq with the current Propaq settings.

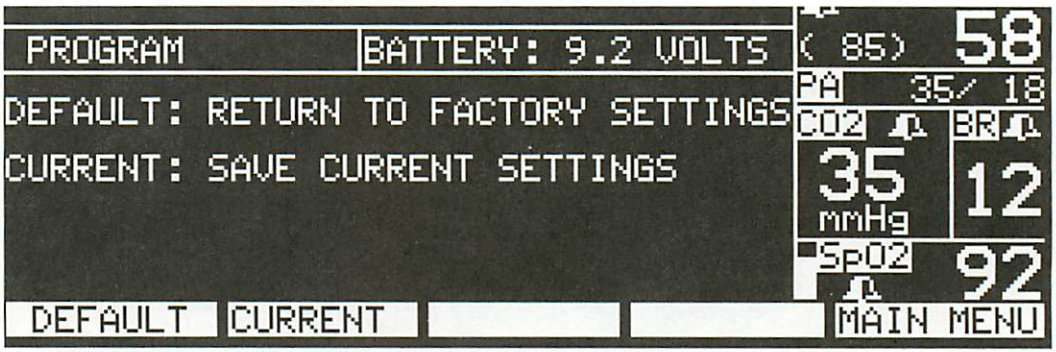


Figure 1-29. Program Status Window and Menu

The program status window and menu lets you program the Propaq to specific settings that are set when you turn on the monitor. Or, you can return the Propaq settings to their factory settings (default).

Printer Functions

When you press SYSTEM and then PRINTER, the Printer Menu appears along with the printer setup window as shown in Figure 1-30. You can set the printer functions listed in Table 1-17 on page 1-50 by selecting the function in the window using the NEXT button and changing the setting using the CHANGE button.

Sample printouts are shown starting on page 1-54.

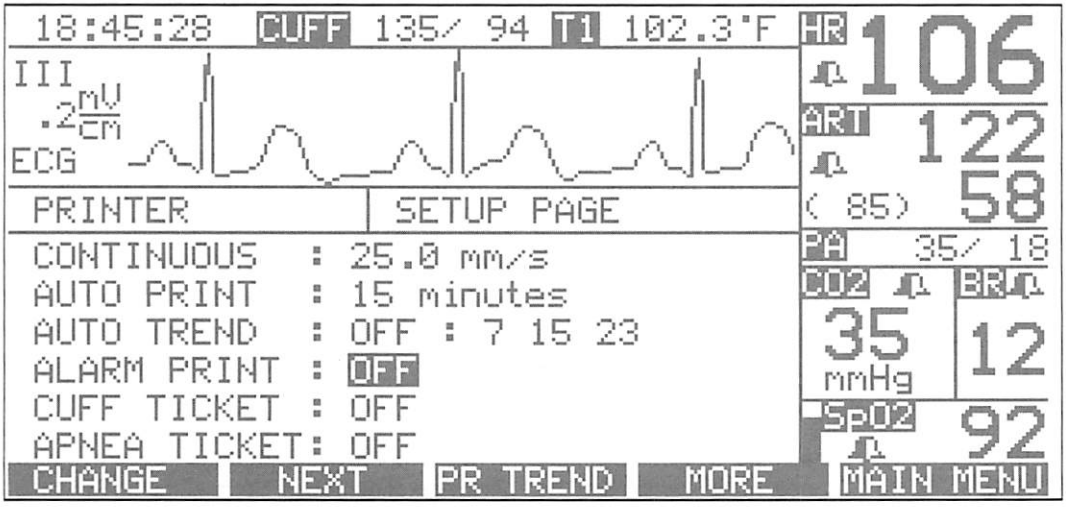


Figure 1-30. Printer Setup Window

The printer setup window displays the current settings affecting the printer.

When AUTO TREND is ON, the Propaq prints selected trends at eight-hour intervals. The interval times are shown next to the ON/OFF selection: 7 15 23 means the trends will be printed at 7:00, 15:00 and 23:00.

Table 1-17: Printer Setup Functions

Function	Description
CONTINUOUS	Sets the print speed for real time (continuous) measurements to 12.5, 25, or 50 mm/sec. This sets the print speed for a printout obtained by pressing the START/STOP button on the printer.
AUTO PRINT	Automatically prints 8 seconds of patient information every 15 minutes, 30 minutes, 1 hour, 2 hours, or 4 hours. This is the latest patient information (real time). The print speed is automatically set to 25 mm/sec.
AUTO TREND	Turns on/off and sets the interval (shifts) at which all enabled trends are automatically printed. Trends that are turned on in the Printer Trend Setup Page will be printed at each of the eight hours selected.
ALARM PRINT	Automatically prints upon an alarm. The Propaq prints 20 seconds of patient information. The first 12 seconds contain information prior to the occurrence of the alarm. The print speed is automatically set to 25 mm/sec.
CUFF TICKET	Automatically prints the results of a cuff measurement (a cuff ticket) when the measurement is taken.
APNEA TICKET	Enables and disables the printing of an Apnea Ticket. When turned on, an Apnea Ticket is printed at the conclusion of an apnea alarm and at the one-minute clock interval if the apnea alarm does not cease.

When you press the MORE button, another printer status window appears shown in Figure 1-31. This window lets you set how often you want patient trend information printed and which trends you want printed.

When ON appears next to the trend title in this setup window, the trend will be printed. Once the selections are made you can print all selected trends by pressing the PR TREND button in the Printer Menu.

You can also print only one trend by using the Trend Menu to display the trend you want printed and then pressing the PRINT button on the Trend Menu. See **Printing a Single Trend** on page 4-11 for more information about trends.

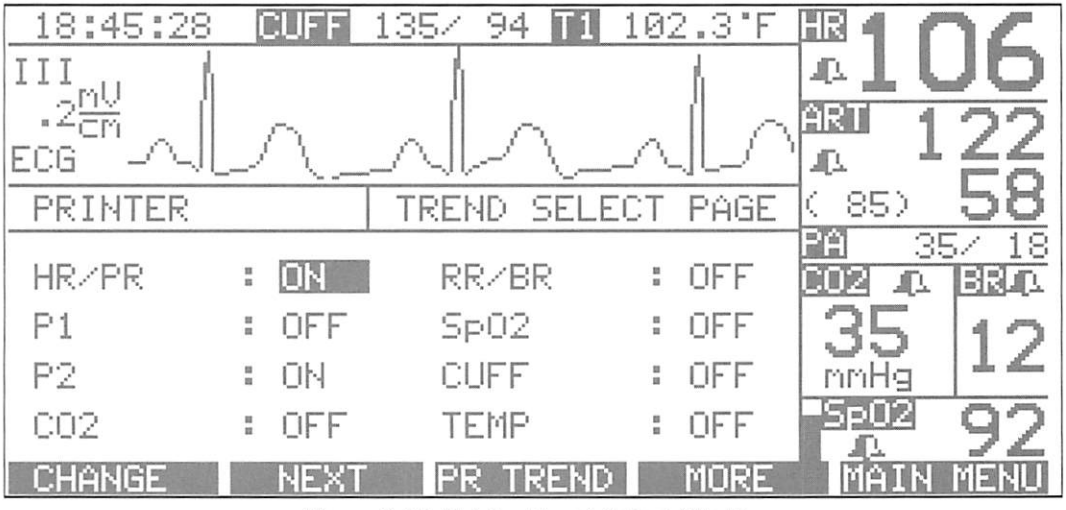


Figure 1-31. Printer Trend Select Window

The printer trend select window lets you select which trends you want printed at the shift intervals you select in the printer setup window.

In addition to the Printer Menu, the front panel of the printer (Figure 1-32) lets you manually start and stop printouts of waveforms and numerics. Table 1-18 on page 1-53 lists the functions of these buttons.

The waveforms you've selected for display (using the Wave Select Menu) are the ones that are printed whenever you press one of the printer buttons on the front of the printer.

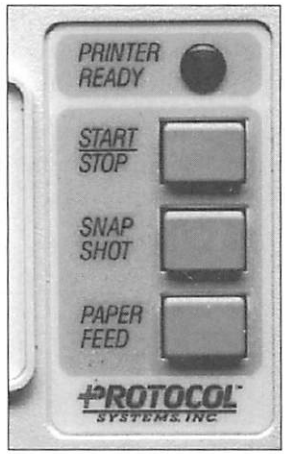


Figure 1-32. Printer front panel buttons

The printer front panel buttons let you manually start and stop printouts.

Table 1-18: Printer Button Functions

Button	Function
START/STOP	Manually starts and stops a printout of patient information as it is monitored (continuous or real time). You must press the button to start the printout and press it again to stop the printout. The print speed is set in the printer setup window (CONTINUOUS setting).
SNAPSHOT	Lets you print the last 8 seconds of patient information for nonrespiration waveforms. The printer prints the 8 seconds of patient information obtained prior to pressing SNAPSHOT. The last bit of patient information on the printout is the data obtained at the time you pressed SNAPSHOT. If you press FREEZE prior to pressing SNAPSHOT, the printer prints the 8 seconds of patient information obtained prior to when you pressed FREEZE. For respiration CO_2 waveforms, the SNAPSHOT command allows you to print 32 seconds of compressed waveform history on the same 8-inch strip. Nonrespiration and respiration waveforms can be printed on the same strip.
PAPER FEED	Advances the paper out of the printer.

Simultaneously pressing START/STOP and PAPER FEED prints a test strip. This should be done after you've changed the printer paper and whenever you suspect the quality of the printouts. See Figure 5-4 on page 5-14 for a sample of test printout.

The following figures show examples of Propaq printouts.

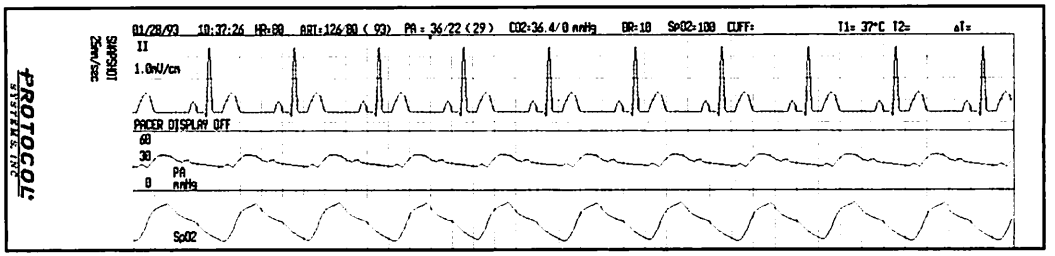


Figure 1-33. Printout showing three waveforms

ECG is always printed if it is monitored.

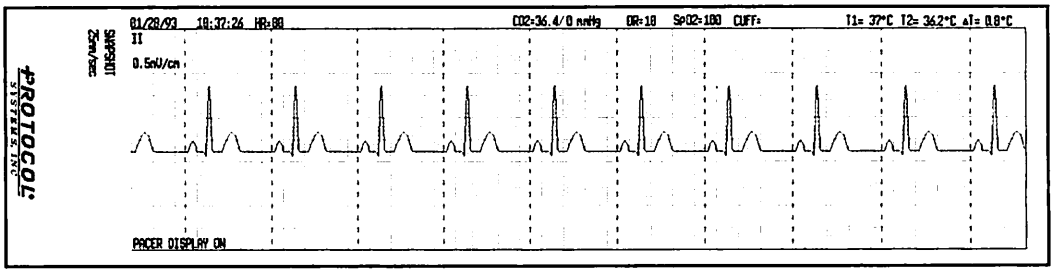


Figure 1-34. Printout showing only an ECG waveform

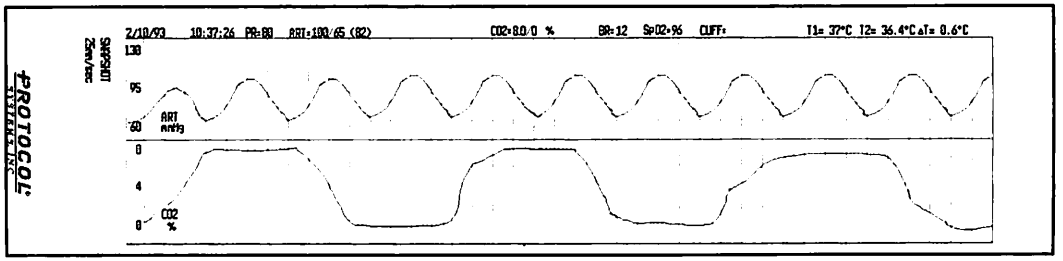


Figure 1-35. Printout showing two invasive waveforms

If invasive pressure is monitored without ECG, you can print the invasive pressure waveforms.

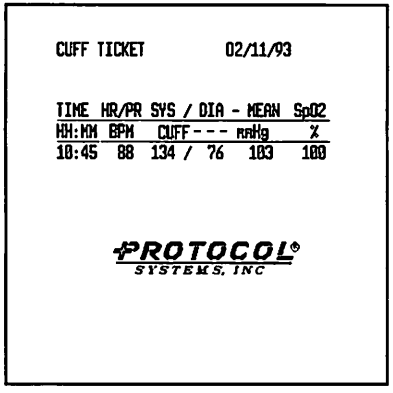


Figure 1-36. Cuff Ticket

The cuff ticket prints the results of each cuff measurement.

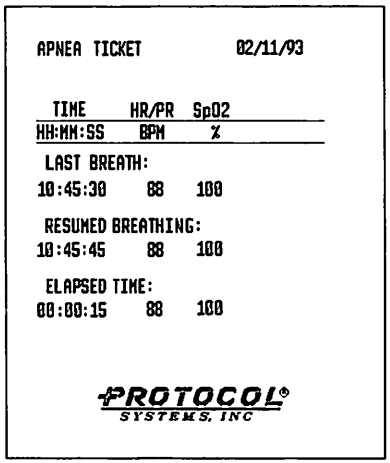


Figure 1-37. Apnea ticket showing that apnea alarm occurred

The apnea ticket setting must be turned on in the printer setup window.

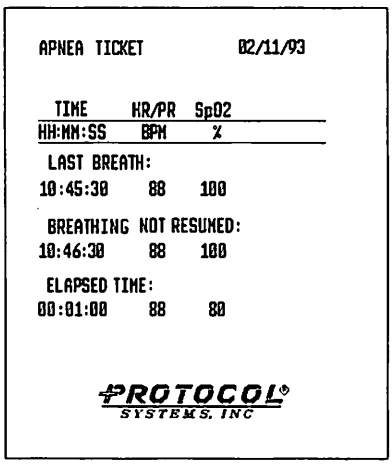


Figure 1-38. Apnea ticket showing that apnea event is still occurring

The Apnea Ticket setting must be turned on in the printer setup window.

Preparing for Use

Ensuring Your Propaq is Ready

Before using the Propaq on a patient, be sure you understand the Safety Summary at the front of this book. It provides important information about safely using the Propaq.

Be sure the Propaq is in top working order. Check to make sure there are no cracks in the case or the display. Use patient cables that are not broken, cracked, or fraying. Any problems with the monitor should be corrected by your biomedical service person or an authorized Protocol Service Center.

After you've checked out the Propaq, turn it on and let it perform its own startup tests to be sure it functions normally. Once it has completed the startup tests, the monitor is ready for use.

You can run the Propaq on its internal battery, or run it from the ac mains using the Propaq power adapter provided with the monitor. If you are going to run the Propaq on its battery, be sure the battery is fully charged. Keeping the Propaq plugged into its power adapter for about eight hours with the monitor turned off should provide the Propaq with a fully charged battery.

Most biomedical service departments have required service intervals for the monitoring equipment in their hospital. If the Propaq has been used longer than the recommended service interval, it should be checked for accuracy and proper functioning before being used on a patient. Never use a monitor that is suspected of being inaccurate or out of calibration. If your biomedical service department does not have a recommended interval, Protocol Systems recommends the Propaq be serviced at regular intervals as described in Chapter 5.

For further operating information about patient monitoring, read Chapter 2. More information about setting up the Propaq is on the following pages.

Selecting Waveforms for Display

A full-featured Propaq 106 (with SpO_2 and CO_2) can monitor six vital signs that can present a waveform on the display. You can display up to three waveforms. The displayed waveforms are also the only ones printed if a printer is attached. You can also display the last cuff measurement in a large window on the display in place of a waveform. Figure 1-40 on page 1-59 shows possible waveform displays.

To select waveforms for display, press DISPLAY, and then WAVE SEL (for EL) or MORE, and then WAVE SEL (for LCD). Use the NEXT and ON/OFF buttons to turn on the desired waveforms in the wave select window (Figure 1-39). Because of the critical nature of the ECG waveform, you cannot turn off ECG. Although if ECG is not monitored, another waveform will occupy its place.

You can turn on more than three waveforms, but only the first three waveforms listed in the window that are monitored are displayed. For example, if you are monitoring ECG, both invasive pressures and SpO_2, only ECG and the two invasive pressure waveforms are shown if they are turned on. To display SpO_2, one of the pressure waveforms will have to be turned off.

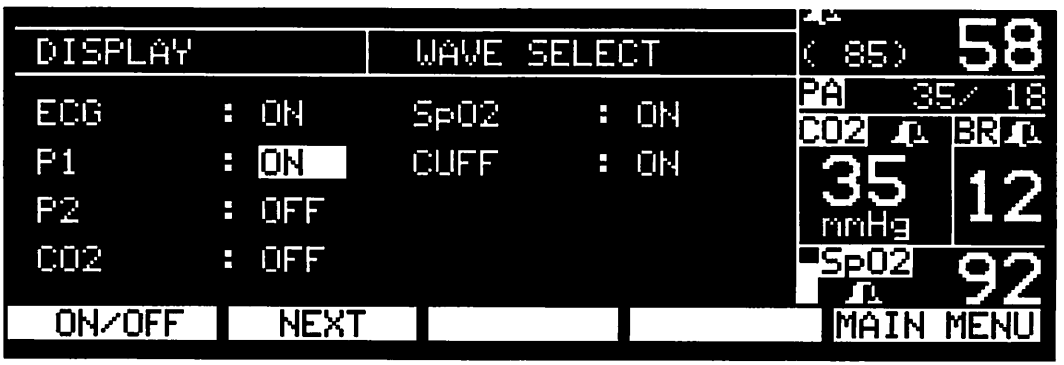
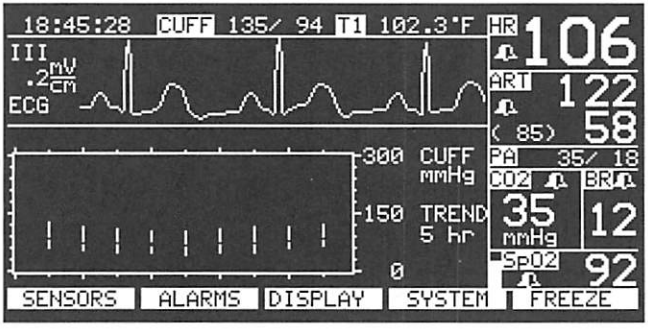
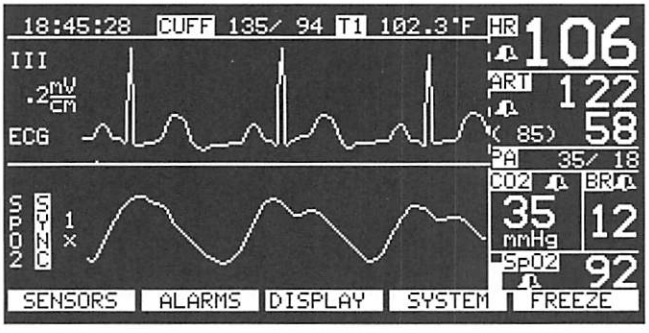


Figure 1-39. Display Wave Select

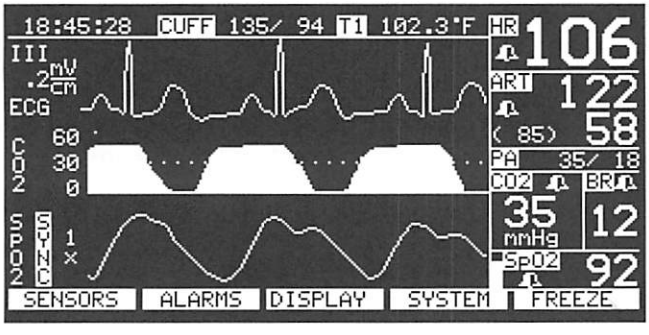
Waveforms that are turned on are displayed. Up to three waveforms can be shown. The same waveforms displayed are the ones printed if a printer is attached.



A single waveform above a trend is displayed by turning on only the desired waveform in the wave select window. If ECG is monitored it will automatically be selected for display. (ECG cannot be turned off.) If ECG is not monitored, the selected waveform will be shown.



Two waveforms are displayed by turning on only one other waveform if ECG is monitored. If ECG is not monitored, turn on the two desired waveforms.



Three waveforms are displayed by turning on three or more waveforms. Only the first three in the list that are turned on will be displayed.

Figure 1-40. Displaying waveforms in three configurations

With the Propaq's flexibility, you can configure the display to show up to three waveforms.

Setting the Time and Date

The time is shown in the upper left corner of the Propaq screen in twenty-four hour format: 00:00:00 is midnight; 12:00:00 is noon. The time and date appear on printouts created with the Propaq printer in the Expansion Module. You should make sure the time and date are set before using the Propaq for patient monitoring. Here's how you do it.

If a "PROGRAM FAULT: SETTINGS LOST, TIME/DAY RESET" equipment alert appears when you turn on the monitor, see **PROGRAM FAULT Equipment Alert** on page 3-18.

1. From the Main Menu, press SYSTEM, press MORE, and then press TIME/DAY. The Time/Day Menu and status window appear (Figure 1-41) with the cursor positioned for time adjustment. Use the NEXT, UP, and DOWN buttons to adjust the time and day as follows.
2. Press the NEXT button to select the hours, minutes, seconds, month, day, or year.
3. Press the UP or DOWN button to increase or decrease the value.
4. Press the ENTER button after the time and date values are selected to program the time and date into the Propaq.
5. When you have finished setting the time and date, press the MAIN MENU button to return to the Main Menu.
6. You must also program either the default or the current setting, otherwise the time and date will not be retained after cycling the power switch, even though you have entered them here.

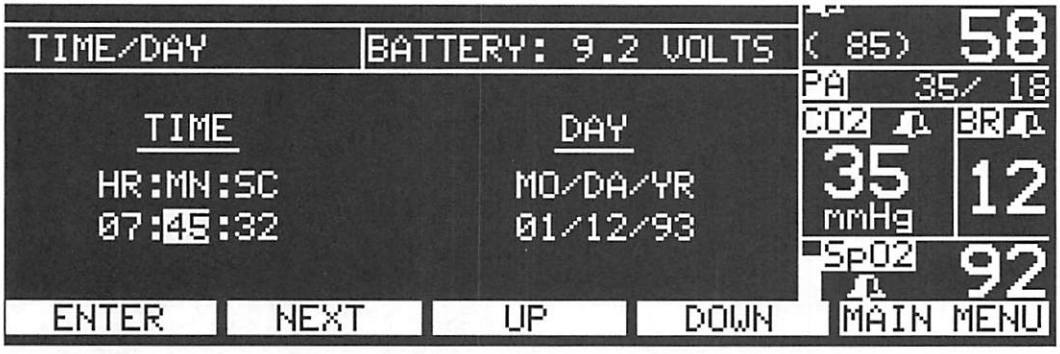


Figure 1-41. Time/Day Menu

Setting the time is simple with these buttons in the Time/Day Menu.

Changing System Settings

From the System Menus, you can set temperature units, the ECG filter, the CO_2 units, the way the date is shown, and the decimal character as either a period (.) or a comma. The settings are shown in the system status window (Figure 1-42) and changed using the NEXT and CHANGE buttons in the third System Menu (SYSTEM, then MORE, and then MORE again).

Refer to Table 1-15 on page 1-47 for descriptions of these parameters.

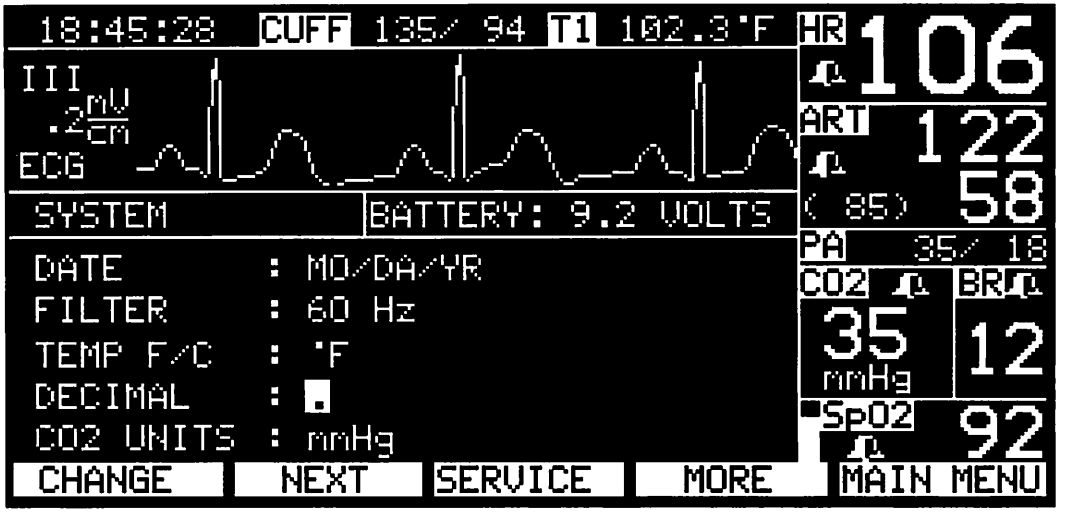


Figure 1-42. System Status Window

Table 1-19: System Functions

Function	Description and Settings
Date	Sets the date format: Month/Day/Year or Day/Month/Year.
Filter	Sets the ECG filter frequency. Usually set to the ac mains frequency: 60 Hz for North America; 50 Hz for most European and South American countries. Some parts of Japan use 50 Hz, others use 60 Hz.
Temp F/C	Sets the temperature display units: either degrees Fahrenheit or degrees Celsius.
Decimal	Sets the decimal character as either a period (.) or a comma (,).
CO_2 Units	Sets the CO_2 display units as mmHg, kPa, or percent (%).

System, More, Program

Programming the Propaq's Turn-on Settings

turn-on settings— *all functions that can be set using the pushbuttons, such as the alarm limit values, trend graph scales, and all patient monitoring functions, can be programmed so these settings will automatically be assumed when the Propaq is turned on.*

At the factory, the Propaq is set up to turn on with the display contrast (LCD only), alarm limit values, trend graph scales, and monitoring parameters already set. However, your particular workplace may "normally" use other settings. With the Propaq's programming ability, you can program the Propaq's *turn-on settings* for your particular application. The PROGRAM button in the System Menu performs this function.

When the monitor is shipped from the factory, it is programmed with factory *"default"* settings. The factory default settings are listed with the specification listings in Appendix B of this manual. You can always reprogram the Propaq to these factory settings by pressing the DEFAULT button of the Program Menu.

The Propaq will turn on with the factory default settings the first time it is used. To program the Propaq turn-on settings for your particular application, perform the following steps. It is important that you make sure you have selected all the desired settings before you program the Propaq, or you may end up with the monitor not programmed exactly the way you want.

1. To set the ECG functions, press SENSORS and then ECG. Using the ECG menus, set all ECG parameters (LEAD, SIZE, HR/PR TONE, and PACER). Press MAIN MENU.

2. To set the invasive pressure functions, press SENSORS and then INV PRS. Using the Invasive Pressure Menu RANGE button, set the desired invasive pressure range (Models 104 and 106 only). Press MAIN MENU.

3. To set the temperature units, ECG filter frequency, and other system parameters, press SYSTEM, then MORE, and then MORE again. Make the desired changes by selecting the system function with the NEXT button and changing it with the CHANGE button. Press MAIN MENU.

4 To set the cuff functions, press SENSORS and then CUFF. If you want the Propaq to turn on with the cuff channel ready to automatically take blood pressure measurements, press AUTO and then INTERVAL in the Cuff Menu until the desired measurement interval is displayed in the cuff status window next to the word TIME. If you don't want the Propaq to automatically take cuff measurements, press MANUAL. Press MAIN MENU.

5 To set the SpO_2 functions, press SENSORS and then SpO_2. Using the SpO_2 Menus, set all SpO_2 functions (SIZE, C-LOCK, and RESPONSE). Press MAIN MENU.

6 To set the CO_2 functions, press SENSORS, then MORE (models 104 and 106 only), and then CO_2. Using the CO_2 Menus, set all CO_2 functions (RANGE, mm/sec, GAS COMPensation, RESPONSE, and ON/OFF). Press MAIN MENU.

7 To set the trend graphs, press DISPLAY and then TREND. Use the SCALE and NXT PAGE buttons to select each trend parameter window and display the scale you want to appear the first time you select each trend. Then, press the NXT PAGE button to display the trend you want first to appear the first time you press the TREND button. Press MAIN MENU.

8 To set the waveform windows you want displayed, press DISPLAY, then WAVE SEL (for EL) or DISPLAY, then MORE, and then WAVE SEL (for LCD). Use the NEXT and CHANGE buttons to turn on only the waveforms you want to see. Press MAIN MENU.

9 To set the alarm tone volume and other display functions, press DISPLAY and then MORE. Use the CHANGE and NEXT buttons to set the display functions (alarm tone volume, heart tone volume, and heart rate source). Press MAIN MENU.

10 To set the alarm limits, press ALARMS. Using the Alarms Menus, set all alarm limit values as you want them to be when you turn on the monitor.

11 To set automatic trend prints and other printer functions, press SYSTEMS > PRINTER. Set the printer functions you need, then press NXT PAGE to set the trends you wish to print. Press MAIN MENU.

12 To program the monitor, press the following buttons:

SYSTEM > MORE > PROGRAM > CURRENT.

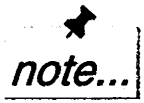
Press MAIN MENU to return to the Main Menu.

The Propaq is now programmed to turn on with all the settings you just selected. You can verify this by turning the monitor off and then on again and selecting each item you programmed.

Learning the Propaq

One of the most convenient Propaq features for new users is the ability to practice using the Propaq without a patient simulator. You can do this using the Propaq's in-service mode of operation shown in Figure 1-43. In-service is activated with the INSERV button located in one of the System Menus.

When you activate in-service mode, the Propaq begins to simulate patient information. The monitor displays an ECG waveform, one or two invasive pressure waveforms with accompanying numeric values (Models 104 and 106 only), and, if so equipped, SpO_2, CO_2, and Breath Rate numerics. All the information is simulated, and the in-service mode cannot be activated while you are monitoring a patient. While using in-service mode, the message "SIMULATING" alternates with the time of day as shown in Figure 1-43.



Simulated data cannot be used to calibrate the monitor.

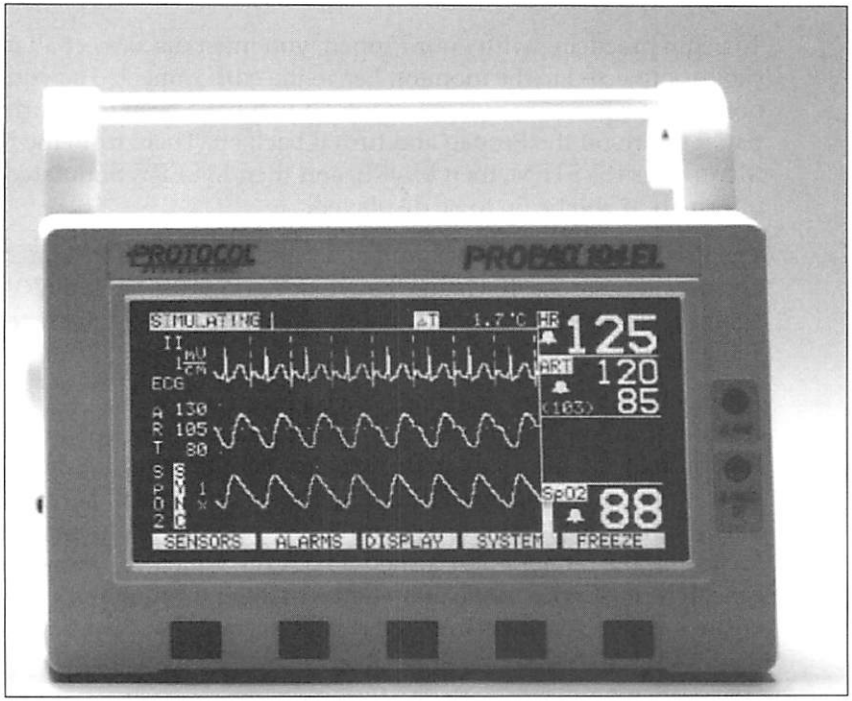


Figure 1-43. In-service Mode

The Propaq's in-service mode can be used for hands-on learning.

Using In-service Mode

To begin practicing with your Propaq, you must disconnect all patient cables connected to the monitor. Leave the cuff connected so you can take noninvasive pressure measurements. If you have been monitoring a patient, turn off the Propaq and turn it back on. Then, from the Main Menu, press SYSTEM, then MORE, and then INSERV. Simulated patient information will begin to be displayed.

The Propaq has two sets of simulated patient information—an initial set and an alternate set. To change between them, press the INSERV button again. The patient information values used for both sets are listed in Table 1-20 on page 1-69.

After activating in-service mode, if you connect a cable or set the cuff channel to automatically take pressure measurements, you are telling the Propaq that you are ready to do actual patient monitoring. The Propaq then stops simulating, goes through its start up tests, and erases any simulated trend data it might have stored. This process is the same as if you turned off the monitor and turned it back on, which you can also do to cancel the in-service mode of operation. Going through this process ensures you never mix simulated data with actual patient information.

Table 1-20: In-service Simulated Patient Values

Channel	Parameter	Initial Value	Alternate Value
ECG	Waveform	Paced, 1mV, Lead II	Same as Initial Value
ECG	Heart Rate	80 bpm	125 bpm
P1	Waveform	Arterial	Same as Initial Value
P1	Pulse Rate	80 pulses per min.	125 pulses per min.
P1	Systolic	121 mmHg	120 mmHg
P1	Diastolic	79 mmHg	85 mmHg
P1	Mean	96 mmHg	103 mmHg
P2	Waveform	Pulmonary Artery	Same as Initial Value
P2	Pulse Rate	80 pulses per min.	125 pulses per min.
P2	Systolic	25 mmHg	25 mmHg
P2	Diastolic	9 mmHg	12 mmHg
P2	Mean	15 mmHg	18 mmHg
Cuff	Mode	Manual (Auto cancels in-service)	Same as Initial Value
Cuff	Numerics	Actual values from patient	Actual values from patient
T1	Numeric	37.0° C	39.1° C
T2	Numeric	36.4° C	37.4° C
ΔT	Numeric	0.6° C	1.7° C
SpO_2	Waveform	Normal, 2x	Same as Initial Value

Table 1-20: In-service Simulated Patient Values

Channel	Parameter	Initial Value	Alternate Value
SpO_2	Rate	80 pulses per min.	125 pulses per min.
SpO_2	Numeric	97%	88%
CO_2	Waveform	Normal	Hyperventilating
CO_2	$ETCO_2$ Numeric	38 mmHg	60 mmHg
CO_2	$INCO_2$ Numeric	0 mmHg	8 mmHg
CO_2	Breath Rate	12 BR/minute	31 BR/minute

What You Can Do With In-service Mode

While using the in-service mode, you can press any of the Propaq buttons, except for the AUTO button in the Cuff Menu, to change a function setting. You can change the ECG waveform size, turn off and on the pacer indicator, zero pressure inputs, change from °F to °C, set alarm limits, cancel alarms, and change any other functions of the Propaq. (Pressing the ECG LEAD button changes the lead selection indicator, but the waveform does not change.) You can even STAT SET alarms and then change the in-service patient data with the INSERV button to violate the alarm limits.

For noninvasive pressure measurements, keep the Propaq in manual cuff operating mode and take pressure measurements by pressing the START button. You can also press the Cuff Menu's TURBOCUF button to consecutively take pressure measurements for five minutes.

Simulated data can be printed on the Propaq Printer. All printouts include the message "SIMULATED DATA" every four inches to prevent simulated data from being mistaken for actual patient data.

It is possible to reprogram the Propaq to new user settings with the PROGRAM button while using in-service mode. Remember, any time you press the System Menu's PROGRAM button, you reprogram all of the Propaq's turn-on settings.

Use in-service mode freely. You can easily experiment with the in-service function in order to quickly learn the functions of the Propaq.

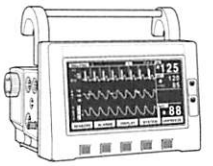
What You Cannot Do With In-service Mode

You cannot use in-service mode to calibrate the monitor.

You cannot set the Propaq to take automatic noninvasive pressure measurements while using in-service mode. If you press the Cuff Menu's AUTO button, the Propaq will turn off in-service, perform its start up tests, and erase all simulated patient information that was saved in trends.

You cannot use Defib Sync while using in-service mode.

You cannot activate in-service mode if you have been monitoring a patient. You must first turn off the Propaq, disconnect any patient cables, and then turn it back on. If the Propaq has been used for patient monitoring, it has stored patient information for displaying trends. This information must not be contaminated with simulated data. That's why in-service cannot be activated after you have monitored a patient. Remember, any time a patient cable has been connected to the Propaq, or if the monitor has been set to automatically take noninvasive measurements, the Propaq must first be turned off and then on again to activate in-service mode.



2

Patient Monitoring

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ECG

Intended Use

The Propaq can be used in many rugged environments, including aircraft, field hospitals, and ambulances. In the hospital, the Propaq can be used in ER, OR, PACU, Cath Lab, Endoscopy, Labor and Delivery, for interdepartmental patient transport, and in many other departments where a vital signs monitor is necessary.

The Propaq can be used during procedures using electrosurgical machines and defibrillators. However, even though the ECG channel contains electrosurgical interference suppression (ESIS) circuitry, noise artifact may be displayed on the ECG trace while an electrosurgical device is in use. This will vary depending on ECG electrode placement and the procedure being used. Special precautions must be observed when using the Propaq (or any monitoring device) with electrosurgical devices.

WARNING

High-intensity radio frequency (RF) energy from external sources, such as an improperly connected electrosurgical unit, can induce heat into electrodes and cables which can cause burns on the patient. Reading errors and damage to equipment may also result. This hazard can be reduced by (1) avoiding the use of small ECG electrodes, (2) selecting ECG electrode attachment points remote from the expected RF paths, (3) using electrosurgical return electrodes with the largest practical contact area, and (4) assuring proper application of the electrosurgical return electrode to the patient.

Even though the Propaq contains fully isolated patient-connected circuitry, it has not been specially designed for direct cardiac application.

The Propaq is intended to be used only with accessories provided or recommended by Protocol Systems. Use of other accessories may cause damage to the Propaq or indicate inaccurate patient information.

To protect the Propaq from damage during defibrillation, for accurate ECG information, for protection against noise and other interference, and to avoid excessive recovery time following defibrillation, use only ECG electrodes and cables (namely, ones with internal current-limiting resistors) specified or supplied by Protocol Systems, and follow recommended application procedures. ECG electrodes must be of similar metal to prevent excessive polarization. See the *Products and Accessories* book for part numbers and ordering information of ECG cables and other accessories.

***diagnostic*—the ability to display very detailed waveforms through extended monitoring bandwidth. The Propaq is not a diagnostic monitor.**

The Propaq is intended for ECG monitoring of leads I, II, III, and Marriott configuration 1 (MCL1—requires all three electrodes). The Propaq 100 series is not intended for *diagnostic* ECG monitoring.

The Propaq can be used on patients with pacemakers. However, as with many monitoring devices, pacemaker patients should be kept under close or constant observation. The Association for Advancement of Medical Instrumentation (USA) cautions that "in some devices, rate meters may continue to count the pacemaker rate during occurrences of cardiac arrest or some arrhythmias. *Do not rely entirely upon rate meter alarms.* Keep pacemaker patients under close observation." See ECG specifications in Appendix B for disclosures of the Propaq's pacemaker pulse rejection capability. For more information on using the Propaq with pacemaker patients, see **Using the Propaq With Pacemaker Patients** on page 2-14.

ECG Connector and Applicable Accessories

The standard ECG connector is a 6-pin connector (Figure 2-1). For information on the optional Hewlett Packard Compatible-Connectors left side panel ECG connector, see **HP-Connectors** on page 6-3.

Only ECG cables meeting Protocol Systems specifications and applicable regulatory standards should be used with the Propaq. The Propaq is protected against damage from defibrillator discharge and electrosurgical machines only when the proper ECG cable is used. ECG cables may be ordered from Protocol or direct from approved manufacturers. Refer to the *Products and Accessories* book for more ordering information.

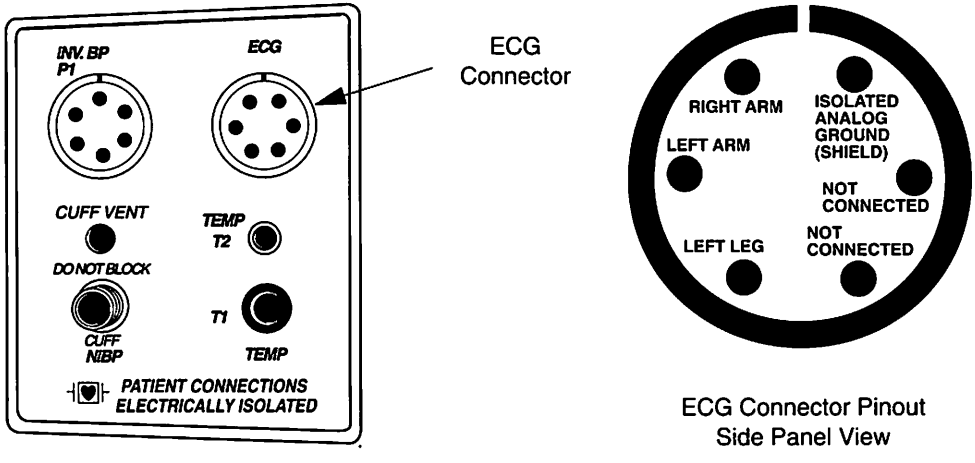


Figure 2-1. ECG Connector

The ECG Connector on the Propaq's left side panel is always located in the upper right corner. The Hewlett Packard Connector-Compatible side panel is described in Chapter 6.

Preparation

Preparing for ECG monitoring with the Propaq requires you to prepare the monitor, prepare the patient, set up the ECG channel, and then set the ECG alarms.

1. **Preparing the Monitor.** Inspect the ECG cable for wear, breakage, or fraying. Replace it if the cable shows signs of any of these. Plug the ECG cable into the ECG connector on the Propaq's left side panel, and plug the lead wires into the ECG cable. (Some cables have nondetachable lead wires.)
2. Press the monitor's OFF (STANDBY)/ON switch to turn it on.
3. **Preparing the Patient.** Thoroughly clean the skin areas where the electrodes will be attached. Attach the lead wires to the electrodes before applying them to the patient.
4. If you are using pre-gelled electrodes, use only electrodes that have not expired. Make sure there is a generous amount of gel in the electrode and that it has not dried. For best results, use silver/silver chloride electrodes.
5. If you are using non-gelled electrodes, apply a 1/4 to 1/2 inch mound of gel over the electrode contact area.

Some electrodes may be subject to large offset potentials due to polarization. This effect is most likely when dissimilar metals are used for different electrodes, and may be severe enough to prevent obtaining an ECG trace. Furthermore, recovery time after application of defibrillator pulses may be compromised when using electrodes of dissimilar metals. Squeeze bulb electrodes, even if all of the same metal, are particularly vulnerable to this effect. Stainless steel needle electrodes are prone to having large erratic offset drifts, and are not recommended.

6 Apply the electrodes to the patient in either the standard lead configuration or the Marriott Configuration for Modified Chest Lead (MCL1) monitoring, as shown in Figure 2-2. If using MCL1, select LEAD II on the Propaq, and use all three electrodes.

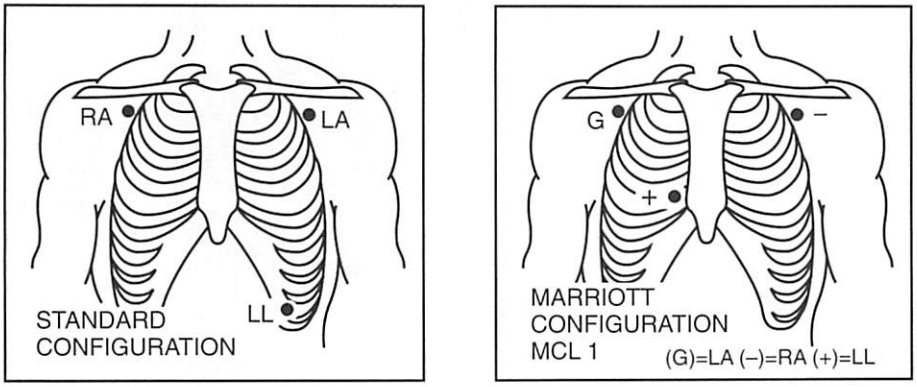


Figure 2-2. ECG leads placement

Placing ECG leads for the standard or Marriott configuration.

7 Support the ECG cable so it does not stress the electrode wires, electrode wire/ECG cable connectors, or electrodes.

8 If an electrosurgical unit is going to be used, place the ECG cable and electrode wires so that interference will be minimal. Operating the monitor on battery power will help minimize interference.

***program**—the settings the Propaq automatically assumes when it is first turned on. You program the Propaq using the PROGRAM function in the System Menu.*

By now there should be some kind of ECG waveform displayed on the monitor. It may exhibit noise or pacer indications (dashed vertical lines), but the waveform should be nearly centered in the display area and sweep from left to right across the display. A heart rate should also be displayed to the right of the waveform. Depending on how the Propaq was *programmed* (see Chapter 1), a beep tone may occur with each detected QRS event. Figure 2-3 on page 2-8 shows a typical display.

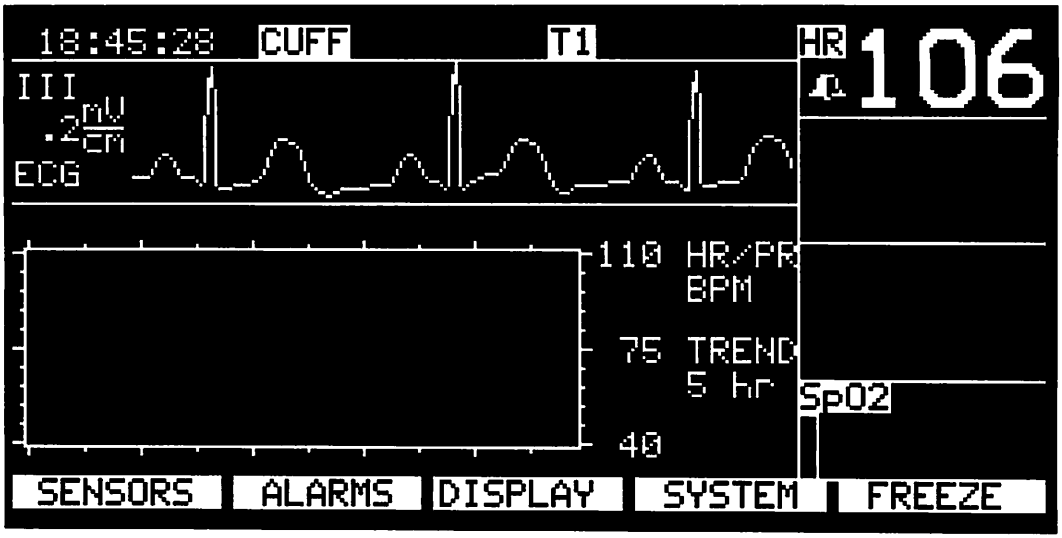


Figure 2-3. ECG waveform display

When you first start monitoring with ECG, the display should look like this.

9 If there is no waveform, check the electrodes, the electrode wires, the ECG cable, and the monitor for a possible lead fault.

10 **Setting Up the ECG Channel.** Press SENSORS and then ECG to set the ECG parameters: LEAD, SIZE, HR/PR TONE, and PACER. See **How ECG is Displayed** on page 2-9 for more information on each of these functions. If the patient being monitored has a pacemaker, you may want to turn on the Pacer function. See **Using the Propaq With Pacemaker Patients** on page 2-14. If the ECG waveform exhibits noise due to ac mains interference, you may want to activate the ac mains filter as described in **Using the Filter to Better Display a Waveform** on page 2-17.

11 **Setting ECG Alarms.** See Chapter 3 for information on setting alarm limits. Set the alarm limits according to your hospital's protocols.

How ECG is Displayed

Monitoring the electrocardiogram (ECG) provides information on the electrical activity of the heart, which is displayed as the ECG waveform in the top part of the waveform display area. Up to two other waveforms can be shown below ECG, but because of the critical nature of monitoring ECG, it is always shown on top. In addition, the ECG waveform is the only waveform that cannot be turned off using the Wave Select Menu described in Chapter 1.

Patient movement and other artifact might cause the ECG waveform to move up and down on the display. Most artifact such as this is automatically detected, and the waveform is adjusted so that ECG always remains centered in the ECG waveform window. However, severe artifact and interference (such as interference from defibrillation) may cause the waveform to move off the display. In such situations, the Propaq will always automatically reposition the waveform in just a few seconds so you can see it again.

The Propaq provides several functions that affect the ECG waveform display and the tone that sounds with each detected heart beat. The buttons that affect these functions are the LEAD, SIZE, and HR/PR TONE buttons. These buttons are all found in the ECG Menus you select by pressing (starting at the Main Menu) SENSORS and then ECG.

In addition, the filter selection (found under the SYSTEM menu) optimizes rejection of power-line-frequency noise.

When you press the MORE button in the first ECG Menu, a status window appears showing you the current ECG settings and additional selections. The ECG menus and status window are shown in Figure 2-4 on page 2-10.

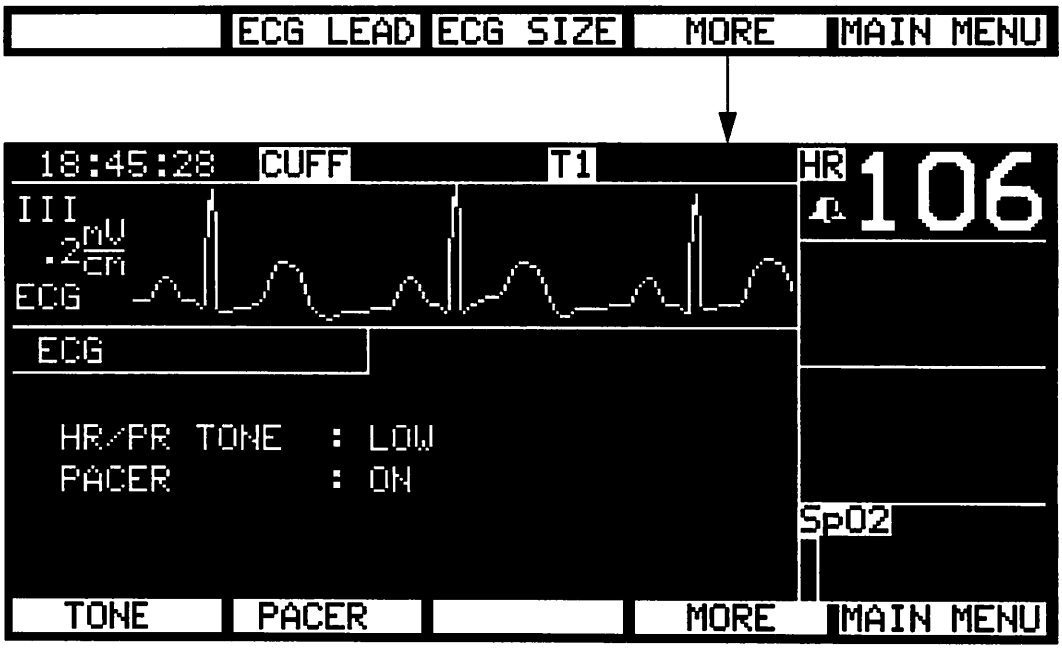


Figure 2-4. ECG Status Window

The ECG status window appears when you press MORE in the first ECG Menu.

LEAD. The electrical signal generated by the heart can be detected along different axes through the heart. Selection of which axis is monitored is done using the LEAD button in the ECG Menu. The Propaq can monitor leads I, II, and III. (By placing the electrodes in the Marriott configuration and selecting lead II, you can monitor the Modified Chest Lead.)

Figure 2-6 on page 2-13 shows the different axes and the resulting displays. Lead II is typically monitored in clinical applications. Therefore, the Propaq's normal, factory-programmed lead setting is Lead II.

The selected lead is indicated in the upper left corner of the display. If at any time after the Propaq begins displaying an ECG waveform, an ECG electrode becomes disconnected or disrupted so that the Propaq cannot receive the ECG signal, it alerts you through an equipment alert. The alarm tone sounds and the disconnected electrode is indicated on the display as shown in Figure 2-5.

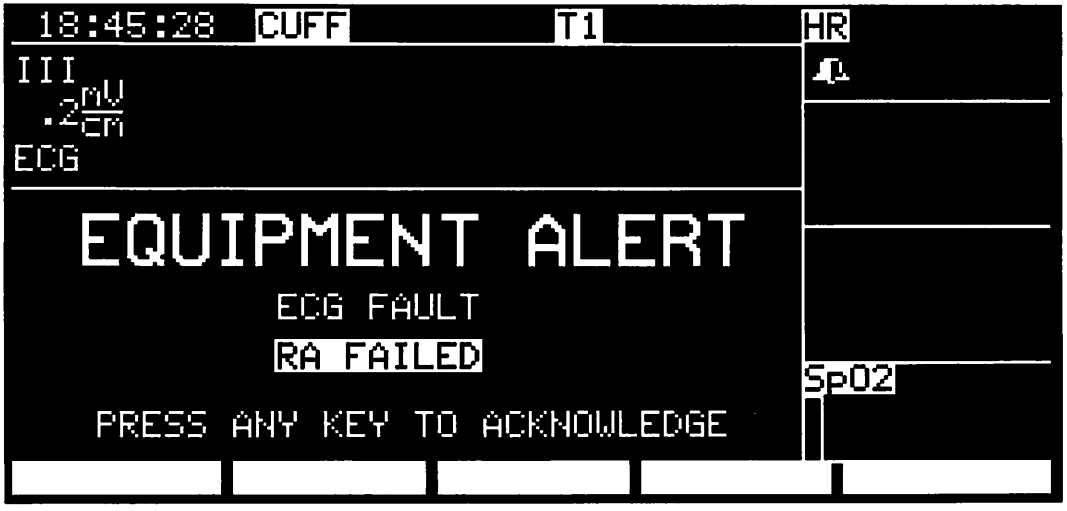


Figure 2-5. ECG Equipment Alert

An ECG equipment alert shows which lead failed. If more than one lead fails, the Propaq displays MULTIPLE in place of the failed lead.

SIZE. The ECG waveform can vary in size depending on the strength of the heart signal and how well the electrodes detect the heart's electrical impulses. To accommodate varying signal strengths, the Propaq allows you to adjust the size of the ECG waveform on the screen. The SIZE function "increases" and "decreases" the ECG waveform size by simply pressing the SIZE button. Each time you press the button, the waveform size approximately doubles in height. When you reach the largest waveform size, the next press displays the smallest size. The ECG channel's sensitivity changes as you press the SIZE button. ECG sensitivity is shown to the left of the waveform in units of mV/cm.

note...

The QRS detector sensitivity threshold is not affected by changing the ECG display size.

The ECG sensitivity factor is always displayed to the left of the ECG waveform. You can use the sensitivity value to determine the electrical amplitude of the heart signal. If the size value is 1 mV/cm, a QRS event on the ECG signal that is 1 cm tall is a 1 mV QRS event.

mm/sec. All waveforms are drawn across the display from left to right. The oldest waveform information is replaced by the newest information, with an invisible erase area separating the two. The rate at which the waveforms are drawn is set by the mm/sec function. The Propaq can draw the "heart synchronized" waveforms at three speeds: 12.5 mm/sec, 25 mm/sec, and 50 mm/sec. At faster speeds, the waveforms are expanded. The fastest speed gives you the most detail of the ECG and other waveforms. The mm/sec function is found in the Display status window.

note...

The mm/sec setting of a CO_2 display (not synchronized with the heart) is set independently.

HR/PR TONE. Each time the Propaq detects the occurrence of a QRS event, it makes a short beep. This is the Propaq's heart tone. You can turn off the heart tone or set it to one of three volumes—LOW, MEDIUM, or HIGH—using the HR/PR TONE button.

The HR/PR TONE sounds for each QRS event, or, if the heart rate source is a pressure channel or SpO_2, for each detection of a pulse wave. Because the heart tone does not depend on just the ECG channel, the HR/PR TONE function can be set in both the ECG and Display status windows.

If SpO_2 is monitored, the heart tone is produced by the speaker in the SpO_2 option. The pitch of the tone varies with the SpO_2 value. If SpO_2 is not monitored, the heart tone is produced by the speaker in the Propaq.

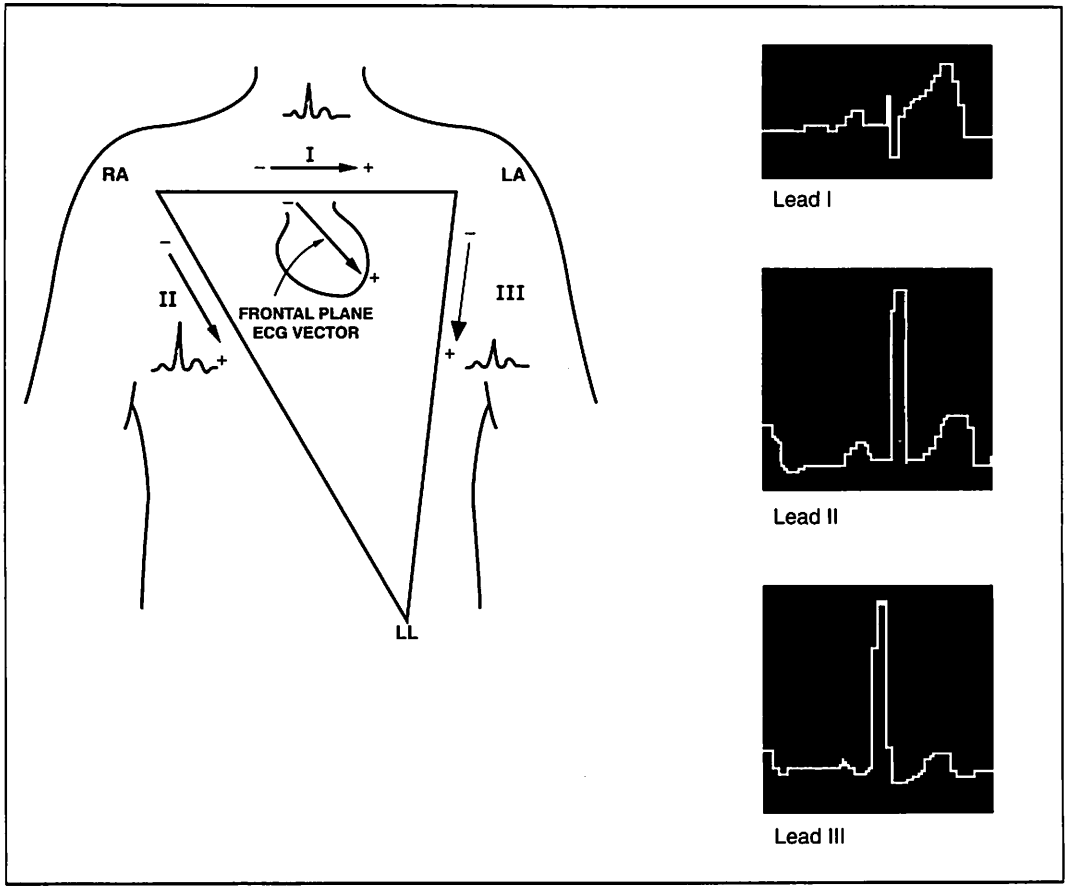


Figure 2-6. ECG lead selection

Where you place the electrodes and which lead you select with the LEAD button determines how the ECG waveform will look on the Propaq.

Using the Propaq With Pacemaker Patients

WARNING

Pacemaker signals can differ from one pacemaker to the next. The Association for Advancement of Medical Instrumentation (USA) cautions that "in some devices, rate meters may continue to count the pacemaker rate during occurrences of cardiac arrest or some arrhythmias. Do not rely entirely upon rate meter alarms. All pacemaker patients should be kept under close or constant observation."

If the patient being monitored has a pacemaker, the Propaq detects and can indicate the occurrence of pacemaker signals. With the Propaq, pacemaker signals are not counted as heart beats as long as the pacemaker signal meets the pulse amplitude, pulse width, and overshoot/undershoot specifications listed in the Specifications of Appendix B.

On the Propaq display, vertical dashed lines indicate each time a pacemaker signal is detected when the Propaq PACER function is turned on. The pacer "spike" is also displayed. Whether the pacer is atrial, ventricular, or both, the indicator and the spike appear as shown in Figure 2-7 on page 2-15. If the PACER function is turned off, only the pacemaker spike is displayed.

Noise on the ECG signal may be detected as pacer signals, causing the pacer indicator to appear on the display. If you don't need to indicate pacemaker signals, you may want to turn off the PACER function for a better display of the ECG waveform.

note...

Regardless of whether the pacer indicator is enabled or not, the ECG data processing algorithm strips a brief interval out of the ECG data stream prior to looking for a QRS complex. Hence, the presence of much pacer-like noise can cause the displayed heart rate to be erratic even though the ECG trace may look clean with the pacer indicator off. Fix the noise issue by using fresh ECG electrodes and an ECG cable whose lead wires make good connections. Avoid locating the Propaq or its ECG cable near electrocautery or dialysis machines which produce large amounts of noise.

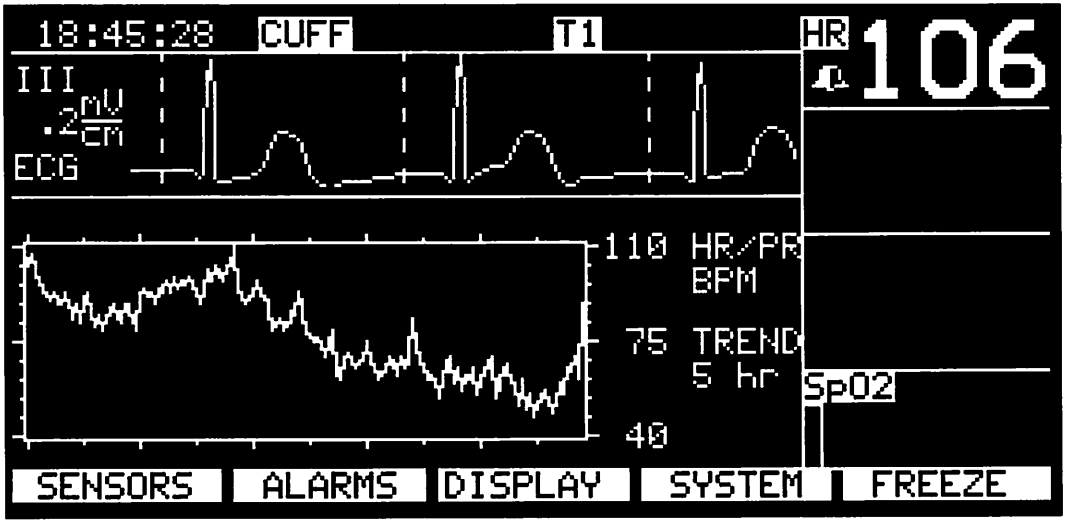


Figure 2-7. Pacer indicator

The pacer indicator (when turned on) indicates pacer signals with a dashed line. When the pacer indicator is turned off, just the pacer signal is shown.

To Turn On and Off the Pacemaker Indicator. To turn on or off the pacemaker indicator, you press the PACER button in the ECG Menu. The status of PACER is shown in the ECG status window above the menu. When PACER is OFF, pacemaker indicators do not appear on the display. When PACER is ON, pacemaker indicators are shown on the display as dashed lines. Pacemaker spikes are always shown on the display if they are detected.

Using the Filter to Better Display a Waveform

Within the hospital, the ac mains emit electrical signals from many sources, including lights, ac power cords, electrical equipment, and other devices that use the mains for power. Any electrically sensitive medical device might pick up these signals, just as a TV antenna picks up television signals. Unfortunately, this signal is unwanted in such devices since it can affect the display of important information like the ECG signal. Therefore, the Propaq includes a FILTER that reduces the noise from the mains signal, producing a much clearer ECG waveform. Figure 2-8 on page 2-18 shows ECG waveforms with the filter turned on and off.

You can turn off or on this filter using the FILTER function in the system status window, which is displayed with the third System Menu: press SYSTEM, then MORE, and then MORE again to display the third System Menu and the status window. You change the filter setting by selecting the filter function with the NEXT button and then pressing the CHANGE button.

With FILTER turned OFF, mains noise may show up on the display as shown in Figure 2-8 on page 2-18. With FILTER turned ON, this noise is reduced.

When setting the filter, you should set it to the ac mains frequency of your hospital. This is typically 60 Hz in North America. European countries, Australia, and countries in South America typically use 50 Hz; the filter should be set to that frequency.

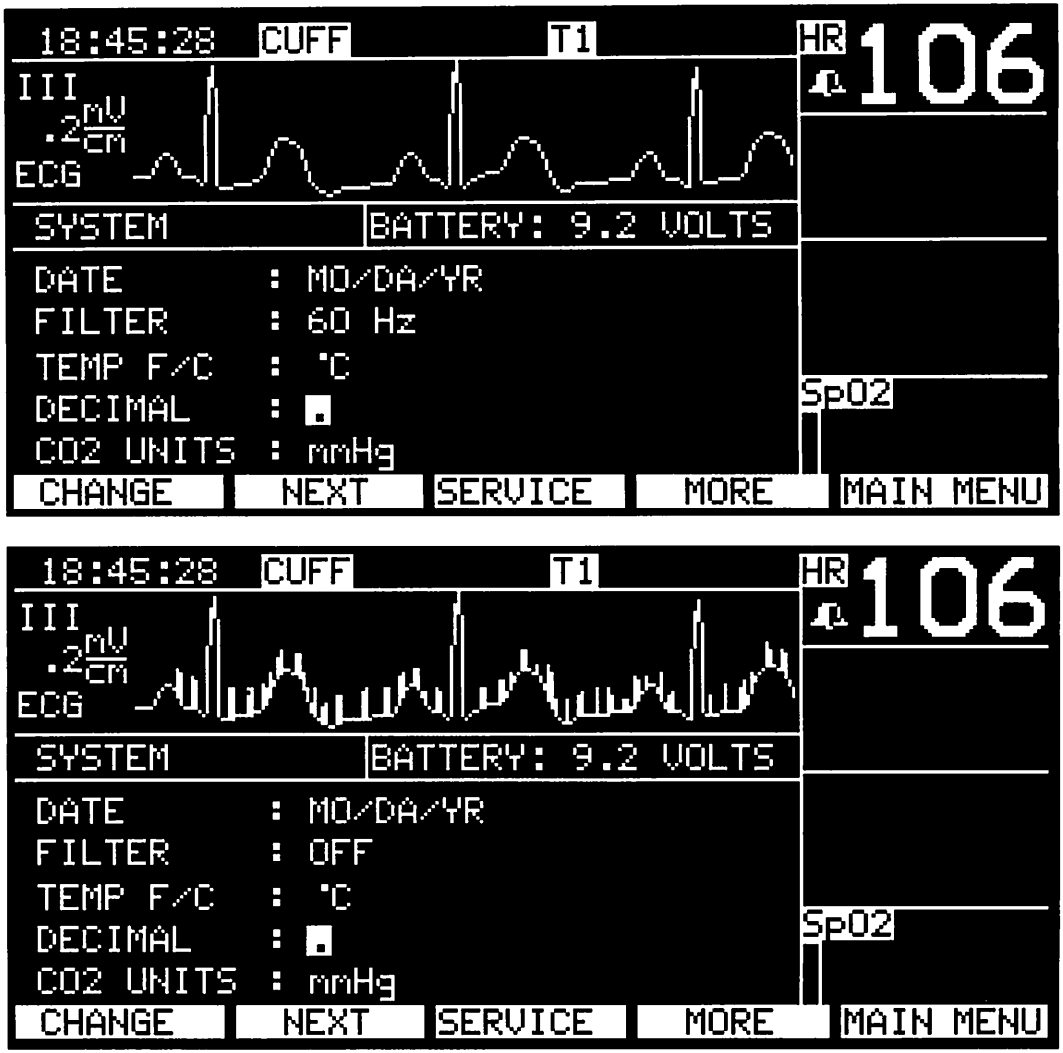


Figure 2-8. ECG waveform filter

Differences in ECG waveform with filter on and set to 60 Hz (top) and off (bottom)

Printing the ECG Waveform

You can print the ECG waveform by pressing either the SNAPSHOT or START/STOP button on the printer when the ECG waveform is displayed on the monitor. ECG is printed on a grid with major divisions (dotted lines) every 5 mm and minor divisions (single dots) every 1 mm (see Figure 2-9). If only ECG is monitored, the ECG waveform is printed by itself; it occupies the entire height of the printer paper. If one or two other waveforms are displayed on the monitor, all waveforms are printed, but only the ECG waveform is printed with 1 mm minor divisions.

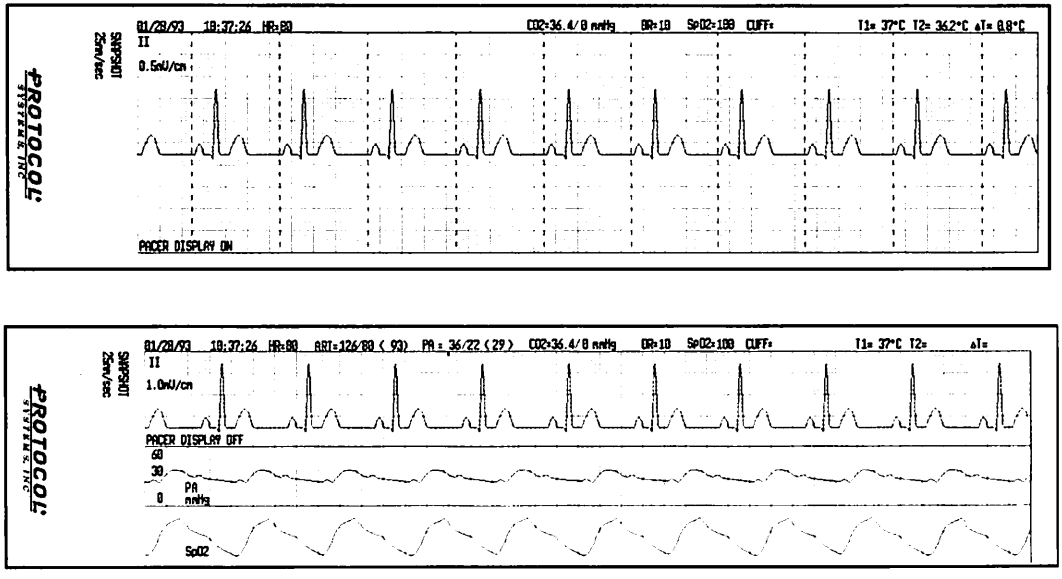


Figure 2-9. ECG waveform printouts

The ECG is always printed if ECG is monitored. Other waveforms are printed if they are displayed.

ECG Messages

ECG messages indicate lead fault for one or more leads. All lead faults initiate an equipment alert, causing the alarm tone to sound for one second at five-second intervals. An equipment alert window also appears indicating which lead or leads are faulty as shown in Figure 2-10. See **Equipment Alerts: Definitions and Indications** on page 3-15 for more information on equipment alerts and how to respond to them.

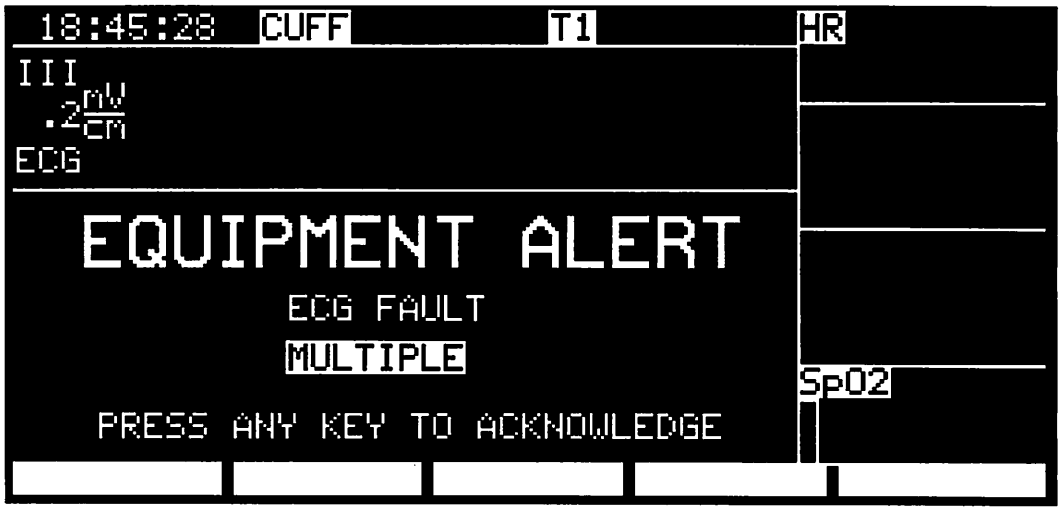


Figure 2-10. ECG Equipment Alert

The ECG alert window indicates lead faults. Both multiple and single lead faults can be identified.

Invasive Pressure

This section applies only to Propaq Models 104, 104EL, 106, and 106EL. If you don't have one of these models, you can skip this section of Chapter 2.

Intended Use

The Propaq invasive pressure channel is intended for measuring arterial, venous, and intracranial pressures using invasive transducers with 5 μV/V/mmHg sensitivity. The Propaq can be used with many types of transducers, including non-disposable, disposable dome, and fully disposable.

Use only recommended transducers listed in Table 2-1 on page 2-23.

The Propaq's invasive pressure range is from -30 to 300 mmHg, allowing you to use the Propaq for measuring arterial pressure, pulmonary artery pressure, central venous pressure, intracranial pressure, etc.

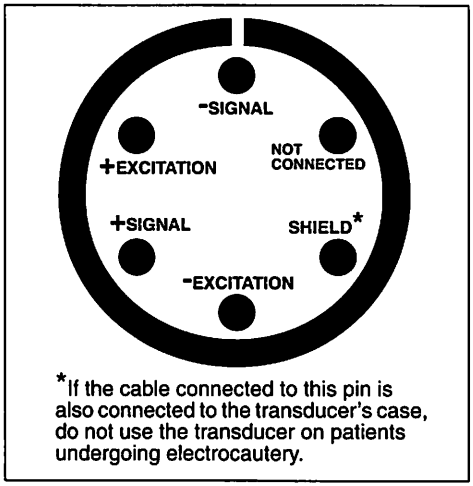
Invasive Pressure Connectors and Transducers

The standard invasive pressure connector is a 6-pin connector compatible with the ITT®-Cannon® plug MS3106F-14S-6P (Figure 2-11). See the Propaq Options section for information on the Hewlett-Packard compatible connector. The invasive pressure channels require transducers with 5 μV/V/mmHg sensitivity.

WARNING

If electrocautery is going to be applied, always avoid using any transducer with a conductive (metal) case that is electrically connected to its cable shield. Using a conductive transducer case with such a shield connection risks high-frequency burns at the ECG electrodes if the transducer case becomes earth grounded.

Table 2-1 lists recommended transducers to be used with the Propaq. Transducers must be used according to your hospital's protocols and the transducer manufacturer's recommendations. Always refer to the transducer manufacturer's *Directions for Use* before using the transducer.



Side Panel View

Figure 2-11. Invasive Pressure connector pinout

The standard invasive pressure connector has a 6-pin configuration.

Table 2-1: Approved Invasive Pressures Transducers for Standard Propaq [a]

Manufacturer	Transducer	Cable #
Abbott Critical Care Salt Lake City, UT (800) 222-6883 (708) 937-1760	Disposable Transpac II Disposable Transpac III	42574-04-04 42661-04-27
Concord-Porter (Telos) Keene, NH (800) 258-5361 (603) 352-3812	Reusable R0001 Disposable T6000 Disposable T6003	R1014 T65-1014 T65-1014
COBE Laboratories, Inc. Lakewood, CO (800) 525-2623 (303) 232-6800	Disposable CDXIII Disposable CDXpress	041-709-012 041-709-012
Utah Medical Products, Inc. Midvale, UT (800) 533-4984 (801) 566-1200	Disposable Deltran II 6199 (non-sterile) DPT-200 (sterile)	650-208
Viggo-Spectramed, Inc. Oxnard,CA (800) 235-5945 (805) 983-1300	Disposable DTX, DTX+	TC-VTK
Medex, Inc. Hilliard, OH (800) 848-1757 (614) 876-2413	Disposable MX900	MX900-42
Baxter Healthcare Edwards Division Santa Anna, CA (800) 424-3278 (714) 250-2500	Trantec Disposable 53 Series Disposable 43 Series Disposable 33 Series	 892083002 893206001 895083001

[a] Approved pressure transducers for the Hewlett-Packard Connector-Compatible side panel option are listed in Chapter 6.

note...

The HP1290C option J01 transducer is not compatible with the standard Propaq even though it can physically plug into the Propaq's standard side panel. Use a compatible transducer.

Preparation

Preparing for invasive pressure monitoring with the Propaq requires you to prepare the transducer, zero the transducer, set up the pressure channel, and set the invasive pressure alarm limits. Figure 2-13 on page 2-26 illustrates an invasive pressure channel preparation setup. Follow your hospital's protocols for your application.

1. **Preparing the Transducer.** Inspect the transducer cable for wear, breakage, or fraying. Replace it if the cable shows signs of any of these. Replace the transducer dome if necessary.
2. Apply the transducer according to your hospital's protocols.
3. If the transducer is a disposable unit with separate cable, connect the transducer to the transducer cable. Plug the transducer cable into an invasive pressure connector on the left side panel (Figure 2-12). The message NOT ZEROED (or NO ZERO, depending on the zone) immediately appears in the blood pressure numerics window for the invasive pressure channel being used (Figure 2-14 on page 2-27).

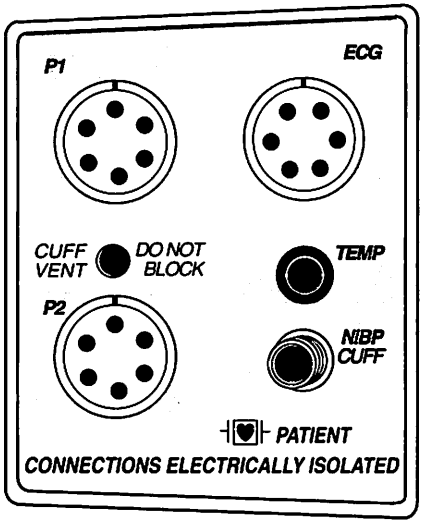


Figure 2-12. Invasive Pressure connectors

The invasive pressure connectors look similar to the ECG connector but are designed to accept only invasive pressure transducer cables.

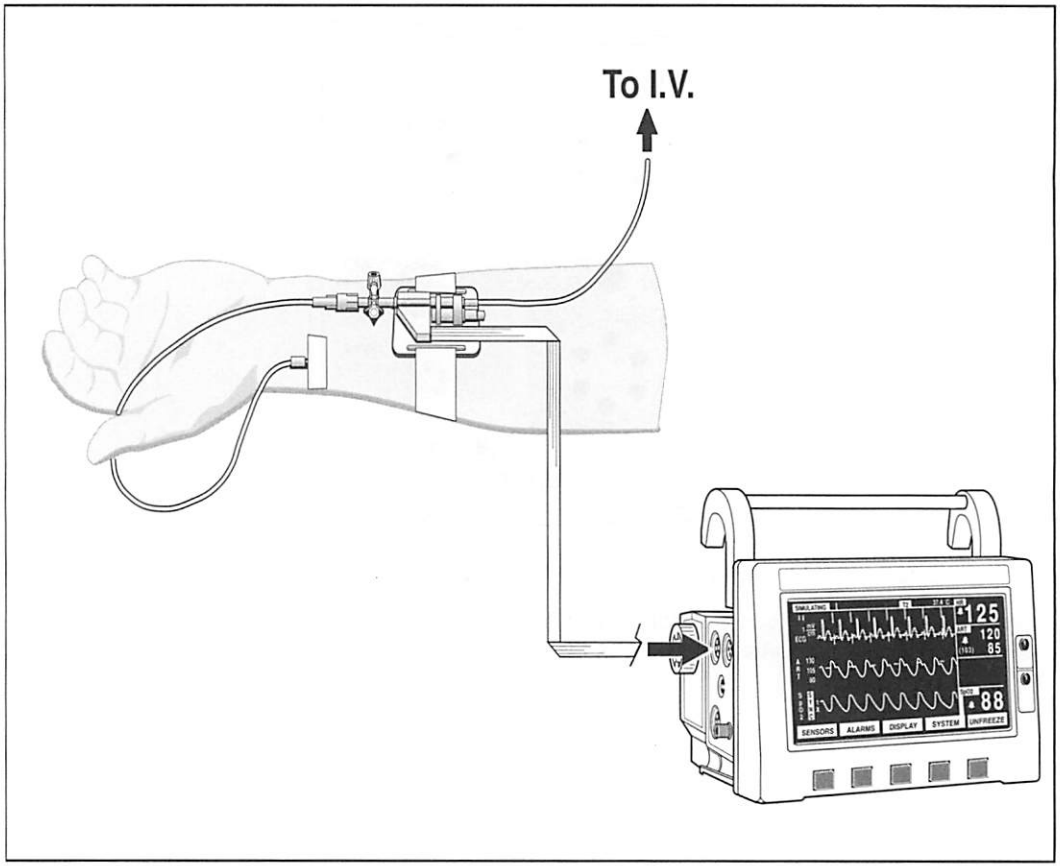


Figure 2-13. Example of invasive transducer

This is a possible application of an invasive pressure transducer. Always refer to the manufacturer's Directions for Use and your hospital's protocols.

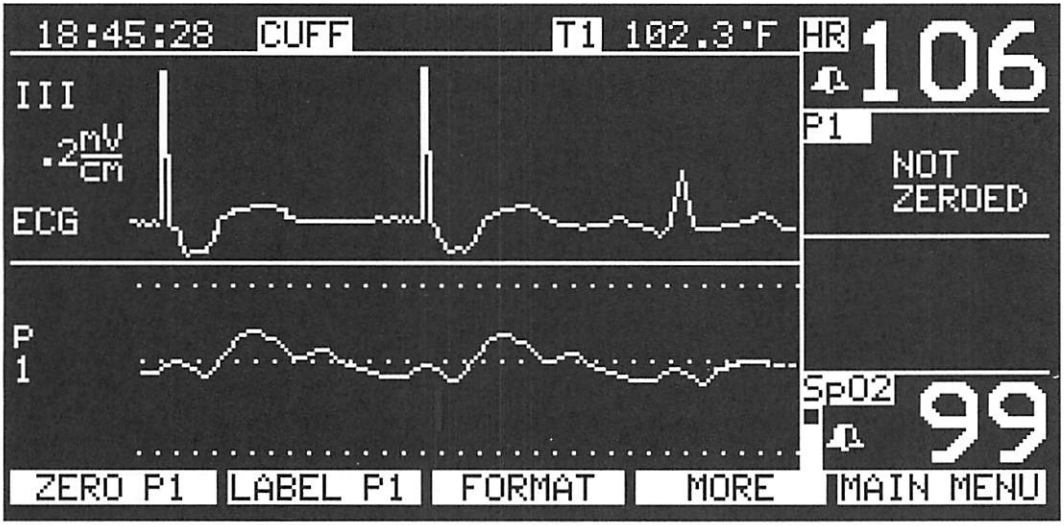


Figure 2-14. Invasive Pressure zeroing

Pressure zeroing is a simple process, and the Propaq lets you know if the transducer needs to be zeroed.

4. **Zeroing the Transducer.** To zero the transducer, open the transducer's stopcock to atmospheric air. Allow a few seconds for the transducer to settle.

5. If the ZERO menu label does not already appear, press the following Propaq buttons if you are using invasive pressure channel 1: SENSORS, then INV PRS, then MORE, and then ZERO P1. If you are using pressure channel 2 (106 only), press the following buttons: SENSORS, then INV PRS, then MORE, and then ZERO P2. The word ZEROING appears in the numerics window during zeroing.

6. Wait for a tone to briefly sound and the word ZEROED to appear in the blood pressure numerics window.

7. Close the transducer's stopcock.

8 If the transducer will not zero, the words ZERO REJECTED (or NO ZERO, depending on zone) will appear in the numerics window. Check that the transducer is open to atmospheric air and that it is properly connected to the Propaq. (The Propaq will not allow zeroing to occur if the pressure waveform is pulsatile.) Then press CANCEL and try zeroing again. If the transducer still does not zero, you should try another transducer or another cable. For more information about zeroing, read **Important Information About Transducer Zeroing** on page 2-29. Once the channel is zeroed, the pressure scale appears next to the waveform.

9 **Setting up the Pressure Channel.** Press SENSORS and then INV PRS to set the invasive pressure channel functions: LABEL, FORMAT, RANGE, and RESCALE. See **How Invasive Pressure is Displayed** on page 2-32 for more information on these functions.

10 **Setting the Invasive Pressure Alarms.** Set the alarm limits according to your hospital's protocols. See Chapter 3 for information on setting alarm limits.

Important Information About Transducer Zeroing

During zeroing, two important things are displayed: the ZERO P1 (or ZERO P2) button label changes to CANCEL to allow you to cancel the zeroing process if necessary, and zeroing messages appear in the blood pressure numerics window.

If the zero value is accepted, the word ZEROED appears in the blood pressure numerics window for a few seconds. The monitor then displays the pressure scale to the left of the waveform, and the pressure numerics appear. No pressure scale is displayed until the Propaq can establish a zero reference.

If the zero value is unacceptable, ZERO REJECTED (or NO ZERO, depending on zone) appears in the pressure numerics window. This message remains until you press the CANCEL button. The pressure values and the scales are not displayed. They won't be displayed until an acceptable zero reference is established. If the transducer does not zero, check that the transducer is opened to atmospheric air and that it is properly connected to the Propaq. Then try zeroing again. Be sure you close the transducer's stopcock after zeroing. If you cannot zero the transducer, there might be a problem with the transducer or cable. You should try another transducer or cable.

Rezeroing a Transducer

You can rezero a transducer at any time. If the transducer has already produced pressure readings, rezeroing provides a new zero reference for the Propaq. To rezero, follow these steps:

1. Open the transducer stopcock to atmospheric air.
2. Press SENSORS, then INV PRS, then MORE, and then ZERO P1 (for pressure channel 2, press MORE again and then ZERO P2).

If the zero value is not accepted, the words ZERO REJECTED (or NO ZERO, depending on zone) appear in the numerics window until you press the CANCEL button. The Propaq continues to use the previous zero reference and displays the pressure values and waveforms based on that value.

If the new zero value is accepted, the word ZEROED appears for a few seconds and a tone briefly sounds. After the zero message is removed, the new pressure values based on the new zero value are displayed, and the waveform is adjusted according to the new scale.

CAUTION

If the ZERO key (either P1 or P2) is pressed after an invasive pressure channel has been successfully zeroed and is currently monitoring a pressure waveform, the message ZERO REJECTED will display in the invasive pressure numerics window. This message will preempt the valid invasive pressure numerics that were displayed in this zone prior to the unintentional ZERO key press and will continue to preempt the numerics until the CANCEL key in the Invasive Pressure Menu is pressed.

In addition, if the invasive pressure channel enters an alarm condition while the ZERO REJECTED message is overriding the invasive pressure numerics, no invasive pressure numerics will flash between inverse and normal to identify which patient channel is in alarm.

To remove the displayed message ZERO REJECTED and to restore the invasive pressure numerics during an invasive pressure alarm, you must return to the invasive pressure menu and press the CANCEL key. This will restore the invasive pressure numerics. The sequence of key presses required to access the invasive pressure CANCEL key will depend on the last menu that you were in before the alarm occurred. Examples of corrective paths to the invasive pressure CANCEL key are listed in Table 2-2.

Table 2-2: Cancelling the Zero Rejected Message

Previous Menu	Hidden Channel	Corrective Path
INV PRS 1	P1	SUSPEND > CANCEL
INV PRS Range	P1	SUSPEND > MORE > CANCEL
INV PRS 2	P1	SUSPEND > MORE > MORE > CANCEL
MAIN	P1	SUSPEND > SENSORS > INV PRS > MORE > MORE > CANCEL
INV PRS 2	P2	SUSPEND > CANCEL
INV PRS 1	P2	SUSPEND > MORE > CANCEL
INV PRS Range	P2	SUSPEND > MORE > MORE > CANCEL
MAIN	P2	SUSPEND > SENSORS > INV PRS > MORE > MORE > CANCEL

How Invasive Pressure is Displayed

From the invasive pressure signal, the Propaq displays both a pressure waveform and pressure numeric values (systolic, diastolic, and mean). The waveform is displayed in a waveform window (if the waveform is turned on in the wave select window). The numerics are displayed in the blood pressure numerics windows.

Along with the numerics, the Propaq allows you to identify the pressure measurement with a selectable label, and the numerics can be displayed in different formats.

Waveforms are displayed against selectable scales. You can independently display each waveform against its own scale that is automatically selected for best viewing of the waveform (RESCALE), or you can display both waveforms against one scale, which you can manually select (RANGE).

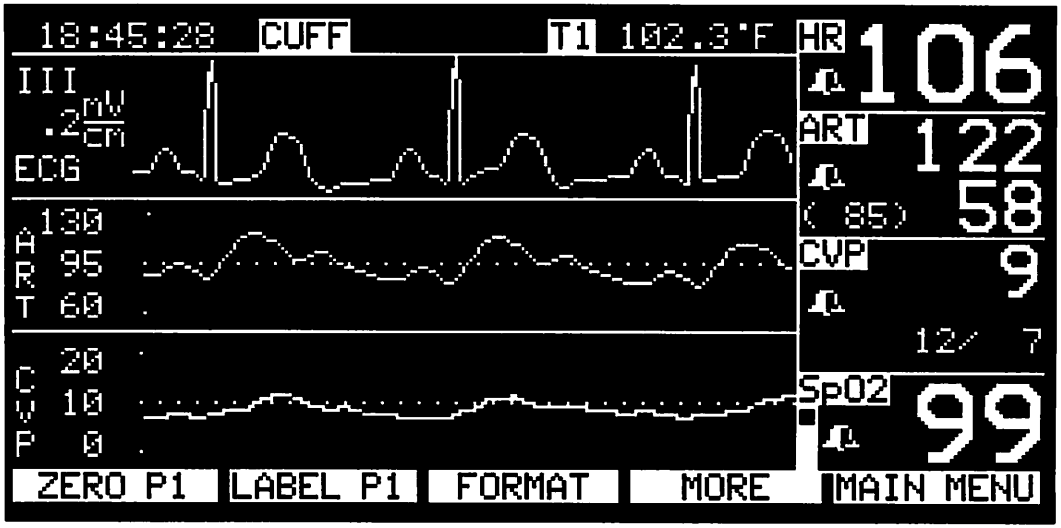


Figure 2-15. Invasive Pressure display

This 106 EL display shows a possible pressure monitoring display.

Channel Labels (LABEL Button). The Propaq allows you to select a pressure channel label so you can clearly identify the pressure measurement, such as arterial, pulmonary artery, or central venous pressure. The label appears in the blood pressure numerics window of the appropriate channel as shown in Figure 2-16.

The Propaq provides several labels to choose from. You select the label by pressing the LABEL button in the Invasive Pressure Menu. The selectable labels are:

- ART—arterial
- PA—pulmonary artery
- CVP—central venous pressure
- ICP—intracranial pressure

You can still use the generic Propaq pressure label, P1 or P2, if you want. Just don't press the LABEL button after zeroing the transducer. If you press the LABEL button and get a label you didn't want, simply keep pressing the button until the desired label is displayed in the numerics window.

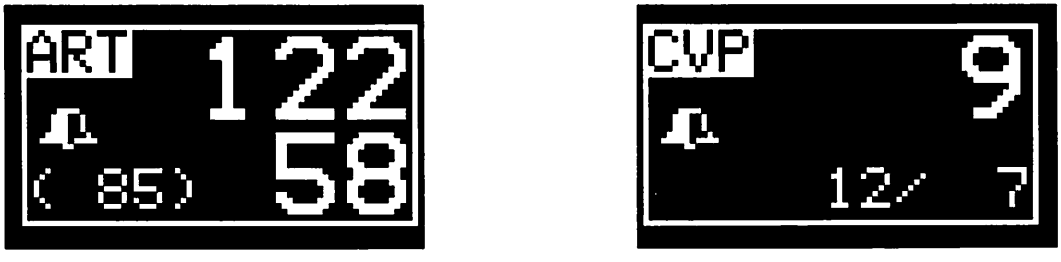


Figure 2-16. Labeling Invasive Pressure numerics

Invasive pressure numerics can be easily identified by labeling them according to the pressure source. Use the LABEL button.

Numerics Formats (FORMAT Button). For some pressure measurements, such as arterial and pulmonary artery, the systolic and diastolic values are of prime importance. You want to clearly see these as they change. For other pressures, such as intra-cranial and central venous pressures, the mean pressure value may be the focus of attention.

The Propaq displays the invasive pressure values in two different sizes in the pressure numerics window, allowing you to select one of two formats in which you want the numerics displayed. When you label a pressure channel, the numerics are automatically displayed in the standard format for that particular label. However, by pressing the FORMAT button, you can select the alternate format. Thus, you can select which pressure value(s) are most prominently displayed. Figure 2-17 shows these formats.

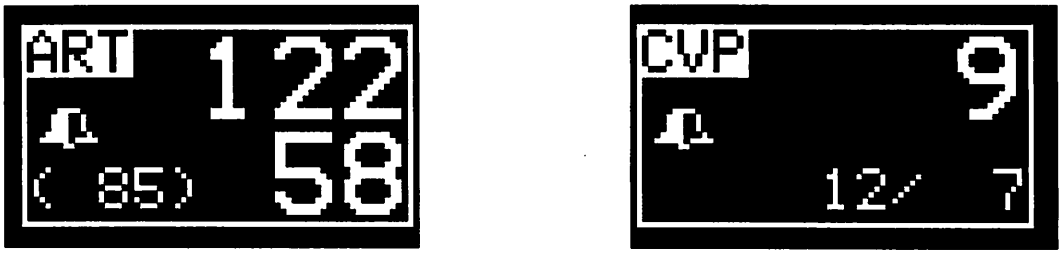


Figure 2-17. Formatting Invasive Pressure numerics

Depending on the type of invasive pressure you are monitoring, you can format the invasive pressure numeric display with either the systolic and diastolic larger than the mean, or the mean as the largest numeric. Use the FORMAT button.

Waveform Scales (RANGE and RESCALE Buttons). Until you zero the transducer, the pressure waveform scales are not displayed. Once the zero reference has been established the scales automatically appear. Waveforms are displayed either together against one scale or independently against their own scales. Figure 2-18 on page 2-36 illustrates these displays.

For some procedures, you will want to display the waveform against one of the five Propaq pressure scales. You can display the waveform this way by pressing the RANGE button. With the Propaq 106, the RANGE button displays both pressure waveforms against this one scale. You can then see each waveform relative to the other. If the waveforms are displayed against independent scales (using the RESCALE button), the first time you press the RANGE button, the Propaq will change the display so both waveforms are against the same scale. You can then change the scale by pressing the RANGE button until the desired scale appears.

If two waveforms have a great difference in their pressures (such as arterial and pulmonary artery) and you set the pressure scale so the lower pressure waveform is large, the higher pressure waveform may not be visible since it is out of the range of the scale. To see both waveforms again, simply press the RANGE button until you get the desired scale.

For some procedures, you may want to see the largest possible view of a waveform without causing the waveform to be out of range of the scale. You can display the waveform this way by pressing the RESCALE button. Each time you press the RESCALE button, the Propaq examines the highest and lowest pressure levels of each pressure waveform and selects the best scale for viewing each waveform. If the pressure levels change and part or all of a waveform goes out of range of its scale, simply press RESCALE again to readjust the waveform scales.

On the Propaq 106, rescaling is especially helpful when you want to see the fine details of two pressure waveforms when one represents a much lower pressure than the other. Both scales are adjusted each time you press RESCALE.

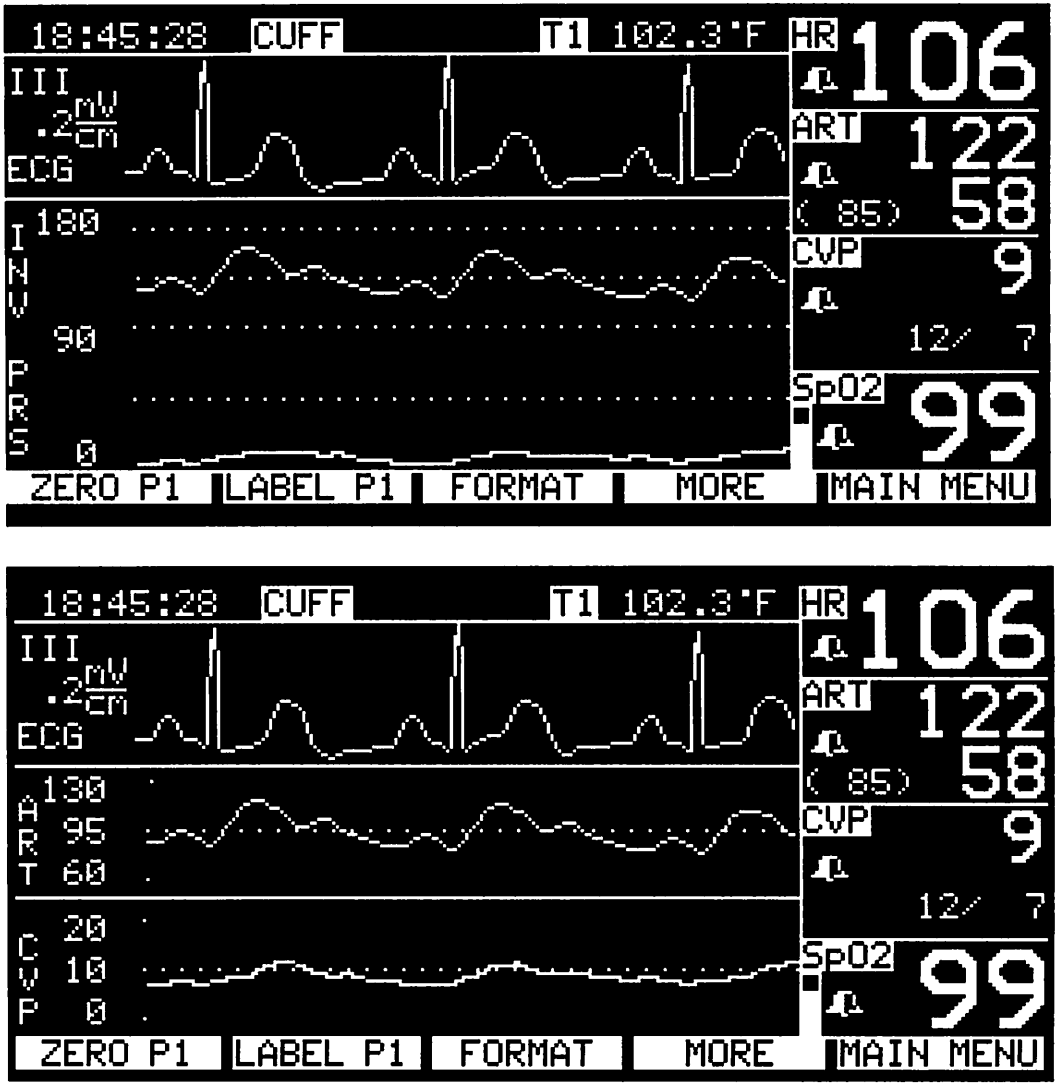


Figure 2-18. Invasive pressure range (top) and rescale (bottom) displays

Printing a Pressure Waveform

You can print the pressure waveform(s) by pressing either the SNAPSHOT or START/STOP button on the printer when the waveform(s) are displayed on the monitor. Pressure waveform(s) are printed on a grid with major divisions (vertical dotted lines) every 5 mm, and the pressure scale grids are printed horizontally (see Figure 2-19). If only invasive pressure is monitored, the waveform(s) are printed by themselves across the paper.

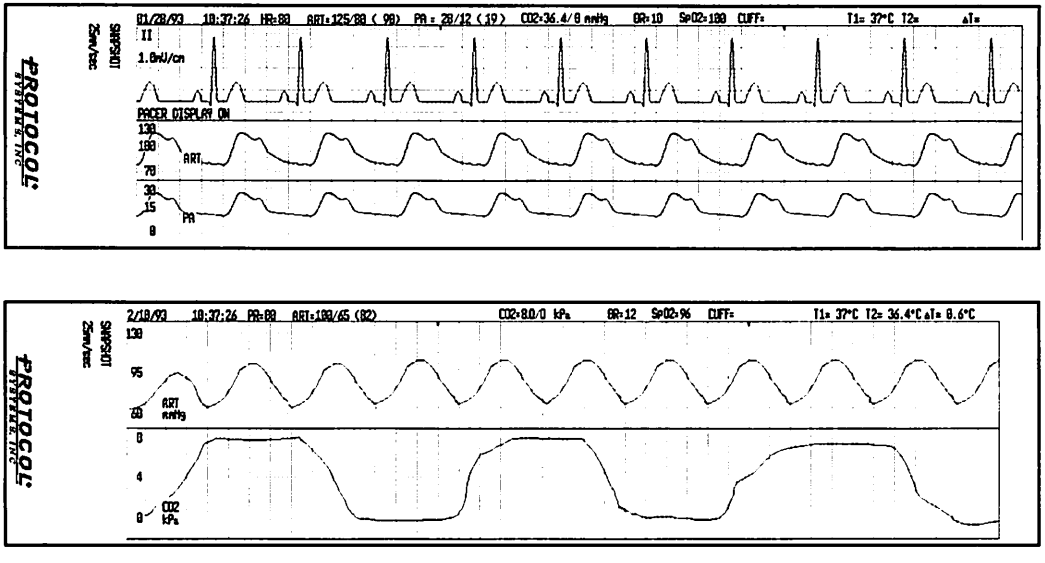


Figure 2-19. Invasive Pressure printouts

These two printouts show invasive pressure printed with ECG (top) and an invasive pressure printed with CO_2 (bottom).

Invasive Pressure Messages

The invasive pressure channel can produce messages that appear in the numerics window, the time of day window, and the equipment alarm window.

The following messages can appear in the numerics window. Each message is described below. (Px in the message represents the pressure label for the channel, such as ART, PA, P1, etc. The message can be for P1 or P2.)

NOT ZEROED (or NO ZERO). This message appears the first time a transducer is connected to the monitor. It indicates that no zero reference has been established. The monitor displays the pressure waveform, but to protect against erroneous readings, the pressure waveform scale is not displayed. To remove this message, zero the transducer.

ZEROING. This message briefly appears as the transducer is being zeroed.

ZEROED. This message appears after the zero value has been accepted. It remains for eight seconds and is replaced by the current pressure values. After zero acceptance, the pressure waveform scale appears.

ZERO REJECTED (or NO ZERO). This message appears after unsuccessfully attempting to acquire a zero reference value. The message remains until the CANCEL button is pressed. Check that the transducer stopcock is opened during zeroing, and check the transducers. Try rezeroing again, or try another transducer.

CANCELED. This message appears after the CANCEL button is pressed and remains for eight seconds.

The following equipment messages can appear in an equipment alert window (Figure 2-20 on page 2-40).

TRANSDUCER NOT DETECTED. This message appears when the Propaq detects that a transducer connection is broken. The transducer connections and the transducer should be checked.

TRANSDUCER SHORT CIRCUIT. This message appears when the Propaq senses a short in the transducer. The transducer should be replaced.

INCOMPATIBLE TRANSDUCER. This message appears when an incompatible transducer has been plugged into the Propaq. Specifically, it means that an HP1290A or other 40 μV/V/mmHg transducer is plugged into the HP connector-option side panel. Check the list of compatible transducers (Table 2-1 on page 2-23 and Table 6-1 on page 6-5) to ensure you are using a compatible transducer.

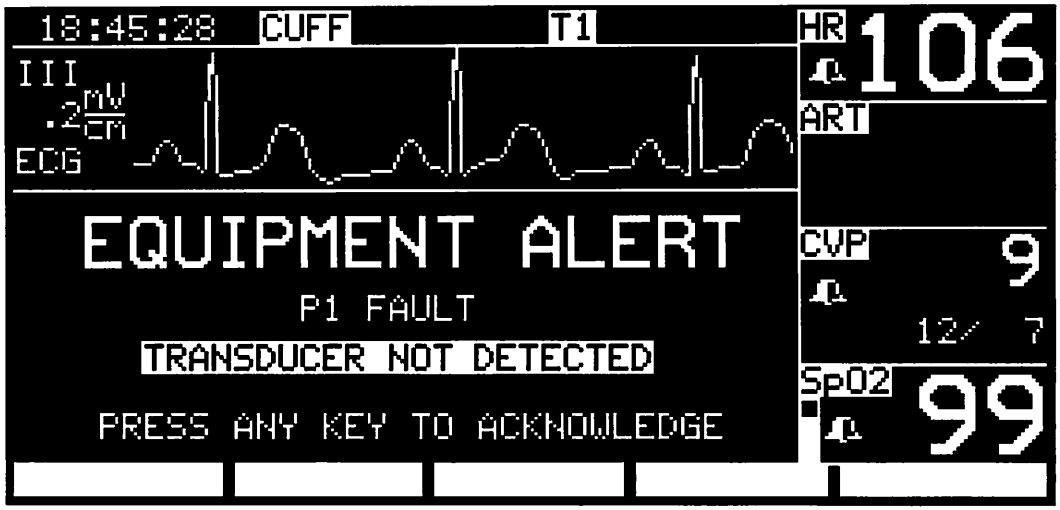


Figure 2-20. Invasive Pressure Equipment Alert

This EL display shows a possible invasive pressure equipment alert message window.

Cuff

Intended Use

The Propaq noninvasive blood pressure channel (NIBP or cuff) measures arterial pressures using an inflatable cuff. If ECG is also monitored, the Propaq synchronizes the cuff measurement process to the occurrences of the R-wave, increasing accuracy in cases of extreme artifact. Although it is not necessary for accurate cuff measurements, it is recommended that you monitor ECG when you use the cuff on patients exhibiting high artifact, diminished pulses, or some dysrhythmias.

WARNING

The Propaq should never be used to monitor NIBP on one patient while simultaneously monitoring ECG on another patient.

The Propaq is intended for use only on pediatric and adult patients with a limb circumference of at least 18 cm for the limb on which the cuff is to be placed. The Propaq is not intended for use on neonate patients or any patient with a limb circumference less than 18 cm.

WARNING

Propaq cuff pressure levels and inflation rates could injure neonates. Do not use on neonates.

Blood pressure measurements determined with the Propaq are equivalent to those obtained by a trained observer using the cuff/stethoscope auscultation method, within the limits prescribed by the American National Standard for Electronic or Automated Sphygmomanometers (United States of America).

WARNING

If a noninvasive blood pressure measurement is suspect, repeat the measurement. If you are still uncertain about the reading, use another method.

When auscultating to verify diastolic pressures, you should use the fifth phase of the Korotkoff sounds (that is, the point when the sound is no longer audible).

WARNING

Do not attempt to take cuff pressures on patients during cardiopulmonary bypass.

Typical cuff measurements are completed within 30 seconds using the Propaq. If the Propaq cannot take a valid cuff measurement within two minutes (longer when using the thigh cuff to allow ample time for inflation), it automatically deflates. However, as with any measurement device that impairs circulation, the patient's limb should be periodically observed to ensure that the circulation is not impaired for a prolonged period of time. The Propaq automatically deflates the cuff if cuff pressure exceeds 260 mmHg for any reason. A safety valve exists in the system to ensure that cuff pressure never exceeds 330 mmHg, even if the normal deflation valve fails.

The Propaq uses the oscillometric method to determine blood pressure. Oscillometry directly detects mean arterial pressure values by (1) occluding a limb artery in stages and (2) monitoring small changes in the cuff's pressure caused by blood pulsing against the cuff pressure. The systolic and diastolic pressures are calculated from the mean pressure based on a patented, proprietary calculation determined by extensive research.

As with any manual or automatic auscultatory or oscillometric pressure measurement technique, the following can adversely affect accurate measurement determination:

- ❑ patients exhibiting cardiac arrhythmias, sudden changes in blood pressure, convulsions, shivering, or other body motion,
- ❑ hospital personnel or other non-stationary objects in contact with the cuff (changes in pressure caused by an object bumping against the cuff can result in erroneous or abortive readings).

Cuff Connector and Cuffs

The Propaq uses a single-hose cuff available from Protocol Systems in several sizes for different applications. The cuff is easily connected and disconnected from the screw-on connector (Figure 2-21 on page 2-44). Only cuffs recommended or supplied by Protocol Systems should be used. Cuff sizes are listed in Table 2-3 on page 2-46

The cuff vent allows air to be pumped into the cuff during inflation and vented to the room during deflation. The vent should always remain free from obstructions.

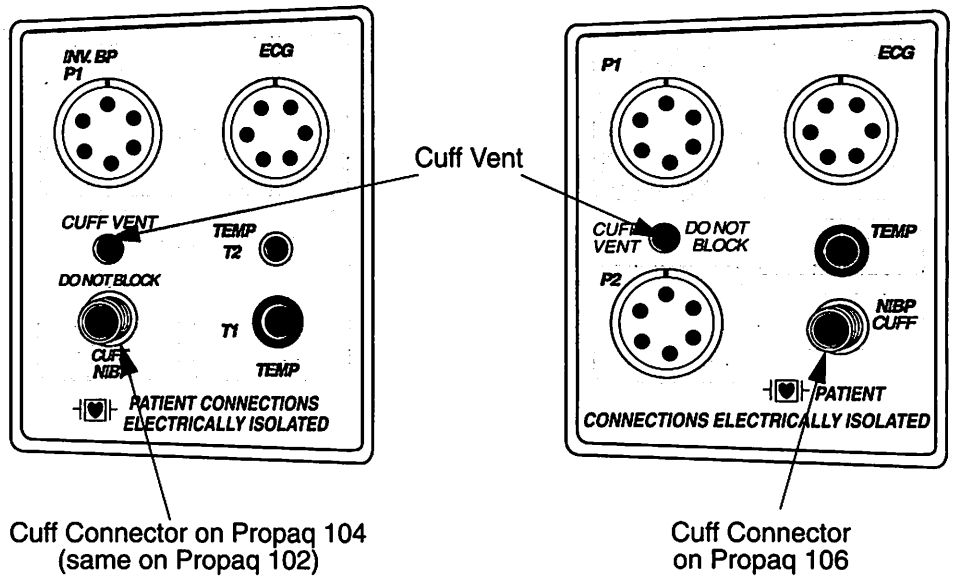


Figure 2-21. The Cuff connector

The Propaq uses a single cuff hose and several different cuff sizes. The cuff vent should never be blocked.

Preparation

You can set up the Propaq to take measurements manually (MANUAL), automatically at periodic intervals from one minute to 60 minutes (AUTO), or consecutively for a period of five minutes (TURBOCUF).

note...

When setting up the cuff channel, be sure that the cuff vent next to the cuff connector on the Propaq side panel is not obstructed. Obstructing this vent will prevent cuff measurements from occurring.

Setting up for noninvasive blood pressure monitoring requires three steps: place the cuff on the patient and connect the cuff to the monitor, set up the cuff channel, and set the cuff alarm limits.

Placing the Cuff. Select the proper size of cuff based on the limb circumference (see Table 2-3 on page 2-46). You can use an arm or thigh for noninvasive blood pressure measurements. Several different cuff sizes are available for taking measurements on limbs of differing sizes. An adult sized cuff for use on an arm is included with the Propaq at the time of purchase. However, other sizes are available from Protocol Systems. See the *Products and Accessories* book for information on ordering cuffs.

1 Squeeze as much air from the cuff as you can before placing it on the patient.

Table 2-3: Cuff Sizes

Limb Circumference	Cuff Type
18 to 26 cm	Small Adult/Child
25 to 35 cm	Standard Adult
33 to 47 cm	Large Adult
46 to 66 cm	Thigh

2 Place the cuff on the limb. If you are placing the cuff on an arm, it should be placed at the same level as the heart (see Figure 2-22 on page 2-47). Add 1.9 mmHg to the cuff measurement for every inch the cuff is above the heart level. If you are placing the cuff on a thigh, subtract 1.9 mmHg from the measurement for every inch the cuff is placed below the heart level. (If the cuff is on an arm and below heart level, you should also subtract 1.9 mmHg for every inch the cuff is below the heart level.) The cuff should fit snugly, but not be uncomfortable. The hose must not be kinked or pinched.

3 Screw the hose connector, finger tight, onto the cuff connector on the monitor's left side.

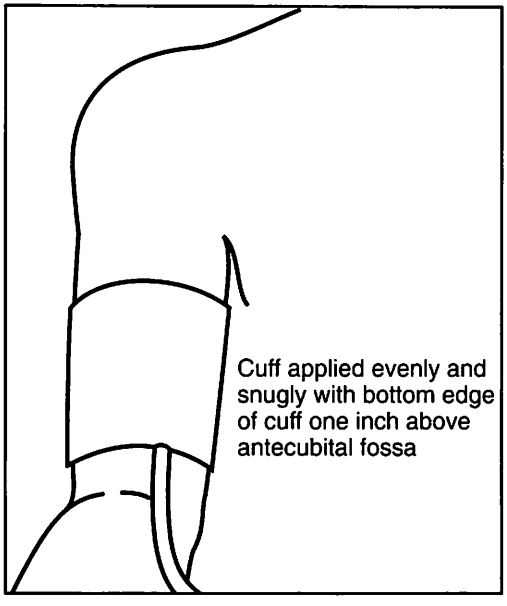


Figure 2-22. Cuff placement

Properly placing the cuff on the patient enables the Propaq to accurately provide cuff measurements.

4 **Setting Up the Cuff Channel.** Press SENSORS and then CUFF to set the cuff functions. Table 2-4 on page 2-48 lists the Cuff Menu buttons and their functions. Figure 2-23 on page 2-49 shows the cuff status window and the Cuff Menu. The cuff status window lets you view the progress of the cuff measurement as it is taken.

Table 2-4: Cuff Menu Functions

Button	Function
START/CANCEL	Starts a blood pressure measurement, whether or not the Propaq is set to automatically take measurements. When you press START, the button label changes to CANCEL so you can cancel the measurement, if desired.
MANUAL	Turns off automatic interval measurements. The INTERVAL label changes to AUTO.
AUTO/ INTERVAL	Sets the Propaq to automatically initiate a noninvasive pressure measurement at intervals from one minute to 60 minutes. When you press AUTO, the button label changes to INTERVAL, and the first interval is shown on the display next to the word "TIME". Press the INTERVAL button to change the interval until the desired value is displayed. Any time the Propaq is taking a noninvasive pressure measurement, the START button changes to CANCEL so you can stop the measurement in progress. For more information about automatic measurements, see **Important Information About Automatic Measurements** on page 2-53.
TURBOCUF	Automatically begins taking consecutive noninvasive pressure measurements for five minutes. As soon as one measurement is complete, the next one starts. After five minutes, measurements are stopped. Any measurement can be canceled by pressing the CANCEL button.

Setting the Cuff Alarms. Set the alarm limits according to your hospital's protocols. See Chapter 3 for information on setting alarm limits.

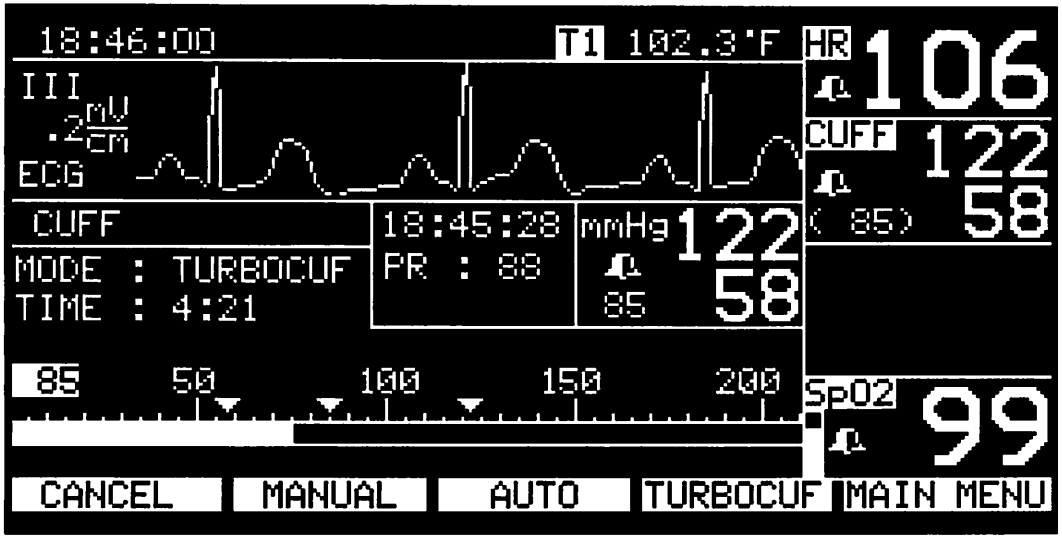


Figure 2-23. Cuff Status Window

The cuff status window shows the current cuff pressure on the manometer bar, the last measurement, the time and pulse rate of the last measurement, and the measurement mode.

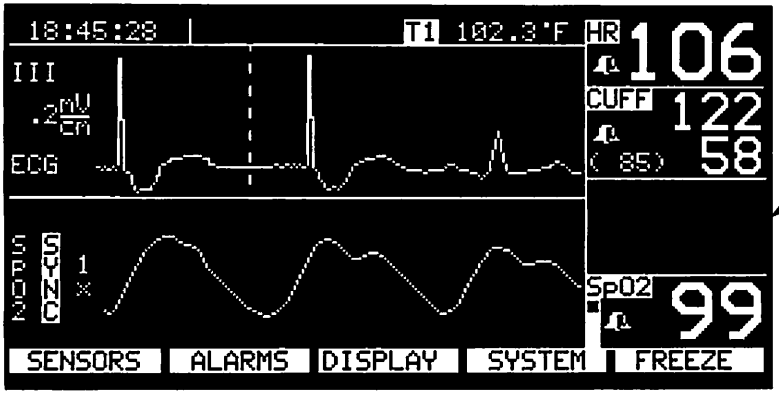
How Cuff is Displayed

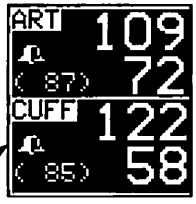
When you press SENSORS and then CUFF, the cuff status window and Cuff Menu appear (see Figure 2-23 on page 2-49). The cuff window displays all the following information:

- ❑ whether the Propaq is set to take measurements automatically, manually, or using TURBOCUF
- ❑ if measurements are taken automatically, the measurement interval next to the word TIME
- ❑ if TURBOCUF is activated, the time remaining to take measurements next to the word TIME
- ❑ the current cuff pressure level with a manometer and a numeric value that changes as the cuff inflates and deflates
- ❑ the last blood pressure readings (systolic, diastolic, and mean values) shown as numerics and indicated above the manometer as small triangles
- ❑ the pulse rate (PR) obtained from the cuff or from the ECG or SpO_2 channel if either is monitored
- ❑ the time the last pressure measurements were taken
- ❑ whether or not alarm limits are set for cuff (the bell symbol)

The cuff status window is displayed until you press MAIN MENU. If you press MAIN MENU during a cuff measurement, the measurement is not canceled.

After a measurement has been determined, if the cuff status window is not displayed, the noninvasive blood pressure values are displayed in a vacant blood pressure numerics window or next to temperature (see Figure 2-24).

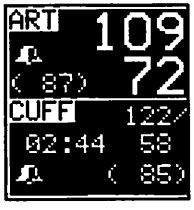




Cuff is displayed in a blood pressure numerics window when one of them is vacant. It is shown in these larger characters for 16 minutes for each new pressure taken.

CUFF 122/ 58 T1

If both blood pressure numerics windows are occupied, the systolic and diastolic values are displayed to the left of the temperature.

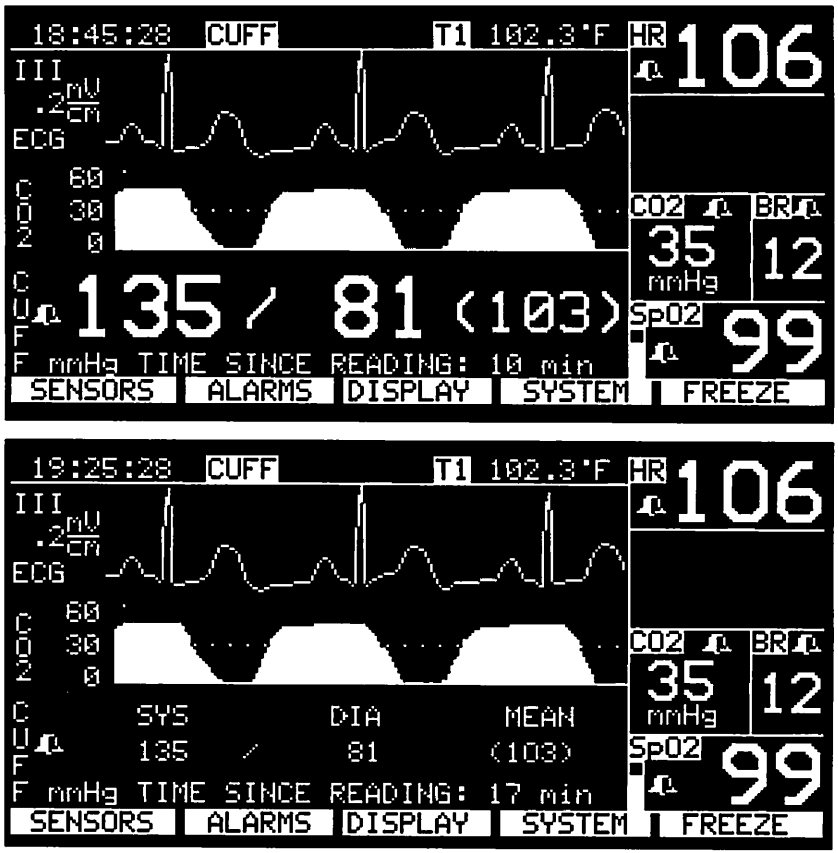


After 16 minutes, the pressure is shown in smaller characters for 44 minutes along with the time of day it was taken. The pressure is displayed for a total of 60 minutes. After that period it is removed.

Figure 2-24. Cuff display formats

Cuff measurements can be displayed in one of many ways for best viewing.

You can display the noninvasive pressure values in a waveform window by turning on CUFF in the wave select window and making sure that, including CUFF, only three windows are activated (see Figure 2-25). Besides CUFF, if more than two other windows are turned on and they are all being monitored, the CUFF numerics will not appear on the display in a waveform window.



By turning on CUFF in the wave select window, the cuff numerics can be displayed in a waveform window.

The numerics are shown in large characters for 16 minutes for each new measurement taken, then they change to the smaller characters for 44 minutes. The numerics are removed after 60 minutes.

Figure 2-25. Cuff measurements displayed in waveform window

If cuff is the only vital sign being monitored, the Propaq determines this and displays the cuff numerics in a waveform window above a trend window. The cuff numerics are displayed where ECG is normally shown as shown in Figure 2-26.

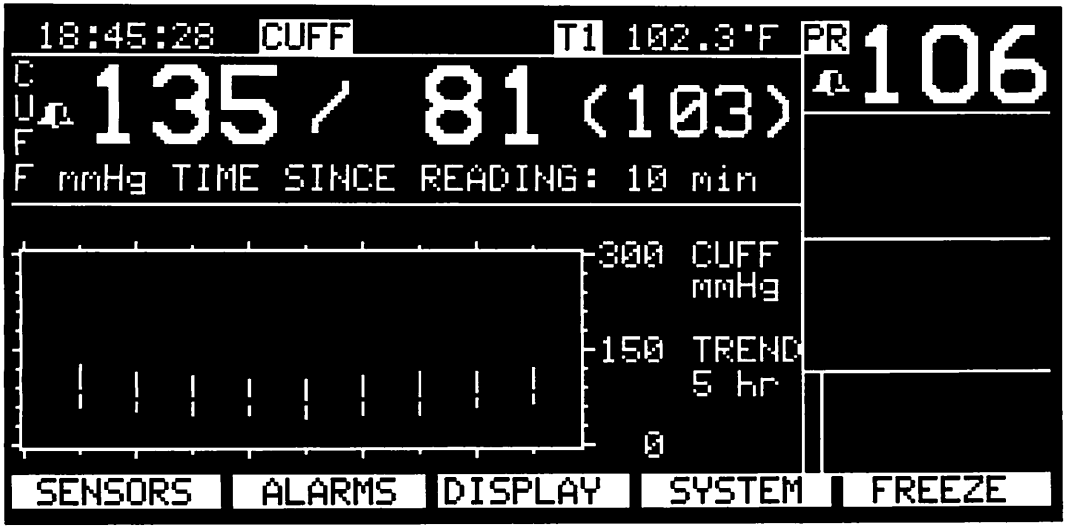


Figure 2-26. Cuff numerics format

With only cuff being measured, the numerics are displayed as large as the heart rate numerics.

Important Information About Automatic Measurements

When the selected interval is from 5 to 60 minutes, a blood pressure measurement will begin when the minute of the time of day clock is evenly divisible by the interval. For example, if the interval is set to 10 (minutes), measurements will begin at the hour and at 10, 20, 30, 40, and 50 minutes past the hour.

When the selected interval is from 1 to 3 minutes, the monitor waits the selected time between the beginning of each measurement. Your results

may vary if the measurement takes longer than 30 seconds, because the monitor requires that the cuff pressure be below 5 mmHg for a minimum of 30 seconds between measurements to give the patient's arm a chance to restore blood flow to the limb. If on Auto Interval, one additional reading will be taken immediately after an auto reading that results in a patient alarm.

Printing Cuff Measurements

A special printer function allows you to print the results of a cuff measurement each time one occurs. The printout is called the Cuff Ticket (see Figure 2-27). The Cuff Ticket must be turned on in the Printer Setup window.

1 To turn on CUFF TICKET, press SYSTEM, and then PRINTER. The printer setup window appears.

2 Use the NEXT and CHANGE buttons to select and turn on the CUFF TICKET (see **Printer Functions** on page 1-49 for more information on setting up the printer).

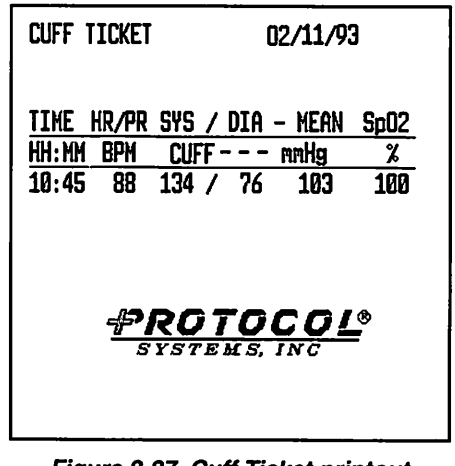


Figure 2-27. Cuff Ticket printout

Cuff Messages

The following cuff messages can appear in the equipment alert window (Figure 2-28 on page 2-56). A CUFF FAULT caution message also appears in the numerics window.

CUFF FAULT: LOW BATTERY, CUFF DISABLED. The battery lacks sufficient voltage to be able to operate the cuff channel. Connect the Propaq to the ac power adapter.

CUFF FAULT: CALIBRATION ERROR, CUFF DISABLED. The Propaq continually recalibrates the cuff channel to ensure it can properly make cuff determinations. If this message momentarily appears and then is removed, the cuff channel was able to calibrate itself and the cuff channel is properly operating. Once the cuff channel is disabled, normal monitor operation continues, but the cuff channel cannot be used. Have the monitor serviced.

CUFF FAULT: MEASUREMENT TIME OUT. A valid cuff measurement could not be determined within 3 minutes. This could be due to patient motion, arrhythmia, or other environmental influences such as transport vibration. Try the measurement again.

CUFF FAULT: EXCESSIVE ARTIFACT. Too much patient motion, patient arrhythmia, or sources of external cuff movement can cause this message.

CUFF FAULT: NO PULSES DETECTED. The cuff may not be on a patient or properly applied to the patient.

CUFF FAULT: CUFF NOT DETECTED. During cuff inflation the detected pressure did not sufficiently rise. Check that the cuff connection is tight and take the measurement again.

CUFF FAULT: NO VALID BLOOD PRESSURE FOUND. The Propaq cannot process the measurement data it acquired. Patient motion, arrhythmia, or outside environmental influences such as transport vibration can cause this message.

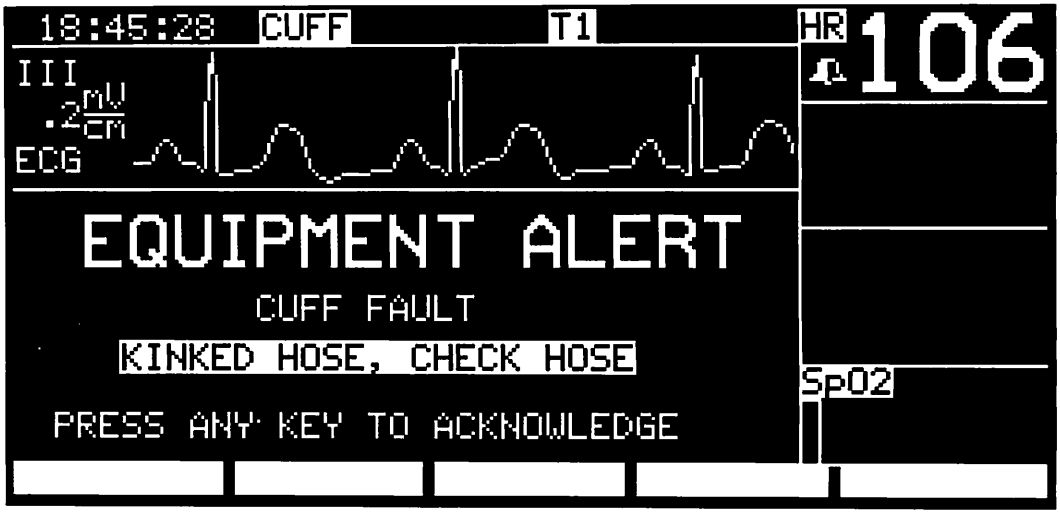


Figure 2-28. Cuff Equipment Alert

The cuff equipment alert window indicates cuff problems.

CUFF FAULT: KINKED HOSE, CHECK HOSE. The Propaq could not properly inflate the cuff. Check for a kinked hose between the monitor and the patient.

CUFF FAULT: BLOCKED VENT. The pressure in the cuff cannot be vented to the atmosphere. Inspect the vent hole for blockage.

CUFF FAULT: AIR LEAK, CHECK HOSE. The Propaq could not properly inflate the cuff. Check the hose and cuff for obvious leaks, such as the O-rings in the hose connections.

CUFF FAULT: WEAK PULSES, CAN'T FIND SYS/DIAS. There are not enough pulses to determine the systolic or diastolic pressures, but a mean pressure is available. Try reapplying the cuff after squeezing as much air from it as you can, and then take another measurement.

CUFF FAULT: OVERPRESSURE CONDITION, CHECK HOSE. The pressure in the cuff exceeded the acceptable limits. Check the hose and try taking another measurement.

CUFF FAULT: OVERPRESSURE CONDITION, CYCLE POWER. The pressure in the cuff exceeded the acceptable limits more than once. To try to use the cuff channel, you must first turn off and then on the Propaq (called "cycling power"). You can continue to use the Propaq without turning it off and on, but the cuff channel will be disabled. A message in the cuff status window indicates the channel is disabled until you turn off and on the Propaq's power. If the message appears again after cycling power, the Propaq needs to be serviced.

The following messages can appear in the cuff status window (Figure 2-29 on page 2-58).

CALIBRATING. The CUFF channel is running an internal calibration.

DISABLED, CAL ERROR. See the description above for CUFF FAULT: CALIBRATION ERROR, CUFF DISABLED.

DISABLED, LOW BATT. See the description above for CUFF FAULT: LOW BATTERY, CUFF DISABLED.

CUFF DISABLED: CYCLE POWER. The cuff has been disabled but is still connected. You can continue to use the Propaq, but the cuff channel will remain disabled until you cycle the power. If the message appears again after cycling power, the Propaq needs to be serviced.

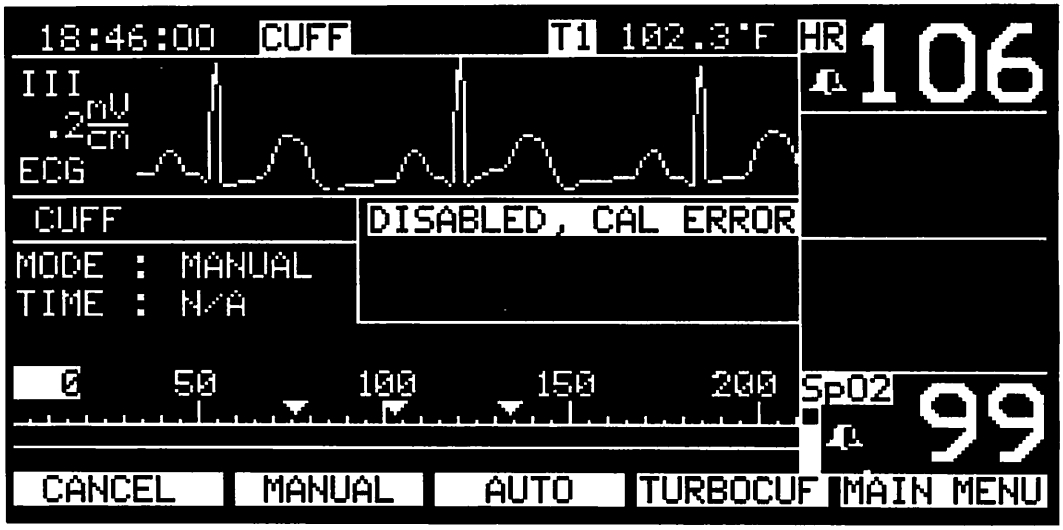


Figure 2-29. Cuff Status Window messages

The cuff status window can also display messages resulting from failed measurement attempts.

Temperature

Intended Use

Propaq monitors provide either two temperature channels (Models 102 and 104) or one temperature channel (Model 106). When two channels are active, the difference temperature (ΔT) is also displayed. You can select in which units, °C or °F, temperature is shown to match your hospital's protocols. (On some non-U.S. models, only °C is available.)

All standard Propaqs are intended to be used with Yellow Springs Instrument Company's (YSI) Models 400 and 700 Series temperature probes, or other manufacturer's models that are equivalent. On standard 102s and 104s, you can also use Electromedics, Inc. 2100 series probes. Other temperature probes that do not match the performance specifications of these probes may produce incorrect temperature readings.

On Propaqs with the Hewlett-Packard connector option, all models have one HP style YSI 400 channel.

You can use several different types of probes, including esophageal, rectal, needle, and skin probes.

Temperature Connectors and Probes

The temperature connectors are compatible with Yellow Springs Instrument Company (YSI) Series 400 and 700, and Electromedics, Inc. Series 2100 temperature probes (Figure 2-30).

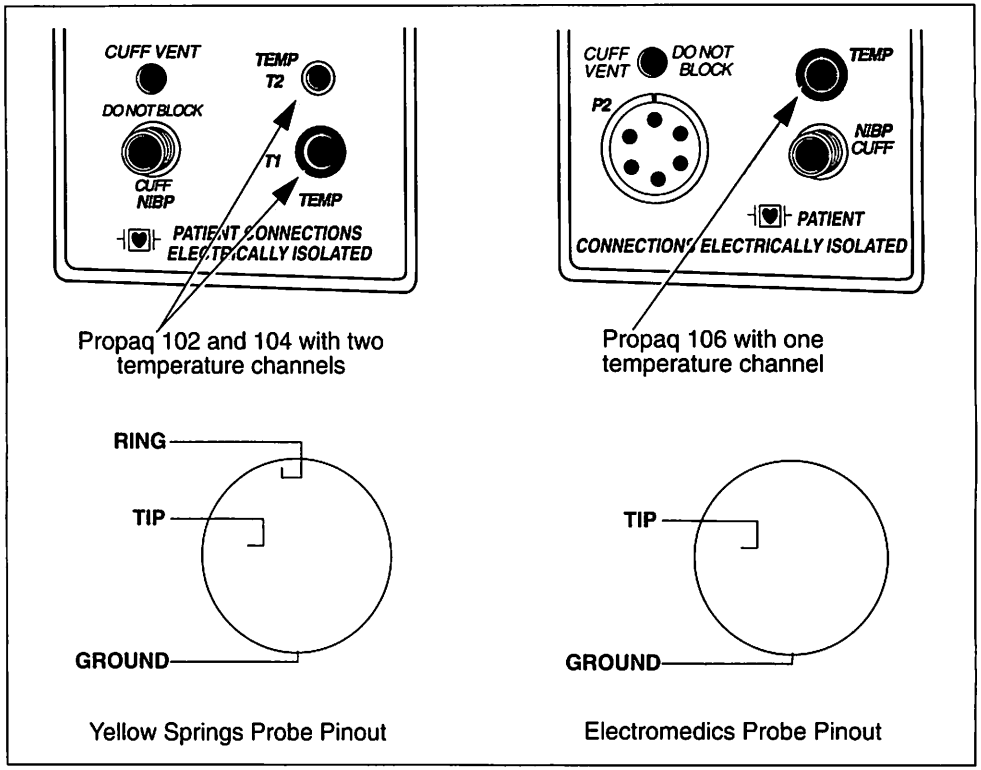


Figure 2-30. Propaq Temperature connectors and probes

Standard Propaq models 102 and 104 have two temperature channels and use both YSI and Electromedics probes. The standard Propaq 106 has only one temperature channel which uses only YSI probes.

Preparation

WARNING

A metal-jacketed temperature probe that contacts conductive objects during electrocautery may increase the possibility of RF burns at the temperature probe site or at the ECG electrodes, especially if the object the probe contacts is earth grounded. During application of the probe, be sure that it is not allowed to touch conductive objects. During electrocautery be sure that the probe does not contact conductive objects and is not in contact with clinical personnel.

Monitoring temperature with the Propaq requires you to place the probe on the patient and connect it to the Propaq, select the temperature units, and set the temperature alarm limits. The temperature value is displayed to the left of the heart rate as shown in Figure 2-31 on page 2-62.

1. Once you have selected the temperature probe(s) you want to use, place the probe on the patient and plug it into one of the connectors on the Propaq's side panel. Within a few seconds, the Propaq will display the temperature next to the heart rate.
2. To select the temperature units (°C or °F), press SYSTEM, then MORE, and then MORE again. Use the NEXT and CHANGE buttons to select and set the temperature units as desired. The Propaq automatically updates the temperature display to show the newly selected units. This choice is not available on models displaying only °C.
3. Set the alarm limits according to your hospital's protocols. See Chapter 3 for information on setting alarm limits.

How Temperature is Displayed

Temperature is displayed in a numeric window at the top of the Propaq screen, to the left of the Heart Rate, in °C or °F. This area displays all temperature measurements (T1, T2, ΔT), one at a time.

Figure 2-31. The temperature numeric window

Printing Temperature

Temperature is a non-waveform vital sign. All monitored temperature values are printed along the top of each printout in numerics.

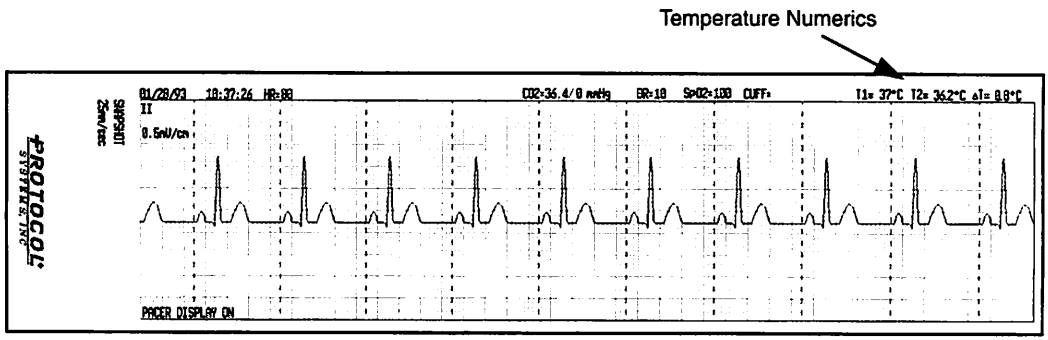


Figure 2-32. Temperature numerics printout

The temperature numerics are printed along the top of a printout along with the other numerics.

Temperature Messages

The following messages can appear in an equipment alert window. A temperature caution message will also appear in the temperature numeric window when one of these messages appears.

PROBE NOT DETECTED. This message occurs when the Propaq has successfully measured temperature and a probe is disconnected. Reconnect the probe or acknowledge the equipment alert by pressing any menu key.

PROBE SHORT OR OUT OF RANGE. This message usually indicates a probe problem. However, the temperature being measured may be beyond the range of the probe or the range of the Propaq. If the probe is correctly applied to a patient who you suspect to have a measurable temperature, replace the probe.

CALIBRATION ERROR, TEMP DISABLED. This message appears when the Propaq has detected that it cannot accurately measure the temperature. The monitor should be serviced.

Pulse Oximetry (SpO_2)

Intended Use

The Propaq's Pulse Oximetry (SpO_2) patient channel noninvasively measures oxygen saturation of arteriolar hemoglobin at a peripheral measurement site, such as a finger, toe, or the bridge of the nose. SpO_2 is the most recent standard term assigned to measuring oxygen saturation using a pulse oximeter as opposed to an arterial blood sample (SaO_2).

The Propaq Pulse Oximetry option is intended for use only as an adjunct in patient assessment. As with any pulse oximeter, the Propaq Pulse Oximetry option must be used in conjunction with patient signs and symptoms. Oxygen saturation measurements using pulse oximetry are highly dependent on proper placement of the sensor and patient conditions. Conditions such as shivering may cause artifact, resulting in erroneous oxygen saturation readings. Patient conditions, such as smoke inhalation, can cause pulse oximetry measurements to be suspect. If pulse oximetry measurements are suspect, verify the reading using another clinically accepted measurement method, such as arterial blood gas measurements.

The Propaq Pulse Oximetry option has been designed to match the performance of a NELLCOR N-200 Pulse Oximeter. The Propaq Pulse Oximetry option is intended for use on adult and pediatric patients using only NELLCOR oxygen transducers (sensors). The Propaq Pulse Oximetry option is not intended for use on neonatal patients.

Only NELLCOR oxygen transducers, including OXISENSOR patient-dedicated adhesive sensors, should be used with the Propaq Pulse Oximetry option. See Table 2-5 on page 2-67 for a list of compatible sensors.

The Propaq SpO_2 channel is self-calibrating, assuring accurate measurements. Self-calibration is performed when the monitor is first turned on, at least every 15 minutes thereafter (sometimes sooner if the channel detects it is needed), and whenever a sensor is connected to the channel.

Oxygen Saturation and Heart Tone

One of the most unique aspects of the Propaq Pulse Oximetry option is the audible heart tone indicating changes in the measured oxygen saturation level. When SpO_2 is being measured, the heart tone is produced using a special speaker in the expansion module. As the oxygen saturation increases and decreases, the pitch of the heart tone rises and falls. This provides immediate recognition of saturation changes. If SpO_2 is not being monitored, the heart tone is produced by the Propaq's speaker.

Measurement Range

The measurable range of saturation depends on the sensor used for measurement, but the Propaq Pulse Oximetry option can display from 0 to 100 percent saturation on both adult and pediatric patients.

note...

The Propaq Pulse Oximetry option is not intended for use on neonates.

SpO_2 Connector and Sensors

The SpO_2 connector is located on the left side of the monitor on the expansion module.

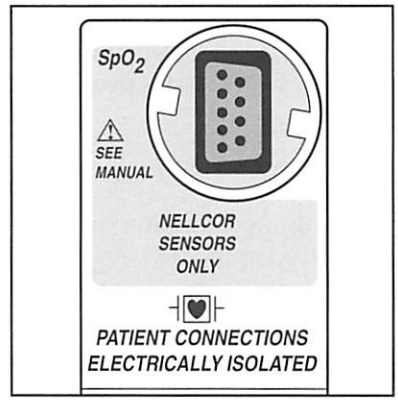


Figure 2-33. SpO_2 connector

A Nellcor sensor can be directly plugged into the Propaq's SpO_2 connector, or plugged into an extension cable.

The NELLCOR oxygen sensor or a sensor extender cable, such as Protocol's 8-foot extension cable, can be directly connected to the D-type connector.

The Propaq Pulse Oximetry option has been designed to operate with a wide range of NELLCOR, Incorporated oxygen transducers. Table 2-5 on page 2-67 lists the NELLCOR accessories and sensors that can be used with the Propaq Pulse Oximetry option. These sensors have no heat source to burn a patient, and NELLCOR sensors are accurately calibrated at the factory.

note...

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

Table 2-5: NELLCOR SpO_2 Sensors

Mode	Description
DS-100A	DURASENSOR Adult Digit Oxygen Transducer
D-25	OXISENSOR Adult Digit Oxygen Transducer (18" cable)
D-25L	OXISENSOR Adult Digit Oxygen Transducer (36" cable)
D-20	OXISENSOR Pediatric Digit Oxygen Transducer
R-15	OXISENSOR Adult Nasal Oxygen Transducer
EC-4	NELLCOR Sensor Extension Cable (4 ft.)
RS-10	Reflectance Oxygen Transducer
DF-A	DURAFORM™ Oxygen Transducer System

NELLCOR's DURASENSOR® is a reusable oxygen transducer supplied in a non-sterile package. Its optical components are mounted in a plastic casing. OXISENSOR™ oxygen transducers are sterile adhesive sensors. Their optical components are mounted in medical-grade adhesive tape.

Each sensor is designed for application to a specific site on a patient within a certain size range. To select the appropriate sensor, consider the patient's weight and which sensor application sites are available, as well as the adequacy of the patient's perfusion, the level of patient activity, whether sterility is required, and the anticipated duration of monitoring.

To ensure optimal performance, use an appropriate sensor, apply it as described in the sensor's Directions for Use, keep the sensor site at the level of the patient's heart, and always observe all warnings and cautions noted in the sensor's Directions for Use.

The sensors are sensitive to light. If excessive ambient light is present, cover the sensor site with opaque material to block the light. Failure to do so may result in inaccurate measurements. Light sources that can affect performance include surgical lights (especially those with a xenon light source), bilirubin lamps, fluorescent lights, infrared heating lamps, and direct sunlight.

WARNING

Sensors exposed to ambient light while not applied to a patient can exhibit semi-normal saturation readings. Be sure the sensor is securely placed on the patient and check its application often to ensure accurate readings.

If poor patient perfusion affects instrument performance and the patient weighs more than 50 kg, consider using the OXISENSOR R-15 adult nasal oxygen transducer. Because the R-15 obtains its measurements from an artery supplied by the internal carotid (the nasal septal anterior ethmoid artery) this sensor can obtain measurements when peripheral perfusion is relatively poor.

If patient movement presents a problem, consider the following possible solutions:

- ❑ be sure the sensor is secure and properly applied
- ❑ apply ECG electrodes and turn on C-LOCK (see below)
- ❑ use a new sensor with fresh adhesive backing
- ❑ move the sensor to a less active site
- ❑ use a type of sensor that tolerates some patient motion, such as the D-25, D-20, or R-15
- ❑ set the RESPONSE mode to SLOW

Preparation

Setting up the SpO_2 channel requires three steps: placing the sensor on the patient, set up the monitor for SpO_2 measurements, and set the SpO_2 alarm limits.

note...

For SpO_2 and Cuff measurements, special considerations are necessary when applying the oxygen sensor to the same limb used for cuff measurements. When placing the sensor on the patient, the sensor may be placed on the same limb as the cuff. If the SpO_2 sensor and cuff are on the same limb, blood circulation to the pulse oximetry measurement site is temporarily impaired while the cuff occludes the limb artery during blood pressure measurements. This affects SpO_2 measurements and could create an SpO_2 patient alarm if limits are set for SpO_2. It is recommended that you place the SpO_2 sensor on a limb that is not used to obtain cuff measurements.

1. **Placing the Sensor.** Attach the sensor to the patient according to the instructions provided with the sensor. Be sure to read all warnings and cautions provided in the sensor's *Directions for Use*. Sensor placement is extremely important.
2. **Setting Up the Monitor for SpO_2.** Turn the locking ring around the connector counterclockwise until it stops.
3. Plug the sensor into the SpO_2 sensor extension cable and plug the extension cable into the Propaq, or plug the sensor directly into the monitor's side panel.
4. Lock the connector by turning the locking ring clockwise until it stops.

5 When the sensor is connected to the monitor, the SpO_2 channel performs a self-calibration to assure measurement accuracy. SEARCH is displayed in the SpO_2 numeric window while the channel tries to detect blood pulsing through the measurement site. Once the measurement has been established, the saturation value is displayed in the numeric window.

6 From the Main Menu, press SENSORS, then SpO_2 (if the monitor includes an invasive pressure channel and CO_2, you'll need to press MORE first), and then SIZE to adjust the size of the waveform for best viewing. There are several waveform sizes to choose from. (If the waveform is to be viewed all the time, you will need to turn on the SpO_2 waveform in the wave select window. You may also have to turn off other waveforms to continuously display the SpO_2 waveform.)

7 If necessary, adjust the placement of the sensor until a good SpO_2 waveform is displayed (see Figure 2-34 on page 2-71). The waveform indicates the quality of the oxygen saturation measurement. A waveform with artifact may indicate erroneous oxygen saturation readings. Turn on the C-LOCK function as described below if you are also monitoring ECG. If the measurement is suspect, use another clinically accepted method of determining oxygen saturation.

note...

If the patient is having frequent arrhythmias and SpO_2 alarms are frequent, turning C-LOCK off may improve performance and cause fewer alarms.

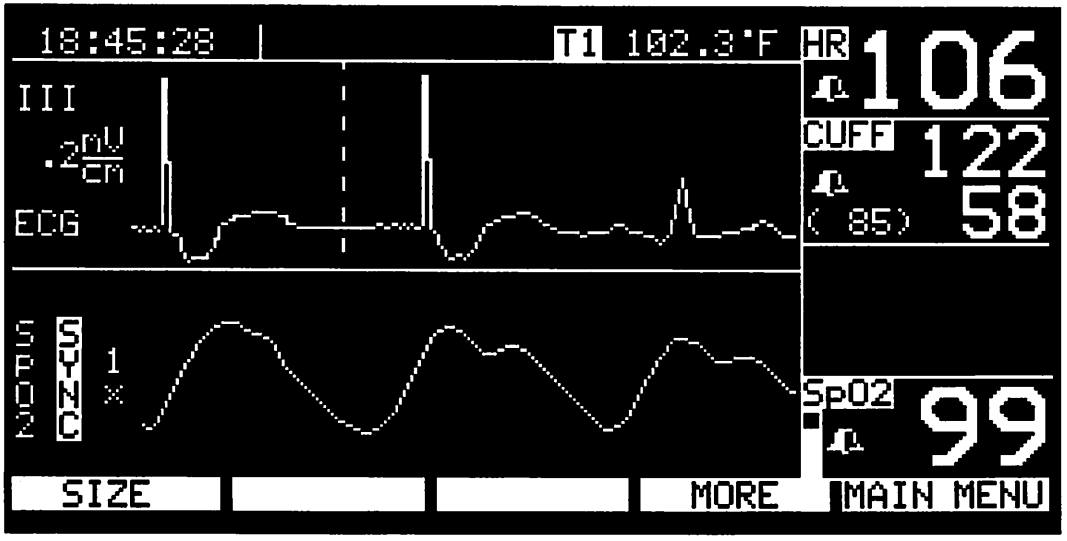


Figure 2-34. SpO_2 waveform

A typical SpO_2 waveform should be free from movement and noise artifact when the sensor is properly placed and the patient is not moving. This SpO_2 measurement is synchronized to the ECG signal.

8 Press MORE to display other SpO_2 functions. When you press MORE, the SpO_2 waveform is removed, and the SpO_2 status window appears showing the current settings of RESPONSE and C-LOCK (see Figure 2-35). RESPONSE sets the time the Propaq Pulse Oximeter takes to acquire the oxygen saturation value. Three averaging times are available as listed in Table 2-6 on page 2-73. C-LOCK™ is a NELLCOR patented function that allows the Propaq Pulse Oximetry option to more accurately make oxygen saturation measurements as described below.

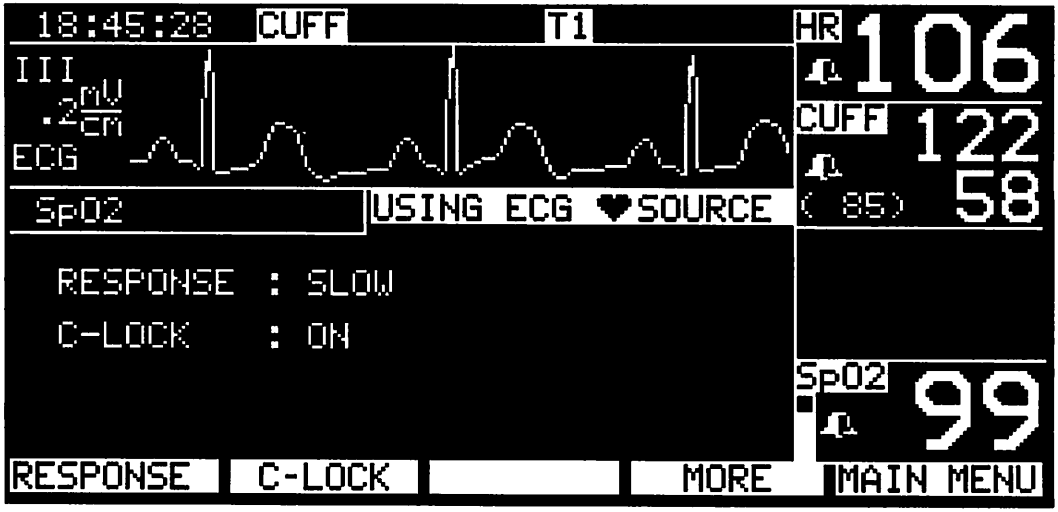


Figure 2-35. The SpO_2 Status Window

9 Press the RESPONSE button to select the desired response time according to the guidelines in Table 2-6.

Table 2-6: SpO_2 Response Settings

Response	Time	Indications for Use
NORMAL	7 seconds	Relatively stable patients.
SLOW	15 seconds	Patients exhibiting movement preventing accurate measurement at NORMAL setting.
FAST	3 seconds	Special studies requiring fast readings (such as sleep studies) and where patient movement and other artifacts are not present.

10 Press the C-LOCK button to activate (C-LOCK ON) or deactivate (C-LOCK OFF) this function. With C-LOCK turned on, the saturation measurements are synchronized to each detected R-wave. Systole is the basis of proper SpO_2 measurement. The Propaq Pulse Oximetry option recognizes systole as the highest pulse signal from the oxygen sensor. Artifact-induced pulses caused by patient movement and other conditions could be recognized as systole.

Synchronizing the pulse oximeter's systole determination to the R-wave reduces the effects artifact may have on SpO_2 measurements. C-LOCK should be turned ON to accurately determine SpO_2 on patients with movement or where other artifact affects the SpO_2 measurement. SYNC appears next to the waveform when synchronization to the ECG has been obtained. When SYNC is not displayed, the SpO_2 measurement is not synchronized. Synchronization takes a few seconds to establish the first time.

note...

When FAST response is selected, C-LOCK is inhibited, however, it is not turned off. C-LOCK is automatically uninhibited if the response is set to other than the FAST setting.

If C-LOCK is on, the heart rate source is automatically set to ECG. An ECG signal must be present or C-LOCK does not activate.

Setting the SpO_2 Alarms. Set the alarm limits according to your hospital's protocols. See Chapter 3 for information on setting alarm limits.

How SpO_2 is Displayed

The Propaq Pulse Oximetry option displays a plethysmograph derived from the oxygen sensor, the oxygen saturation value as a percentage, and a pulse amplitude indicator that shows the relative change in the pulsatile signal coming from the measurement site (see Figure 2-36). The pulse amplitude indicator is helpful when the plethysmograph is not shown because other waveforms or a status window is displayed.

If the heart rate source is set to SpO_2, the pulses from the Propaq Pulse Oximetry option are counted to determine the pulse rate. The pulse rate measurement is displayed in the heart rate window. SpO_2 data is trended similarly to other patient data.

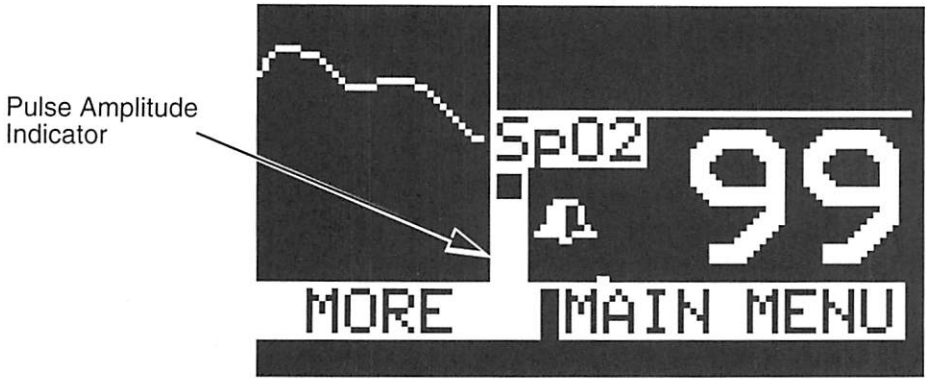


Figure 2-36. The pulse amplitude indicator

The pulse amplitude indicator shows the pulse activity measured through the pulse oximetry channel.

Printing the SpO_2 Plethysmograph

You can print the SpO_2 plethysmograph by pressing either the SNAPSHOT or START/STOP button on the printer when the waveform is displayed on the monitor. The plethysmograph is printed without a grid, and the size is printed at the beginning of the printout and every eight seconds afterwards (see Figure 2-37). If only SpO_2 is monitored or displayed, the waveform is printed by itself across the paper. The oxygen saturation value is printed along with other patient vital sign numerics along the top of the paper.

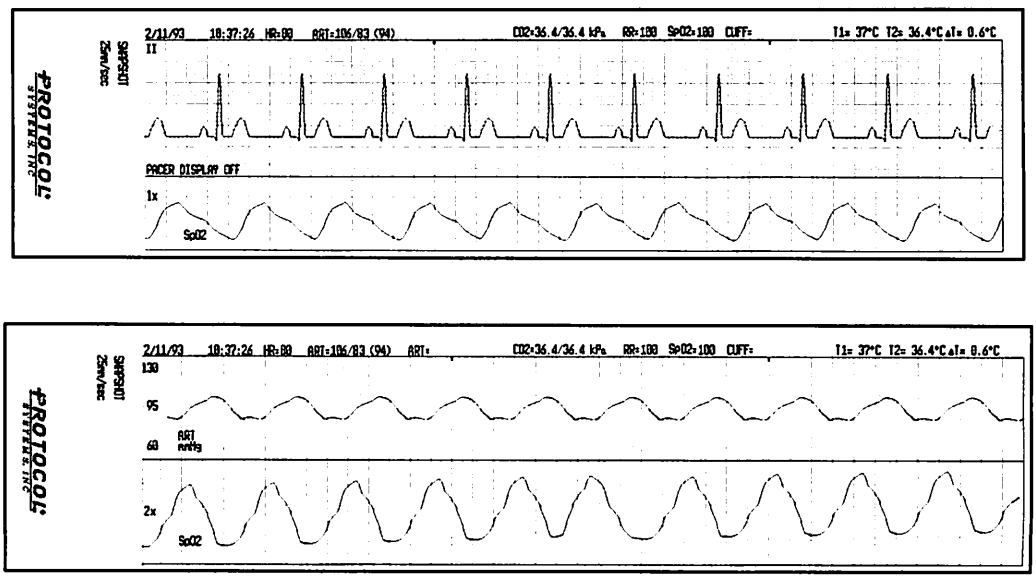


Figure 2-37. SpO_2 printouts

SpO_2 Messages

SpO_2 messages can appear in the equipment alert window (SpO_2 equipment alert), the SpO_2 numeric window, or alternate with the time of day (SpO_2 caution messages).

NO SENSOR DETECTED appears in the equipment alert window and indicates a probe has been disconnected from the monitor after being plugged in for a few seconds.

Pressing any key deactivates the alert, removes the SpO_2 plethysmograph, and deactivates the channel.

If an SpO_2 sensor is subsequently connected to the Propaq, the channel becomes active and performs its self-calibration.

SEARCH is displayed in the numeric window after the Pulse Oximetry sensor is first connected to the monitor. During this search time, the SpO_2 channel tries to detect blood pulsing through the measurement site. Once the measurement has been established, the oxygen saturation value is displayed in the numeric window.

CO_2

Intended Use

The Propaq's Mainstream CO_2 option is intended to be used to noninvasively measure the following vital signs/events:

- ❑ Inspired CO_2 ($INCO_2$)
- ❑ End-tidal CO_2 ($ETCO_2$)
- ❑ Breath Rate
- ❑ Apnea

The Propaq's Mainstream CO_2 option is intended for use only on adult and pediatric patients. Patients must either be intubated or breathing through a well-fitting face mask connected to a breathing system such as an anesthesia circle system. It is not recommended for use on neonates.

CAUTION

The Mainstream CO_2 option is not recommended for use during magnetic resonance imaging (MRI) procedures. The magnetic fields involved will permanently damage the CO_2 sensor.

The Mainstream CO_2 option's operating altitude is -2,000 to 15,000 ft. The Propaq automatically and continuously makes corrections for altitude. No manual entry or correction is required.

The CO_2 option should only be used with the mainstream sensor and single-use airway adapter supplied by Protocol Systems, Inc. When using the CO_2 option in critical care, the adapter should be replaced every 24 hours or sooner if it becomes occluded.

CO_2 reading accuracy is affected by the presence of interfering gases and vapors. If the CO_2 option is used on patients who are being administered oxygen (O_2) or nitrous oxide (N_2O), be sure to set the appropriate compensation setting using the GAS COMP button (described later).

The CO_2 option and sensor should be verified every 6 months for compliance with operating specifications. Refer to the Functional Verification section of the *Propaq Service Manual*.

CO_2 Connector and Sensor

The Propaq's Mainstream CO_2 option is housed in the Propaq expansion module. The CO_2 sensor connector is located on the lower left side panel as shown in Figure 2-38.

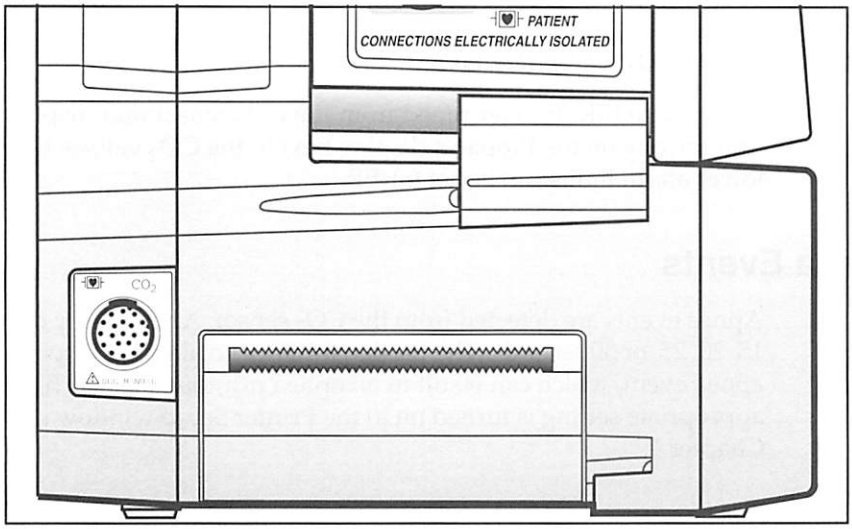


Figure 2-38. CO_2 Option

The Mainstream CO_2 option connector is housed in the expansion module, which also includes the SpO_2 option.

CO_2 Measurements

The Propaq Mainstream CO_2 option determines carbon dioxide content of a patient's inhaled and exhaled breath. A mainstream sensor is attached to an airway adapter in series with a ventilator's patient

breathing circuit. A CO_2 waveform can be displayed on the Propaq, and end-tidal CO_2 ($ETCO_2$) and inspired CO_2 ($INCO_2$) numeric values are shown.

Displayed values of $ETCO_2$ and $INCO_2$ are the highest and lowest values (respectively) of CO_2 measured during the time interval set by the RESPONSE setting (described later). $INCO_2$ numerics are shown only when they are too high.

Alarm limits can be set for both measurements. Only a high alarm limit can be set for $INCO_2$.

Breath Rate Measurements

Breath Rate (BR) is determined from the CO_2 sensor and displayed numerically on the Propaq's display next to the CO_2 values. Upper and lower alarm limits can be set for BR.

Apnea Events

Apnea events are detected from the CO_2 sensor. Apnea delay can be set to 15, 20, 25, or 30 seconds. The Propaq initiates an alarm in response to each apnea event, which can result in an apnea printout (Apnea Ticket) if the appropriate setting is turned on in the Printer Setup window described in Chapter 1.

Preparation

Setting up the CO_2 option for monitoring involves (1) inspecting the airway adapter, (2) attaching the sensor to the adapter, (3) attaching the adapter to the airway circuit, (4) setting up the CO_2 channel, and (5) setting the CO_2 alarms.

Read the following warnings before setting up the CO_2 channel for patient monitoring.

WARNING

Do not attempt to verify operation of the CO_2 sensor by blowing through it directly. Always blow through an attached airway adapter. Otherwise, a small amount of CO_2 from your breath may enter the CO_2 sensor housing and cause a small shift in the measured CO_2 values. It may take 3-24 hours for the sensor to return to proper calibration.

WARNING

Protocol airway adapters are for single-patient use only. Replace the adapter with every new patient or if it becomes occluded.

When using the CO_2 Option in critical care, replace the adapter every 24 hours or if it becomes occluded.

Prior to using an airway adapter, always inspect it for inadvertently lodged obstructions and for window integrity.

After attaching the sensor to the adapter, always check the adapter again for proper placement of the sensor and for window integrity.

1 Remove an airway adapter from its plastic bag and inspect it for any obstructions in the lumen and for window integrity (see Figure 2-39).

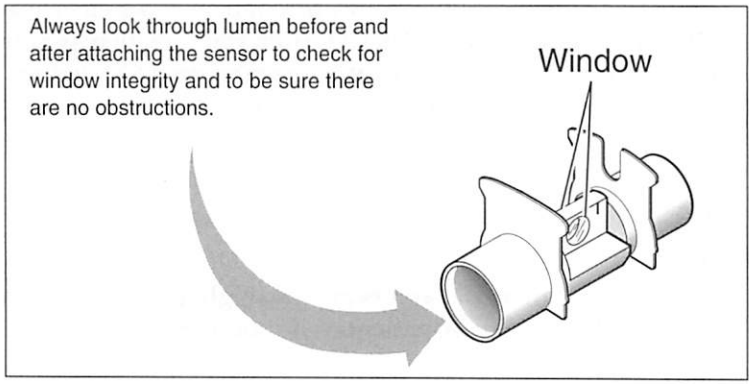


Figure 2-39. Airway adapter

WARNING

Always gently attach the sensor to the airway adapter away from the patient, and take care not to damage the glass windows.

2 Holding the airway adapter in one hand and the sensor in the other, align the sensor over the adapter and between the protruding "tabs" as shown in Figure 2-40 on page 2-83.

CAUTION

If the sensor does not easily slide onto the adapter in the next step, do not attempt to force these components together. They fit together in only one way.

3 Gently slide the sensor onto the airway adapter using a downward motion and keeping the sensor properly aligned. The sensor will quietly snap in place.

4 After the sensor is in place, check the airway adapter again by looking through the lumen. The windows should be intact.

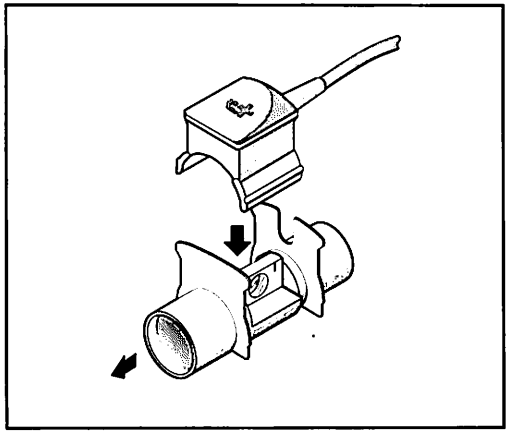


Figure 2-40. Attaching CO_2 sensor to adapter

Properly attaching the sensor to the adapter ensures accurate CO_2 readings and prevents damage to the window. Always attach the sensor away from the patient.

WARNING

When attaching the airway adapter in the next steps, position the adapter so that the sensor is on top as shown in Figure 2-41 to avoid fluid collection in the sensor airway slot. Any concentration of fluids here can cause inaccurate CO_2 readings.

5. Gently push and twist the **larger** end of the adapter onto the patient's tracheal or endotracheal tube (see Figure 2-41).
6. Gently push and twist the **smaller** end of the adapter onto the ventilator circuit tubing (see Figure 2-41).
7. Check to make sure both connections are tight to prevent air leaks.

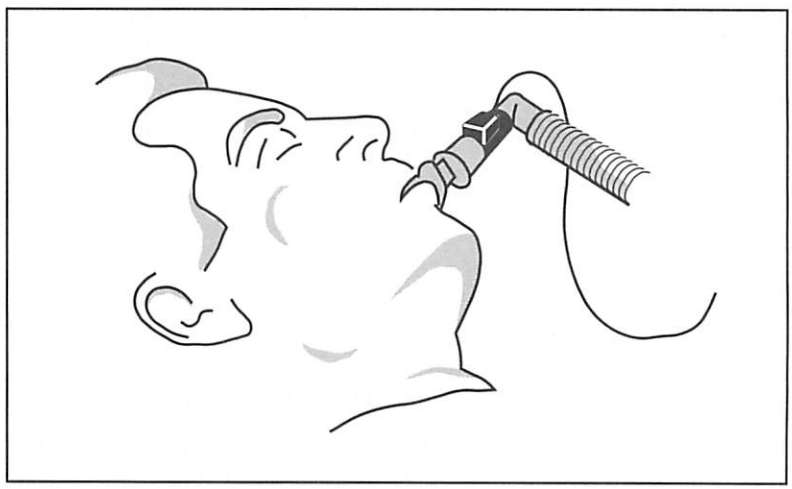


Figure 2-41. Positioning CO_2 sensor on top

When the adapter is attached to the breathing circuit, always position the sensor on top to keep fluid from collecting in the adapter window.

WARNING

Always double check to ensure that there are no leaks in the breathing circuit at any point of connection.

8 Plug in the CO_2 sensor cable to the CO_2 connector on the Propaq's left side panel (Figure 2-42).

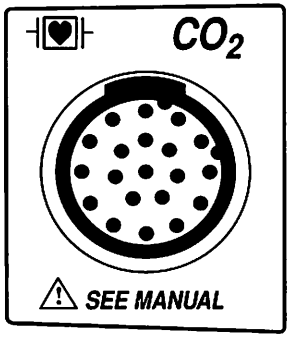


Figure 2-42. CO_2 connector

The Propaq's CO_2 connector is located on the lower left side panel.

note...

After the sensor is plugged in, WARM UP appears in the CO_2 numerics zone and the waveform is displayed without a value range. Warm-up time is typically 20 seconds, after which the CO_2 measurement and waveform range are displayed.

9 Press SENSORS, then MORE, and then CO_2 to reach the first CO_2 Menu. (You don't need to press MORE if the monitor has no invasive pressure channels.)

10 Press the RANGE button until you see the desired waveform scale range on the Propaq screen. The range choices are shown in Table 2-7.

note...

If an inspired value is displayed indicating patient rebreathing (non-zero inspired CO_2), check the patient breathing circuit for proper function. Verify the sensor calibration against room air. If the Propaq continues to display inspired values, return the sensor to Protocol Systems for service.

Table 2-7: CO_2 Range Values

Units	Waveform Scale Range
mmHG	0-100 0-60 (default setting) 0-30
kPa	0-14 0-10 0-4
%	0-14 0-10 0-4

11 Press MORE to view the CO_2 status window as shown in Figure 2-43.

12 If either O_2 or N_2O is being administered to a patient, press the GAS COMP button to set the proper gas compensation as listed in Table 2-8 on page 2-88. If no other gas is being administered, set the GAS COMP to OFF. OFF is the default setting. Refer to Table 2-8.

note...

If the $ETCO_2$ value is displayed as +++, the sensor could be damaged. Verify calibration against a known reference gas. If the sensor does not verify, return it to Protocol Systems for service.

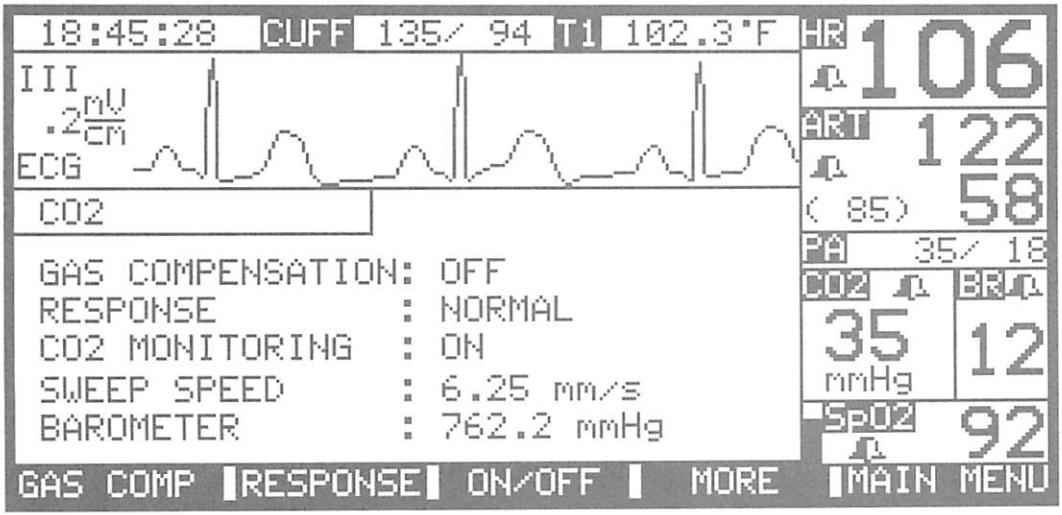


Figure 2-43. LCD display showing CO_2 Status Window

Table 2-8: Gas Compensation Values

Gas Administration Level / GAS COMP Setting	$ETCO_2$ or $INCO_2$ Value
OFF	CO_2 value = actual CO_2 value
O_2 > 50%, No N_2O	CO_2 value = actual CO_2 value x 1.03
N_2O > 50%	CO_2 value = actual CO_2 value x 0.952

13 Press RESPONSE to select either NORMAL, SLOW or FAST. The FAST setting is recommended where a sudden step change in $ETCO_2$ is of concern, such as that induced by an air embolus in certain neurosurgical procedures. A SLOW response will decrease $ETCO_2$ false alarms when breath morphology varies considerably from one breath to the next. The default setting is NORMAL. Refer to Table 2-9.

Table 2-9: CO_2 Response Settings

Response Time Setting	Time Period of Sampling	Typical Indications for Use
FAST	15 seconds	During neuroanesthesia
NORMAL	30 seconds	During routine use
SLOW	45 seconds	To decrease $ETCO_2$ false alarms

14 Press mm/sec and view the CO_2 Status window to select either 3.13, 6.25 or 12.5 mm/sec. The default setting is 6.25 mm/sec.

15 Set upper and lower alarm limits for $ETCO_2$. Refer to Chapter 3 for information on setting alarm limits.

16 Set only an upper limit for $INCO_2$. Refer to Chapter 3 for information on setting alarm limits.

17 Set both upper and lower Breath Rate alarm limits. Refer to Chapter 3 for more information.

WARNING

To ensure patient safety, it is recommended that the Breath Rate alarm limits always be turned on and set appropriately.

18 Set the alarm limit for Apnea Delay—this is the number of seconds that elapse before the Propaq alarms when the next breath is not detected. The default setting is 20 seconds. Once the first breath has been detected, the Apnea alarm limit setting is always turned on as long as the CO_2 channel is active. The BR and Apnea Alarm Limit window is shown in Figure 2-44 on page 2-90. STAT SET does not affect the Apnea limit.

During an apnea alarm, the CO_2 waveform is always displayed on the Propaq screen.

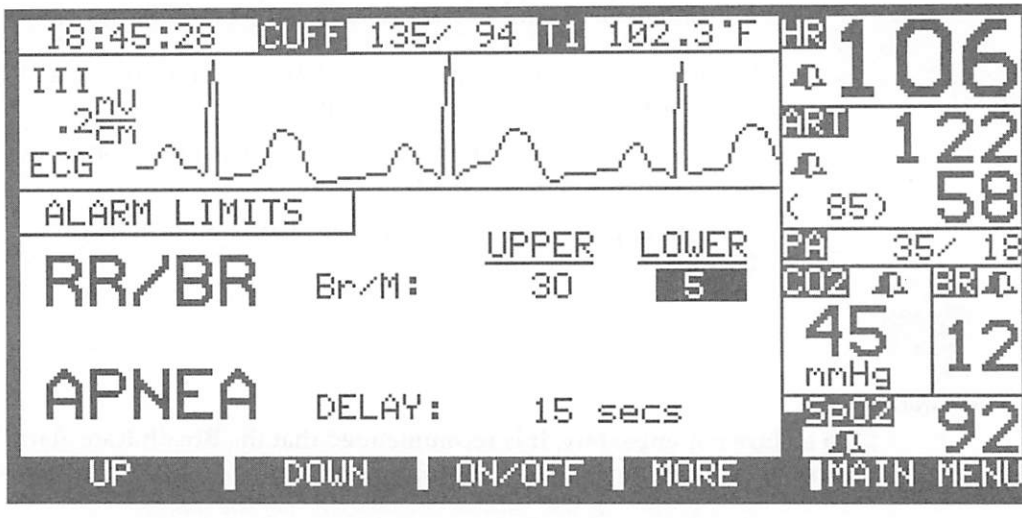


Figure 2-44. LCD display showing Breath Rate and apnea alarm limit status window

The ON/OFF Button

The ON/OFF key allows you to disable CO_2 monitoring without removing the sensor.

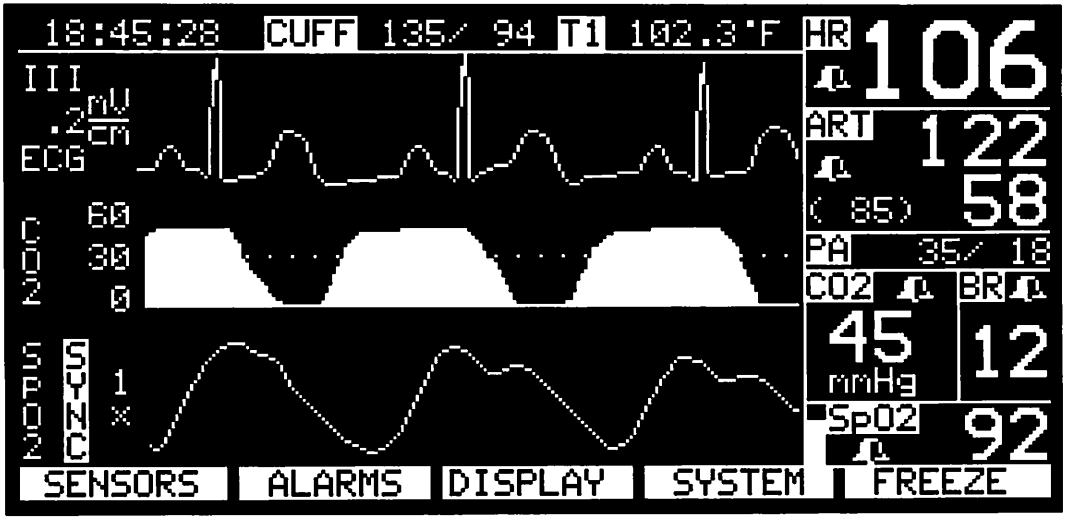
When you plug in the sensor, CO_2 monitoring turns on automatically.

When monitoring status is Off, the word OFF is shown in place of CO_2 and BR numerics. An Equipment Alert is displayed if the CO_2 sensor is disconnected.

The waveform window remains active until you turn off the CO_2 waveform in the Display Wave Select status window.

How CO_2 is Displayed

CO_2 levels are normally shown on the Propaq screen in two forms: a CO_2 waveform and an end-tidal CO_2 ($ETCO_2$) numeric value as seen in Figure 2-45. When inspired CO_2 ($INCO_2$) numeric values are at alarm levels or greater than 7.5 mmHg (1 kPa or 1%), they are shown numerically along with the $ETCO_2$ value. The measured breath rate (BR) is displayed to the right of the CO_2 values, as shown in Figure 2-45.



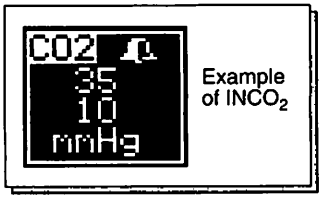


Figure 2-45. EL display showing CO_2 waveform and Breath Rate numerics

Apnea Alarm

When an apnea event is detected, the BR numeric automatically goes to 0 and an apnea alarm occurs.

During the alarm, the CO_2 waveform is automatically displayed until the patient takes a breath, which cancels the alarm. After the alarm is cancelled, an Apnea Ticket is printed, if the Apnea Ticket setting in the Printer Setup window is set to ON.

Sample Apnea Tickets are shown in Figure 2-46.

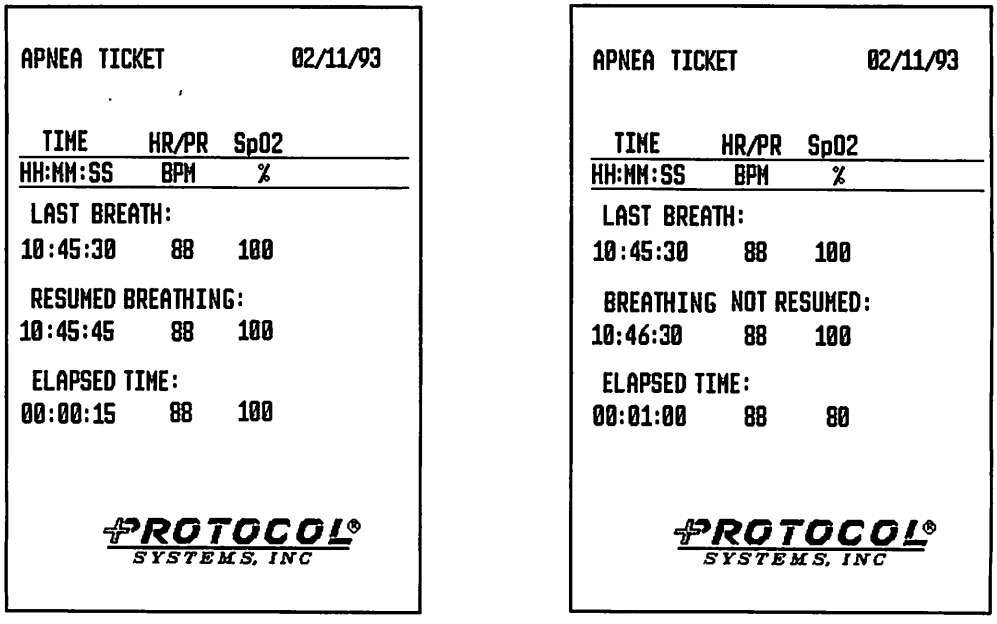


Figure 2-46. Examples of Apnea Tickets

The Apnea Ticket is printed after the patient resumes breathing (left printout) or when the clock reaches 60 seconds (one minute) if the patient has not resumed breathing (right printout). The Apnea Ticket setting must be set to ON.

Printing CO_2

Waveform and Numerics. You can print the CO_2 waveform by pressing the SNAPSHOT or START/STOP button on the front of the printer. Breath Rate (BR), end-tidal CO_2 ($ETCO_2$), and inspired CO_2 ($INCO_2$) numeric values appear in the numeric area above the waveforms.

The number of seconds of data shown on the printout depends on the print speed set in Printer Setup window. See Chapter 1 for information on print speeds and their effects on the printouts.

Apnea Ticket. The Apnea Ticket documents the length of each apnea episode. To set the Propaq to print an Apnea Ticket after an apnea event, follow these steps.

1. From the main menu, press the following buttons: SYSTEM > PRINTER.
2. Press the NEXT button until APNEA TICKET is highlighted in the Printer Setup window.
3. Press the CHANGE button until APNEA TICKET is set to ON.

CO_2 Messages

Equipment Messages regarding the CO_2 Option can appear on the display in an equipment alert window and in numeric zones. These messages, their meanings, and possible solutions are described below.

ALTIMETER FAILURE, RANGE. This message appears when the Propaq is operated at an altitude out of the CO_2 option's operating range. The option's operating altitude is -2,000 to 15,000 feet. Returning the monitor to within this range will automatically cancel this message and restore operation.

ALTIMETER FAILURE, RATE. This message appears when the altimeter detects an altitude change rate greater than 100 mm/minute. The altitude change rate must be less than 100 mm/minute. When it is within this range, simply disconnect and reconnect the CO_2 sensor to the Propaq.

DEGRADED WAVEFORM. This message appears along with UNCAL in the CO_2 numerics area when the CO_2 mainstream adapter is obstructed or the CO_2 sensor has failed. The CO_2 waveform is displayed without range values. Replace the adapter or replace the sensor.

LACK OF WAVEFORM, SENSOR DISABLED. This message appears when either the adapter is obstructed or the CO_2 sensor has failed. Replace the adapter if it is obstructed. Sensor must be unplugged and plugged in again.

LOW BATTERY, HEATER DISABLED. This message appears along with UNCAL in the numerics area when the Propaq's battery voltage is less than 7.3 volts. The CO_2 waveform is displayed without range values. To continue operation, plug the ac power adapter into the Propaq and operation will automatically be restored when the battery voltage becomes high enough. Ensure that the battery is fully charged before you unplug the power adapter.

NO SENSOR DETECTED. This message appears when the CO_2 sensor has been disconnected from the Propaq after providing CO_2 values. The breath rate numeric area displays SRCH. Check the sensor connection. Disconnect and reconnect the sensor to the Propaq if necessary.

NON-PROTOCOL SENSOR. This message appears along with UNCAL in the CO_2 numerics area when a CO_2 sensor has been connected that does not match Protocol's specifications. The CO_2 waveform is displayed without range values. Replace the sensor with a Protocol Systems CO_2 sensor.

SENSOR FAILURE , E2PROM. This message is caused by a sensor that is defective or out of calibration. The sensor will be disabled until disconnect.

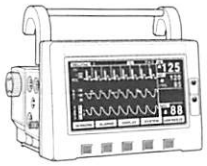
SENSOR FAILURE , E2PROM. This message appears when the sensor has failed. Replace the sensor.

SENSOR FAILURE, HEATER. This message appears when the sensor temperature control circuit or the Propaq's CO_2 circuitry has failed. Try replacing the sensor. If the message reappears, have the Propaq serviced.

SENSOR FAILURE, MOTOR DRIVE. This message appears when the sensor's motor drive (in the sensor head) has failed. Replace the sensor.

SENSOR TEMPERATURE TOO HIGH. This message appears when the sensor's temperature is too high. The sensor's operating range is 10° to 46° C. When the ambient temperature is returned within this range, this message will be removed automatically and operation restored.

WARM UP or **WARM.** This message appears in the CO_2 numerics area while the sensor heater is warming up. Wait 20 to 30 seconds for the sensor to heat. Values should appear in the numerics area once the sensor is warm.



3

Alarms and Limits

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Alarms Window and Menu

The alarms status window and Alarms Menu appear when you press ALARMS in the Main Menu. These give you immediate indications and control of the Propaq's alarms.

APPLICATION HELP

The best way to become efficient at setting Propaq alarms is to practice the procedures in this chapter using the Propaq's in-service mode. You can use the in-service mode's simulated data to set and change alarms, and to practice responding to patient and equipment alarms. See Learning the Propaq on page 1-66 for more information on the in-service mode.

Alarms Status Window

The alarms status window (Figure 3-1) indicates the alarms status of each vital sign parameter. The presence of a bell symbol (full or half) shows you that alarm limits are turned on and set for the vital sign parameter. The full bell indicates all alarm limits are turned on. The half bell indicates at least one alarm limit is turned off. The absence of a bell shows you that no alarm limits are turned on. Bells only appear when at least one limit is turned on and the vital sign parameter is being monitored.

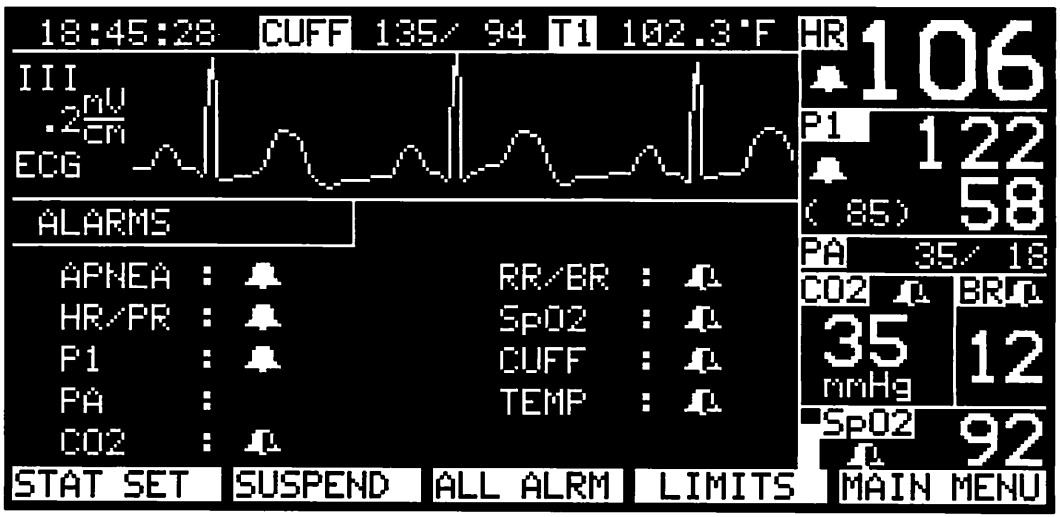


Figure 3-1. Alarms Status Window

Alarms Menu

The Alarms Menu shown below the status window in Figure 3-1 lets you access other alarm functions to automatically set alarm limits or individually set them. The menu also lets you silence the alarm tone that occurs when a limit is violated.

Adjusting the Alarm (Bell) Tone

You can adjust the loudness of the alarm tone to one of three volumes. Except for temporarily suspending the alarm tone using the SUSPEND button, you cannot turn off the tone completely.

The alarm tone function is set using one of the Display Menu functions. To adjust the alarm tone volume, press DISPLAY, then MORE, and then MORE again. The display status window appears (Figure 3-2). Use the NEXT button to select the Alarm Tone function. Use the CHANGE button to change the setting.

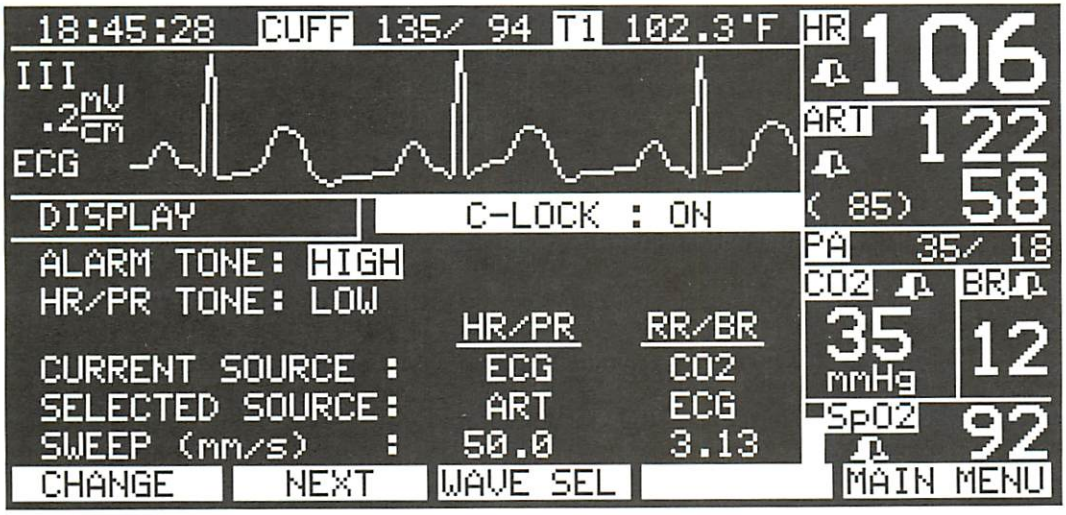


Figure 3-2. Alarm tone setting

The alarm tone loudness is changed using the functions of the Display Menus and the display status window.

Types of Propaq Alarms

The Propaq can alert you to changing patient conditions (Patient Alarms) and changing equipment conditions (Equipment Alerts). Both require your attention.

Patient Alarms: Definitions and Indications

The Propaq can alert you to changing patient conditions through its easily programmable alarm functions. Once you set alarm limits, any vital sign that violates any of its limits results in both audible and visual alarm indications. The Propaq also shows you when any alarm limit is turned off by illuminating the amber ***ALARM(S) OFF*** light. Table 3-1 on page 3-7 summarizes the Propaq alarm indications. The following information provides details on the Propaq alarms.

A steady, high-pitched, clearly audible alarm tone sounds whenever a limit is violated on most patient channels. The tone for SpO_2 alarms is lower in frequency. In addition, Apnea alarm tone is one second on, one second off.

The alarm tone continues until

- ❑ the patient condition changes and no longer violates the limit,
- ❑ you *suspend the alarm tone* by pressing the SUSPEND button,
- ❑ you *reset the alarm limit* so the vital sign does not violate it,
- ❑ you *turn off* the violated alarm limit.

Table 3-1: Alarm Indications

ALARM Light	ALARM(S) OFF Light	Tone	Numeric	Bell	Condition
OFF	ON	OFF	ON	OFF	No alarm and alarms off.
ON	ON	ON	FLASH	ON	Patient alarm and at least one alarm on.
ON	OFF	ON	FLASH	ON	Patient alarm and all alarms on.
ON	X [a]	OFF	ON	ON	Temporary Patient alarm. Check Alarms Parameter window for parameter that caused alarm. [b]
OFF	FLASH	OFF	ON	X [c]	No alarm and alarms suspended.
FLASH	OFF	OFF	FLASH	ON	Suspended patient alarms.

[a] The state of this light doesn't matter for the condition.

[b] To turn off the ***ALARM*** light, view each alarms parameter window until you find the limit with an asterisk (*) next to it. This limit caused the alarm. (It is possible to have more than one parameter cause a temporary alarm.) The asterisk(s) are cleared when the alarms parameter window is removed by pressing MAIN MENU.

[c] The state of the bell (ON or OFF) indicates whether alarms were on or off before they were suspended.

note...

See Table B-7 on page B-18 for more information on tones and flashing rates of lights and messages.

Visually, the alarm limit violation is indicated by the illuminated red ***ALARM*** light on the front panel and by the slowly flashing vital sign numeric that violates the limit. When the alarm first occurs, a Patient Alarm Menu is displayed allowing you to immediately respond to the condition. Figure 3-3 shows a Propaq with a patient alarm.

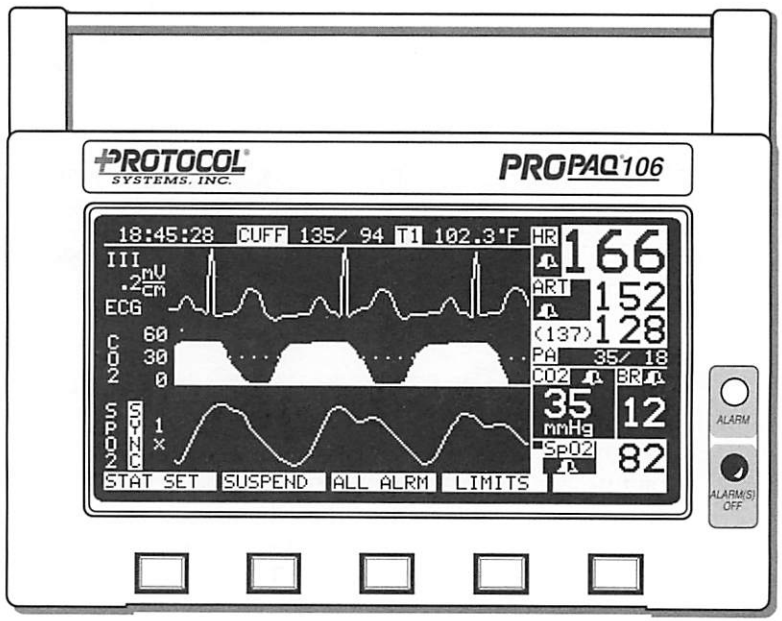


Figure 3-3. Patient alarm indicators

The Propaq alerts you of patient alarms through flashing numerics and illuminated ALARM light.

The Propaq's ultrasmart capabilities include being able to let you know when a patient's condition changed, causing an alarm to occur in your absence, but later changed again and no longer violates a limit (*temporary alarm*). See **Responding to Equipment Alerts** on page 3-17 for more information on temporary alarms.

You can also have the Propaq automatically print the patient's vital sign information when an alarm occurs. (See **Printing When a Patient Alarm Occurs** on page 3-13.)

Life-Threatening Alarms

A life-threatening alarm is the highest priority patient alarm. You are notified of any life-threatening alarm as soon as it is detected regardless of any other patient alarms or equipment alerts. An apnea alarm is an example of a life-threatening alarm. For more information on apnea events and alarms see **Apnea Events** on page 2-80.

Responding to Life-Threatening Alarms

During a life-threatening alarm, you can SUSPEND the alarm tone and adjust the Alarm Limits. See **Responding to Patient Alarms** below for a description of the SUSPEND function. The STAT SET and ALL ALRM keys are not available for life-threatening alarms.

Responding to Patient Alarms

During a patient alarm, typically the first thing you will want to do is temporarily turn off the alarm tone. You can immediately do this by pressing the SUSPEND button in the Patient Alarm Menu, which is automatically displayed as soon as the alarm occurs. The tone is suspended only for 90 seconds with all alarm monitoring. After that period, the tone will again sound if the alarm condition still exists; alarm monitoring will also resume. You can "unsuspend" the alarm before 90 seconds has elapsed by pressing the RESUME button in the Alarms Menu. If an alarm condition still exists, the tone will again sound.

WARNING

Suspending an alarm tone also suspends all alarm monitoring for 90 seconds or until the RESUME button is pressed.

When you suspend the alarm, the Patient Alarm Menu is removed, and the red ALARM light begins to slowly flash, indicating a suspended patient alarm condition. If you were looking at the patient's trends on the Propaq or making some other monitor-setting adjustments prior to the alarm, whatever was displayed prior to the alarm is again displayed.

Once the alarm tone has been suspended and the patient's condition has been assessed and responded to, you can make Propaq alarm adjustments if necessary. Possible adjustments in order to cancel the alarm are (the buttons you press to achieve the following results are indicated in parentheses):

- ❑ Turn off all alarm limits by pressing ALL ALRM in the Alarms Menu (ALARMS > ALL ALRM). See **Turning On and Off All Limits** on page 3-21.
- ❑ Automatically recalculate and reset all alarm limit values so they don't produce a violation by pressing STAT SET in the Alarms Menu (ALARMS > STAT SET). See **The Quickest Way to Set Limits (STAT SET and PARAM SET)** on page 3-19.
- ❑ Turn off the alarm limits only for the violating vital sign by pressing PARAM OFF in the Limits Menu once you've selected the appropriate vital sign *limits window* (ALARMS > LIMITS > NXT PAGE > PARAM OFF); all limits for the violating vital sign are turned off. See **The Quickest Way to Set Limits (STAT SET and PARAM SET)** on page 3-19.

- ❑ Automatically recalculate and reset the limits only for the violating vital sign by pressing PARAM OFF and then PARAM SET in the Limits Menu once you've selected the appropriate vital sign limits window (ALARMS > LIMITS > NXT PAGE > PARAM OFF > PARAM SET). See **The Quickest Way to Set Limits (STAT SET and PARAM SET)** on page 3-19.

- ❑ Manually change the violated alarm limit value by selecting the violated limit value and adjusting it or turning it off (see **Changing Individual Limits** on page 3-21).

During a **temporary alarm**, typically you will first want to find out which vital sign violated its limit. (Since the condition that caused the alarm no longer exists, the alarm tone no longer sounds and the Patient Alarm Menu is not displayed.) To find the violating vital sign, you locate the alarm limit value with an asterisk character (*) displayed next to it (Figure 3-4 on page 3-12). The steps are simple:

1. Press ALARMS and then LIMITS to display the first limits window.

2. Once the asterisk is located, the ALARM light turns off.

3. Press NXT PAGE until all asterisks are located (in the event of multiple alarm violations).

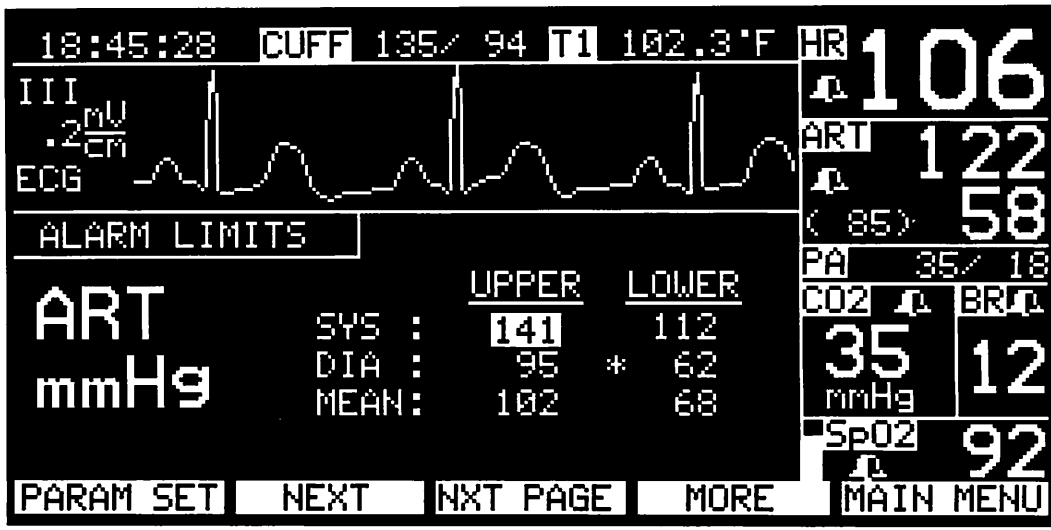


Figure 3-4. Alarm Limits Status Window

An asterisk next to a limit indicates a temporary alarm limit violation.

Printing When a Patient Alarm Occurs

If your Propaq monitor includes the optional Expansion Module with Printer (EMP), you can have the Propaq print the patient's vital signs information whenever a patient alarm occurs. The printout includes waveforms and patient numerics for 20 seconds: the first 12 seconds of the printout shows the patient's condition prior to the alarm; the last 8 seconds shows the patient's condition from the start of the alarm. The alarming parameter numeric is shown in a block of black with white type. Figure 3-4 illustrates a typical patient alarm printout.

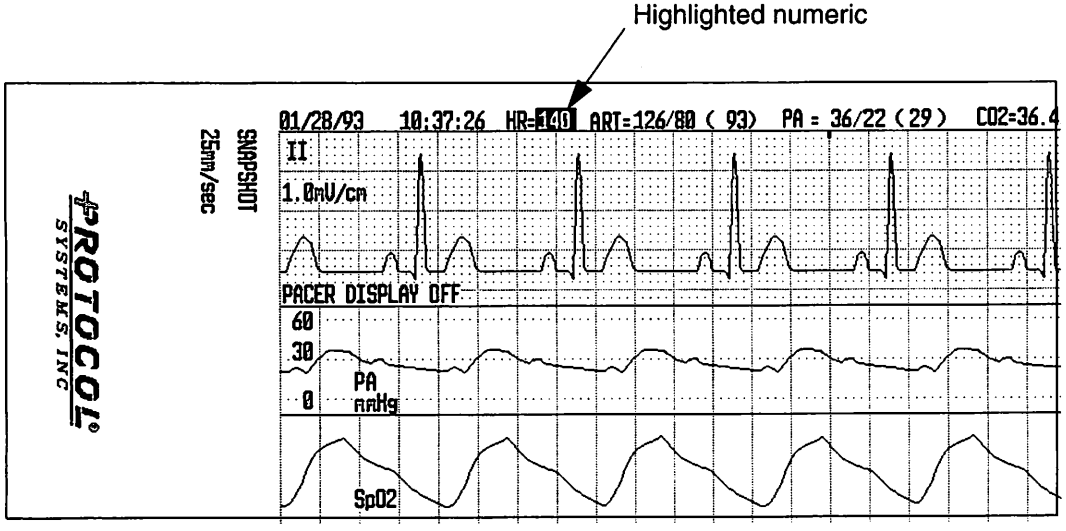


Figure 3-5. Vital signs in alarm

The printout indicates vital signs in alarm with numerics highlighted by a black background.

To set up the printer to print on a patient alarm, follow these steps.

1. From the Main Menu, press the following buttons: SYSTEM > PRINTER.
2. The printer setup window appears (Figure 3-6).

   Use the Printer Menu's NEXT button to select ALARM PRINT in the printer status window.
3. Press the CHANGE button until ALARM PRINT is set to ON.
4. Press the MAIN MENU button.

   Make sure the printer contains enough paper. See **Loading Paper** on page 5-12 if you need instructions for changing the paper.

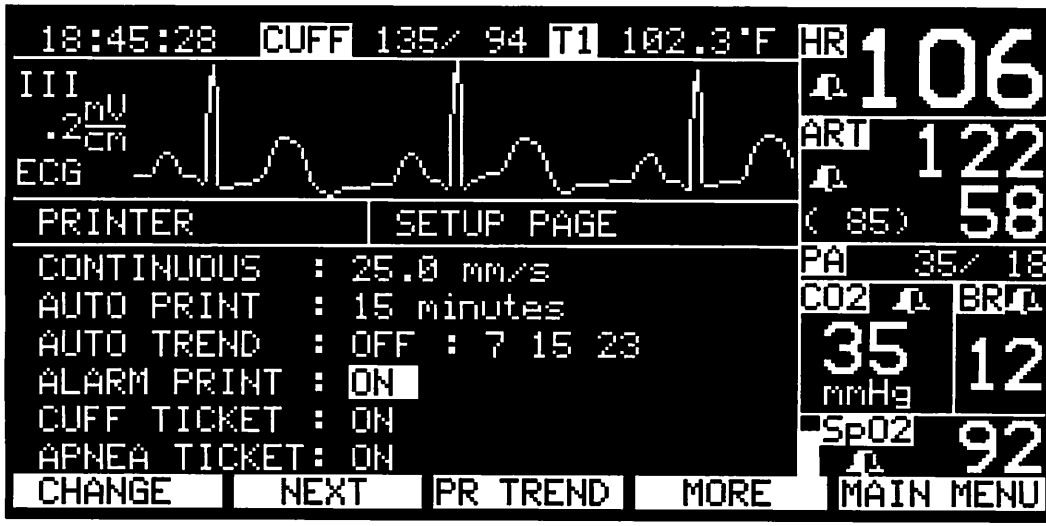


Figure 3-6. Printer Setup Window

To activate printing on alarm, you turn on the ALARM PRINT function in the printer setup window.

Equipment Alerts: Definitions and Indications

The Propaq can alert you to changing equipment conditions, such as disconnected or faulty sensors, low battery voltage, lost programmed settings, and many other conditions that can affect patient monitoring. An *equipment alert* results in audible and visual indications.

If an equipment alert condition is detected, a high-pitched, clearly audible alarm tone sounds for one second followed by four seconds of silence. This alert tone pattern repeats until you respond to the equipment alert or the equipment condition is corrected. In addition, an equipment alert window appears on the display identifying the faulty equipment condition. Some equipment conditions also result in a caution message alternating with the time of day, cuff, or temp numerics. Table 3-2 on page 3-16 lists caution messages that appear here. An example of an equipment alert window and caution message is shown in Figure 3-7.

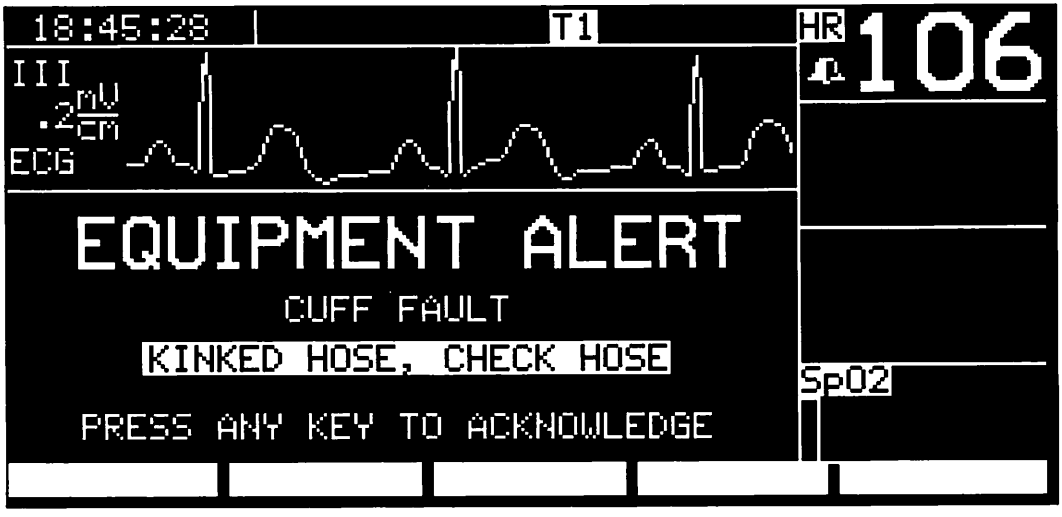


Figure 3-7. Cuff Equipment Alerts

Equipment alerts notify you of Propaq conditions needing your attention.

Table 3-2: Caution Messages

Message	Condition	Possible Correction
LOW BATT	Low battery voltage.	Plug the Propaq into ac mains using the power adapter to recharge the battery.
ECG FAULT	Faulty ECG lead connections.	Check all ECG lead wires, electrodes, and cable.
PRNT FAULT	Problem with the printer.	Check the printer paper, paper door, and general functionality of printer.
SIMULATING	In-service mode is activated; simulated patient data is being displayed and saved in trend memory.	To deactivate, turn Propaq off and then on. See **Learning the Propaq** on page 1-66.
ON NETWORK[a]	The network is active.	Not applicable.

a. Only on models with the Acuity Network option and when connected to the network.

The equipment alert tone continues to sound and the window remains on the display until

- ❑ the equipment condition is corrected
- ❑ you press any button

Some equipment conditions resulting in an equipment alert also interrupt normal patient monitoring and cause a patient alarm. Patient alarms always take precedence over an equipment alert. If an equipment alert occurs followed by a patient alarm, the Patient Alarm Menu is automatically displayed with the equipment alert window above the menu.

Responding to Equipment Alerts

During an equipment alert, typically the first thing you will want to do is turn off the alert tone. You can immediately do this by pressing any button. If the equipment alert also resulted in a patient alarm, you can suspend the tone and then assess the patient and the equipment.

WARNING

Suspending an alarm tone also suspends all alarm monitoring for 90 seconds or until the RESUME button is pressed.

For some equipment alerts, such as a lead failure caused by patient movement pulling off a lead wire from its electrode, all that is necessary is to correct the condition. The Propaq immediately recognizes the corrected condition and resumes normal monitoring.

Other equipment conditions, such as a faulty transducer, require more attention. In such cases, if the equipment condition also caused a patient alarm, you will need to first suspend the alarm tone by pressing SUSPEND. You can then replace the sensor or take whatever action is necessary.

After you have replaced a sensor, the Propaq automatically detects the new sensor and activates the patient channel, resuming normal monitoring. If you replace a pressure transducer, the Propaq resumes monitoring only after the transducer has been zeroed. The Propaq returns the channel to its settings prior to the equipment alert. If a patient alarm occurred and you turned off any alarm limits, you will need to turn them back on. You can quickly assess which alarm limits are turned on by pressing ALARMS in the Main Menu. See **Setting Alarm Limits** on page 3-19.

Cuff Equipment Alerts

For a cuff equipment alert (other than CUFF CAL), you can continue to take cuff measurements (after any kinked hoses, leaks, etc., are fixed). However, if there is a cuff problem, and you suspect cuff readings, use another method to take noninvasive blood pressures and have the monitor serviced.

Acuity™ Network Equipment Alerts

For an Acuity communication alert that is caused by intentionally disconnecting the Acuity communications cable, reconnect the cable to resume communications. However, if there is an actual communication failure, it should be further investigated by a service person.

PROGRAM FAULT Equipment Alert

If a "PROGRAM FAULT: SETTINGS LOST, TIME/DAY RESET" equipment alert appears when you first turn on the Propaq, the monitor cannot recall the current time and the programmed turn-on settings. This is usually caused by a drained lithium battery inside the Propaq. The monitor can be used, but all settings will be set to their factory defaults each time you turn on the monitor. The monitor should be serviced and the battery replaced. See the *Propaq Service Manual.*

Setting Alarm Limits

The Propaq allows you to quickly set alarm limits with minimal button pushes, and also gives you complete control over individual limits for tailoring each vital sign alarm limit according to your protocols.

The Quickest Way to Set Limits (STAT SET and PARAM SET)

When it is necessary to immediately set alarm limits, simply press the STAT SET button in the Alarms Menu (ALARMS > STAT SET). The Propaq quickly turns on all alarm limits and calculates the alarm limits for all vital signs that are being monitored. The calculated values are based on the patient's current values as shown in Table 3-3 on page 3-20.

Table 3-3: Stat Set and Param Set Limit Calculations

Parameter	Lower Limit	Upper Limit
Heart Rate	HR × 0.8 + 5	HR × 0.8 + 50
Cuff Systolic	SYS × 0.68 +10	SYS × 0.86 + 38
Cuff Diastolic	DIA × 0.68 + 6	DIA × 0.86 +32
Cuff Mean	MN × 0.68 + 8	MN × 0.86 + 35
Invasive Pressure ≤ 25	Invasive Pressure - 5	Invasive Pressure + 5
Invasive Pressure = 26 to 99	Invasive Pressure × 0.8	Invasive Pressure × 1.2
Invasive Pressure ≥ 100	Invasive Pressure - 20	Invasive Pressure + 20
Temperature	Temp - 0.5	Temp + 0.5
SpO_2 <95	SpO_2 - 5	100
SpO_2 ≥95	90	100
$ETCO_2$	-5 mmHg -0.7 for % and kPa	+10 mmHg +1.4 for % and kPa
$INCO_2$	N/A	$INCO_2$ + 5 $INCO_2$ + 0.7 for % and kPa
Breath Rate (BR)	BR × 0.5	BR × 1.5
Apnea Delay	Is not affected by STAT SET	Is not affected by STAT SET

If you need to quickly set alarm limits for just one vital sign, use the PARAM SET button. PARAM SET automatically calculates the alarm limits in the same way STAT SET does, however, PARAM SET only affects the vital sign parameter you select with the NXT PAGE button.

The PARAM OFF function, which uses the same button as PARAM SET, automatically turns off all limits for just the selected parameter. When you first select a vital sign parameter's window you will see the PARAM OFF button if limits are already set for the parameter (see Figure 3-8 on page 3-23), and you will see the PARAM SET button if no limits are set.

To reset limits for just one parameter, press the PARAM OFF button once and then press PARAM SET. This process first turns off limits and then recalculates and resets limits just for the selected parameter.

Turning On and Off All Limits

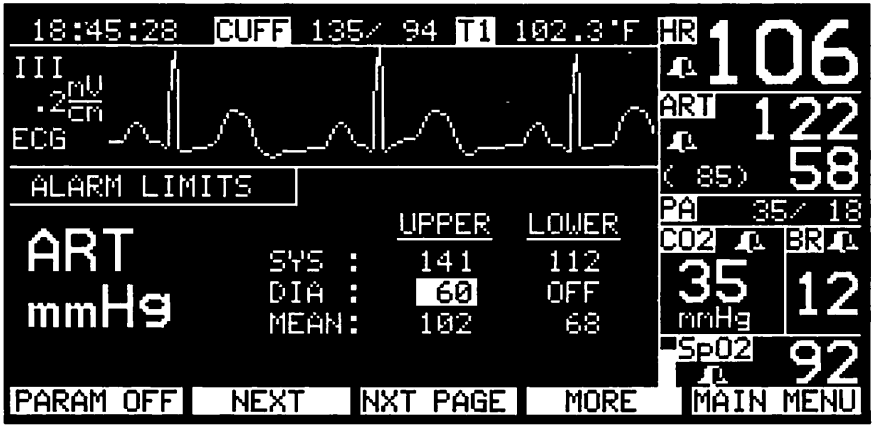
Whenever you press STAT SET or PARAM SET, the Propaq calculates the alarm limits and turns them on, only for monitored channels. If you only want to turn all limits on and off, without changing their values, press the ALL ALRM button in the Alarms Menu. The alarms status window lets you know when all alarms are on or off by the displayed bells. See **Alarms Status Window** on page 3-4 for more information.

Changing Individual Limits

Sometimes it is necessary to set or change a single alarm limit. Or, your hospital's protocols may use different protocols from the Propaq's to calculate alarm limits. You must then set each alarm limit according to your hospital's protocols, or program the Propaq to turn on with the limits you want.

Setting each limit is a simple process which includes (1) selecting the desired vital sign parameter window, (2) selecting the limit to adjust, (3) selecting the Limits Adjust Menu, and (4) changing the limit.

1. From the Main Menu, press ALARMS.
2. Press LIMITS to display the alarm limits window and the Limits Menu (Figure 3-8 on page 3-23).
3. Press NXT PAGE to change to the desired alarm limit window.
4. Press the NEXT button to move the cursor. Continue to press NEXT until the desired limit is selected.
5. Press the MORE button to select the Limits Adjust Menu.
6. Press ON/OFF, UP, or DOWN to set the limit to the desired limit value.
7. When the limit is set, press the MORE button and select the next limit with the NEXT button. Or, to select another vital sign, press NXT PAGE.
8. Repeat steps 4 through 6 to adjust the desired limits.
9. Continue the process until you've set all the limits you want.



Select limits by pressing the NEXT button and then pressing the MORE button to access the Limits Adjust Menu (bottom picture). Adjust limits by pressing the UP and DOWN buttons. Select the next limit by pressing the MORE button and the NEXT button. Select the next vital sign by pressing the NXT PAGE button.

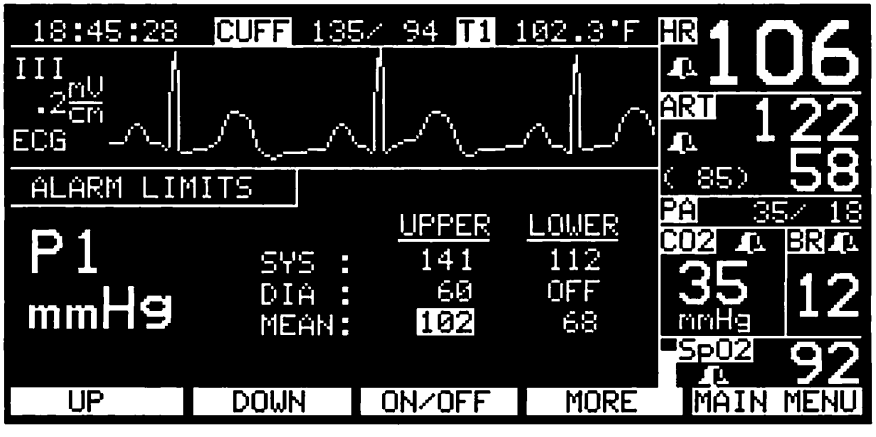
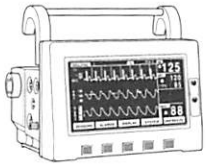


Figure 3-8. Alarm Limits Menus and Limits Windows

Programming Propaq Alarm Limits

Although setting the Propaq's alarm limits can be automatic with STAT SET and PARAM SET, you can also program the limits you want to appear every time you turn on the monitor. If, for example, patients in your unit are typically stable enough that you generally set alarm limits to the same values for nearly every patient, you can program these values into the Propaq so that when you begin monitoring, the alarm limits are already set. You only need to check that the alarms don't need minor adjustment because of the patient's condition.

When you program the alarm limits, you also program several other Propaq settings, including display settings, such as contrast (LCD models only) and wave selection, and all vital sign parameter settings, such as heart rate tone, heart rate source, sweep speed, and temperature units to name just a few. So when you want to program the alarm limits, be sure you check all Propaq settings to ensure they are set as you want them each time you turn on the Propaq. Programming the Propaq is described in Chapter 1. You should always follow the programming instructions in Chapter 1 to be sure you program the Propaq exactly the way you want.



4

Trends

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Trend Types

The Propaq can show you a patient's vital signs over the last several hours. Every two minutes, the Propaq averages the monitored vital signs and stores them in its trend memory, which can save the last eight hours of trend information. All this information can be printed on the Propaq Printer and viewed as a trend print. The last five hours of data can be viewed on the display. You can view trends either as a table (tabular trends) or as a graph (graphical trends).

Tabular Trends

A tabular trend shows you the last five noninvasive blood pressures, SpO_2, CO_2, and breath rate readings as a table (Figure 4-1).

The table shows the time, systolic, diastolic, and mean pressures, the pulse rate determined for each cuff measurement, and the SpO_2 value at the time the cuff measurement was taken (if available). If the Propaq was set to automatically take noninvasive pressure measurements at a selected interval, you can easily determine the interval by checking the time column.

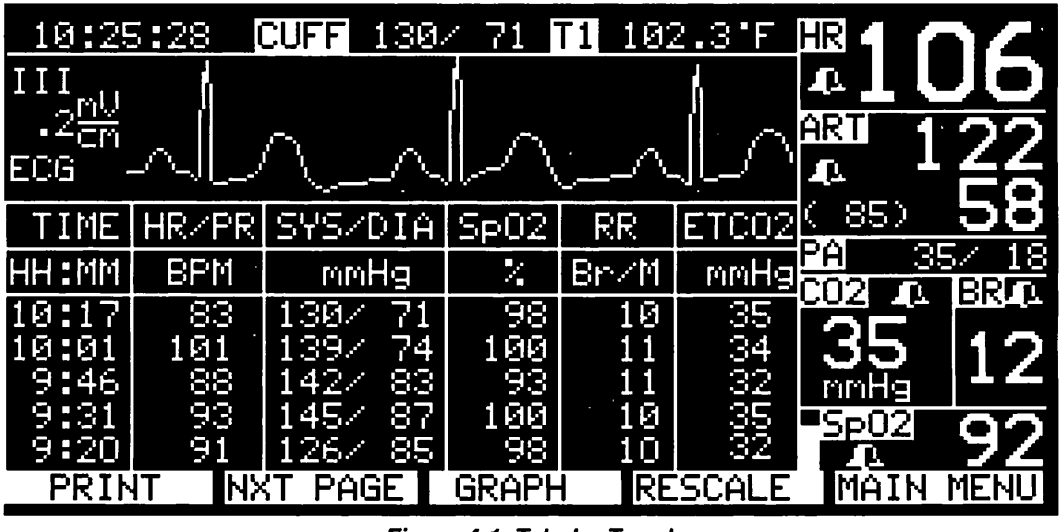


Figure 4-1. Tabular Trends

The Propaq tabular trend shows the last five measurements for cuff, SpO_2, pulse rate, CO_2, and breath rate.

Graphical Trends

A graphical trend shows the trend values plotted against time with each point representing the patient's vital signs averaged over a two minute period.

There are three types of trend graphs—single-point, two-point, and three-point graphs. Table 4-1 lists the types of graphs displayed.

Table 4-1: Graphical Trends

Points Graphed	Parameters Graphed	Figure Reference
Single-Point	Heart Rate, Breath Rate, SpO_2, Single Temperature	Figure 4-2 on page 4-5
Two-Point	Two Temperatures, CO_2	Figure 4-3 on page 4-5
Three-Point	Cuff, Invasive Blood Pressure	Figure 4-4 on page 4-6

Except for cuff, all vital signs are continuously monitored from the time monitoring begins to the time it ends. If a monitored vital sign value dramatically changes (for example, goes to 0) at any time during monitoring, the value is considered a "real" value and averaged with other values, which affects the displayed trend value. This dramatic change can show up in the trend as a large difference between adjacent trend points. Continuously monitored values are always trended, except for the cuff measurement. Cuff is a special graphical trend situation.

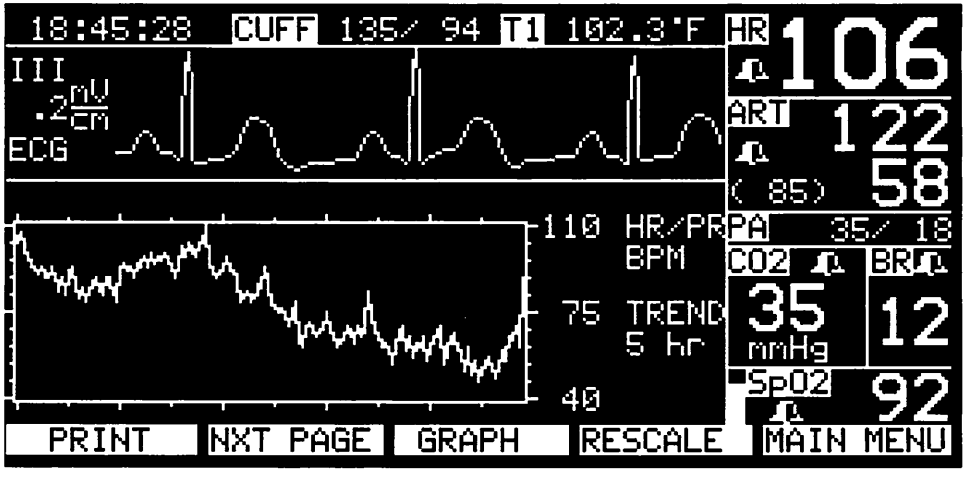


Figure 4-2. Single-point graph

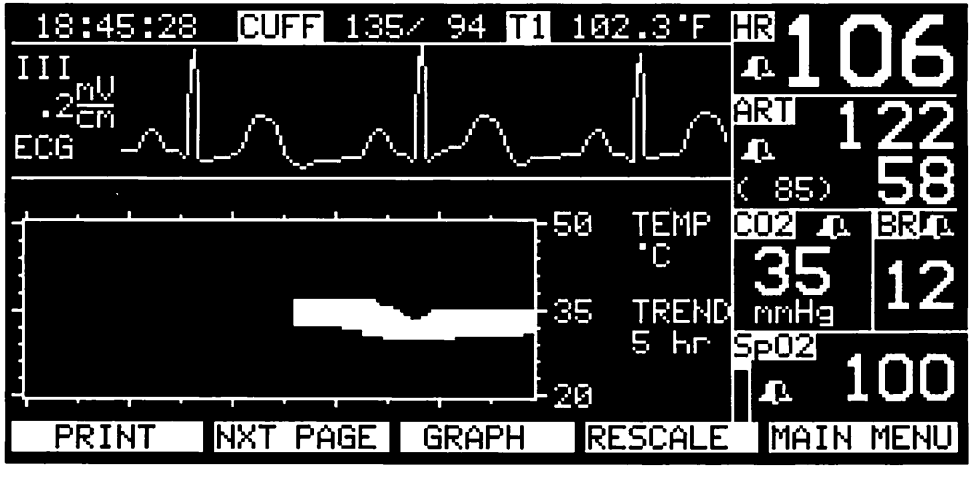


Figure 4-3. Two-point graph

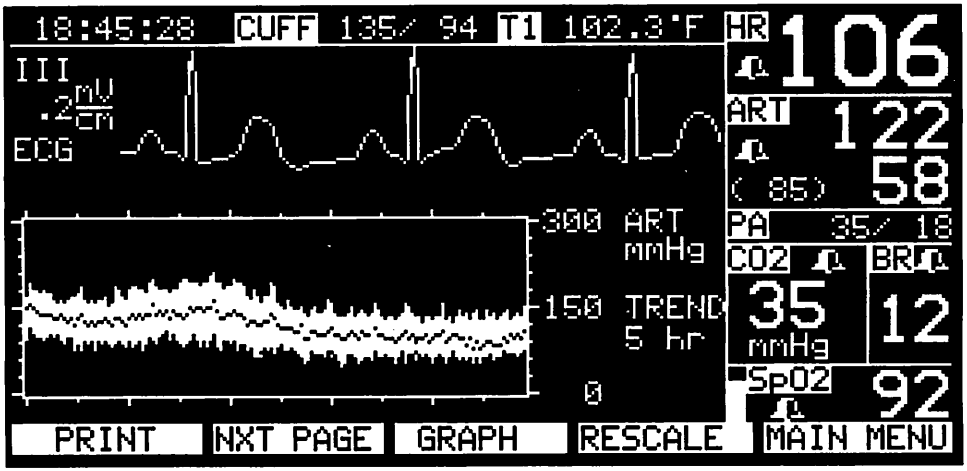


Figure 4-4. Three-point graph

Cuff is not measured continuously like other vital sign parameters; cuff measurements are "discontinuous". The smallest interval at which the Propaq can take cuff measurements is 30 seconds, except for cuff's turbo-cuf mode. The longest automatic cuff interval is 60 minutes.

When trends are averaged every two minutes, the Propaq averages only the cuff measurements actually taken. If the Propaq obtained cuff measurements only twice over a two-minute period, then only the results of those two measurements are averaged. Figure 4-5 shows graphed cuff measurements. The Propaq's cuff measurements are accurately trended.

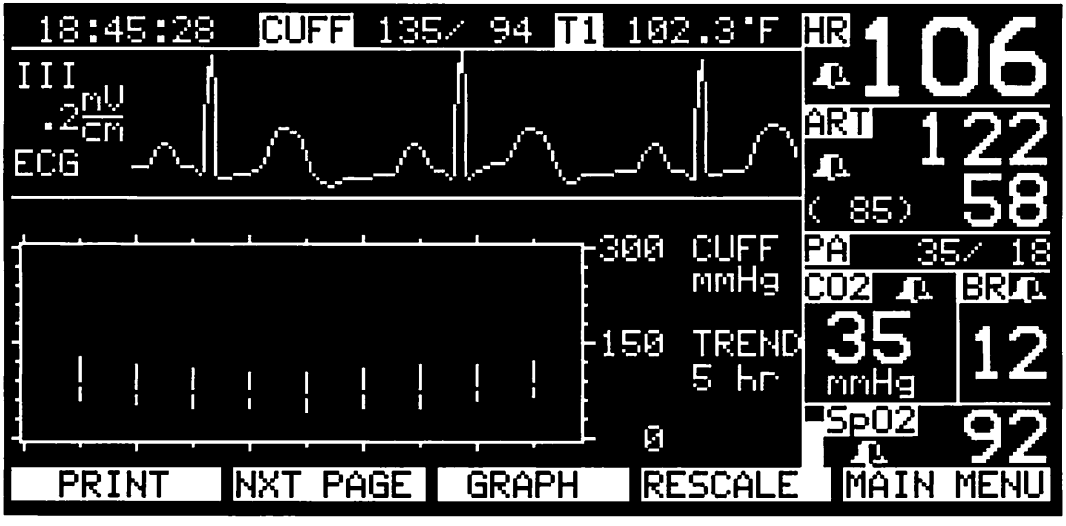


Figure 4-5. Cuff Trend

The cuff trend is a "discontinuous" trend, averaging only the cuff measurements actually taken over a two-minute period.

Displaying Trends

Displayed trends show the last five hours of data. Trends are displayed only if you have one waveform turned on in the wave selection window, or, if more than one waveform is displayed, when you press the TREND button in the Display Menu.

Trend Menu

The Trend Menu allows you to select trended data for display, change the scales of the displayed trend, and print the displayed trend if a printer is attached.

Figure 4-6. Trend Menu

The Trend Menu is accessed by pressing the DISPLAY and then TREND.

Selecting a Trend (NXT PAGE)

Except for temperature, all vital sign parameters are shown on their own trend graph. If two temperatures are monitored, both are shown on one graph. You select the trend you want displayed by pressing the NXT PAGE button.

The trend is identified by a label to the right of the scale. The trend labels are:

- ❑ HR/PR source for heart rate/pulse rate as selected by the HR/PR source within the Display menu.
- ❑ P1, P2, ART, PA, CVP, and ICP for invasive pressures (the trend uses the selected label)
- ❑ $ETCO_2$ for end-tidal CO_2
- ❑ $INCO_2$ for inspired CO_2
- ❑ BR for breath rate derived from CO_2

- ❑ CUFF for noninvasive pressures
- ❑ SpO_2 for oxygen saturation
- ❑ TEMP for T1, T2, and ΔT

Changing the Trend Scale (GRAPH and RESCALE)

Each parameter has three scales to allow the best viewing of the trend. Besides the three scales, the cuff trend can also show in a table the last five cuff measurements with the time and pulse rate. You select the desired scale by pressing the GRAPH button. The scales for each trend are listed in Table 4-2 on page 4-10.

The Propaq's ultrasmart capability can also automatically select the best graph for the current trend values with its rescale function. Each time you press the RESCALE button, the Propaq examines the highest and lowest values for each trend and automatically selects the scale for the best viewing of the trend.

note...

Rescale considers the last 8 hours of trend information and includes data that may not be visible on the display.

Table 4-2: Trend Display Scales

Vital Sign Parameter	Lowest Values	Highest Values
Heart Rate/Pulse Rate	0 25 50	250 125 100
Invasive Pressure	0 30 -30	300 180 70
Carbon Dioxide (CO_2) mmHg	0 0 0	100 60 30
Carbon Dioxide (CO_2) kPa	0 0 0	14 8 4
Carbon Dioxide (CO_2) %	0 0 0	14 8 4
Breath Rate (BR)	0 0 0	150 50 20
SpO_2	0 60 80	100 100 100
Cuff	0 0 50 Table of last five	300 150 100 Table of last five
Temperature (°F)	60 90 95	130 110 105
Temperature (°C)	10 25 30	50 45 40

Printing Trends

Printed trends are useful for reviewing the patient's vital signs over the last several minutes to the last eight hours. Some hospital protocols require printed trends to accompany patient records for each work shift. The Propaq has made it easy for you to print one or several trends whenever you want or automatically at a selected interval.

Printing a Single Trend

The best way to print just one trend is with the PRINT button in the Trend Menu (Figure 4-6). When you press the PRINT button, the displayed trend is printed using the scale shown on the display. However, instead of five hours of data, all eight hours of trend information are printed. If you want to print a trend different from the one displayed, press the NXT PAGE button until the desired trend is shown. Press the SCALE or RESCALE button to change the scale.

An example of a printed trend is shown in Figure 4-7.

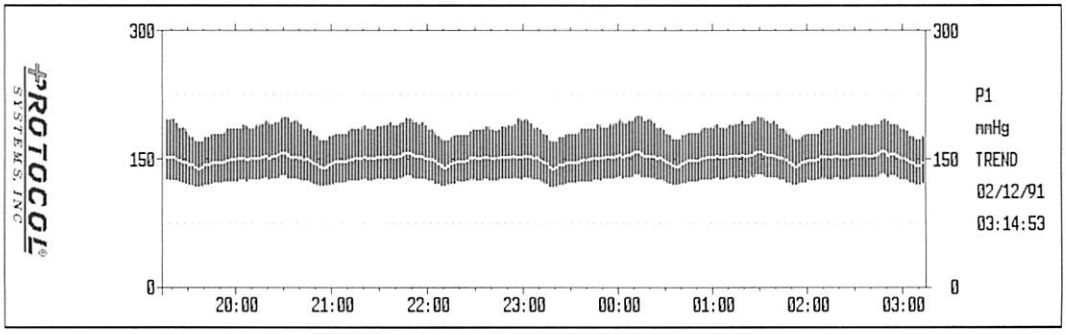


Figure 4-7. Trend printout

The trend printout prints up to the last eight hours of collected patient data.

Printing Several Trends

To print several trends at one time, you could select each trend with the Trend Menu and print it using the PRINT button. But a much quicker way is to set up the printer to print the trends you want and then press the PR TREND button in the Printer Menu whenever you want the trends printed. Here's how you do it.

1. From the Main Menu, press SYSTEM, then PRINTER, then MORE. The printer trend select window (Figure 4-8 on page 4-14) appears. In this window you turn on the trends you want printed and turn off the trends you don't want printed.

2. Using the NEXT and CHANGE buttons, select each of the trends you want printed and turn them on. Turn off all other trends.

3. Press MAIN MENU.

4. Using the Trend Menu, select each of the trends that is turned on in the trend select window and make sure the scale for the trend is the one you want printed. Press the SCALE or RESCALE button to change the scale. Or press the STATSCALE button in the Display Menu to change all scales.

5. Press MAIN MENU.

6. Now, each time you want to print the selected trends, you simply press SYSTEM, then PRINTER, and then PR TREND. It's a good idea to do that right after you've set up the printer to print trends so you make sure the trends print just the way you want them.

Printing Trends According to Shift

A common hospital protocol is to print trends for all monitored vital signs at the end of each work shift and place the printout in the patient's record. Work shifts usually run in 8-hour periods. You can set the Propaq to automatically print trends at 8-hour intervals by turning on the printer's AUTO TREND function in the printer trend select window (Figure 4-8 on page 4-14) and selecting the shift interval. Here's how you do it.

1. Select the trends you want printed as described in the previous section, **Printing Several Trends** on page 4-12.
2. After the trends are selected, press the PR TREND button in the Printer Menu to make sure the trends print just the way you want them.
3. Set AUTO TREND in the Printer Setup page to ON and then press the NEXT button to move the cursor to the print time.
4. Use the CHANGE button to select the print times. Select the print time according to the start time (hour) of each shift.

Once the Propaq is set up, it will print all the selected trends at each 8 hour shift. All you have to do is detach the printout from the printer and place it in the patient's records.

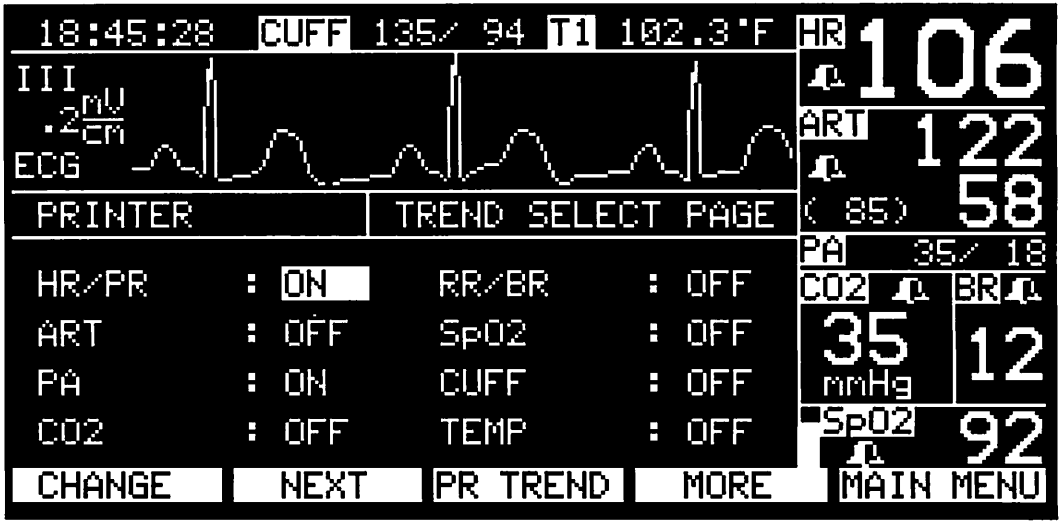
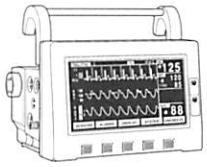


Figure 4-8. Printer Trend Select Window



5

Care and Maintenance

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Cleaning

Cleaning Recommendations

The Propaq should be wiped with a nearly dry cloth containing hydrogen peroxide solution, Cidex®, or warm water and a mild detergent. Be sure to thoroughly wipe any residual cleaning solution from the enclosure of the Propaq. Do not allow the cleaning solution to run into crevices or connector openings. Isopropyl alcohol or other solvents should not be used for cleaning. Refer to Table 5-1, on page 5-4 for a list of cleaning agents OK to use on the Propaq.

The cuff should be cleaned by sponging with a damp cloth. If washing is necessary, the air bladder should be removed and the cuff hand-washed with soap or detergent-disinfectant. After washing, the cuff should be air-dried.

Cables, cuff tubing, and accessories, including the CO_2 sensor, can be wiped with a damp cloth moistened in a mild detergent solution.

Nellcor cables and durasensors can be cleaned with isopropyl alcohol only. Do not immerse.

note...

The side panel connectors of the Propaq have been specially designed to prevent water or other liquids from entering the monitor. However, liquids can get into the connectors. If liquid does get into the newer right side panel connectors, it will drain through a hole in the bottom of the panel. If moisture gets into the left side panel connectors or into the older right side panel connectors, the connectors must be dried with warm air, and then all monitoring functions should be checked for proper operation.

While cleaning the monitor, it should be checked for unusual wear or possible damage from an accident. All external cables and hoses should be checked for fraying or cracking. All damage should be reported to the biomedical department or biomedical repair service person.

Cleaning Agents

Use only the recommended cleaning agents listed in Table 5-1 in the **OK To Use** column. The agents listed in the **Never Use** column should never be used on the Propaq.

CAUTION

Do not autoclave this product or its accessories.

Table 5-1: Cleaning Agents OK and Not OK To Use on Propaqs [1]

OK To Use	Never Use
Warm Water	Butyl Alcohol
Hydrogen Peroxide Solution	Denatured Ethanol
Cidex®	Freon
Liquid Soap	Mild Chlorine Bleach Solution
Windex®	Isopropyl Alcohol
Formula 409®	Trichloroethane, Trichloroethylene
Fantastik®	Acetone
Coverage	Vesphene II
T.B.Q. *	Enviroquat
Wex-cide *	Staphene
	Misty

[1] Propaq monitors may be disinfected to comply with OSHA requirements for cleaning and decontaminating spills of blood and other body fluids. (Federal OSHA Standard on blood-borne pathogens: 29 CFR 1910.1030, 12/6/91.) ***Wex-cide** (Wexford Labs, Inc., Kirkwood Missouri) and ***T.B.Q.** (Calgon Vestal Lab., Calgon Corp., St. Louis, Mo.) are disinfectants that meet the OSHA requirements, are EPA approved, and will not harm the outside of the Propaq. Only Wex-cide is recommended for disinfecting the inner surface of the display window. The disinfectants should be thoroughly rinsed away with water (do not immerse Propaq in water) after ten minutes.

Maintenance

Service Interval Recommendations

At the intervals recommended in Table 5-2, and as further described in the *Propaq Service Manual*, verify the Propaq for proper operation of all channels and internal circuitry. Such checks and verifications should only be carried out by a qualified biomedical service person.

Other Propaq service information, including calibration procedures, is described in the *Propaq Service Manual*. Refer to it for more information.

Use the following intervals for a guideline. Service may be indicated more often in extreme environments (heat, cold, dust, etc.)

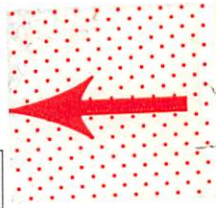


Table 5-2: Recommended Service Intervals

Recommended Interval	Service Action
Semiannually	Complete Functional Verification and Safety Check
Minimum every three years	Replace lithium battery Replace battery pack Replace air filter
Every 5,000 hours of operation or when screen becomes difficult to view	Replace LCD backlight (LCD monitors only)

Monitor Care

Replacing the Fuse

The Propaq is protected against power surges by a 3 Ampere, Slow-Blow fuse, which can easily be replaced through the right side panel (Figure 5-1). (If the green "Battery Charging" lamp does not light when an ac adapter is connected, this fuse may be blown.) Fuse replacement should only be performed by a qualified service person.

note...

Only right side panels with the defibrillator synchronization connector have a replaceable fuse.

To replace the fuse, follow these instructions.

1. Disconnect the Propaq from the patient.
2. Turn off the Propaq by pressing the OFF (STANDBY)/ON switch on the right side panel.
3. Disconnect the ac power adapter from the Propaq's input connector.
4. Using a small screwdriver or similar device, unscrew the fuse carrier by turning it counterclockwise.
5. Remove the fuse holder and replace the fuse with a 3 Ampere, 2AG, Slow-Blow fuse. Do not use a fuse of any other rating type, or damage to the Propaq may be the result.
6. If replacing the fuse does not fix the problem, the ac power adapter may be defective or unplugged from the mains.

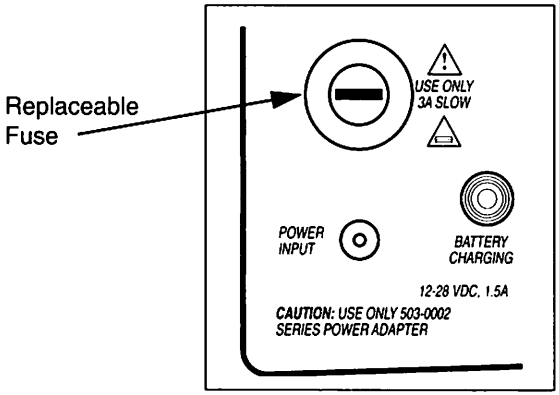


Figure 5-1. The replaceable fuse

This fuse can be easily removed with a screwdriver.

Maximum Safe Voltages

Damage to the Propaq can result from applying more than the maximum voltages listed in the following table.

Table 5-3: Maximum Safe Voltages to Inputs and Outputs

Connector Location	Pin	Maximum Voltage
Analog Out/Defib Sync	ECG	±10V
Analog Out/Defib Sync	P1	±10V
Analog Out/Defib Sync	Sync	-.5 to +5.5V
Analog Out/Defib Sync	Mark in	±15V
Acuity	TXD/	±15V
Acuity	RTS	±15V
Acuity	RXD/	±15V
Acuity	CTS	±15V
Acuity	RCV COM	±15V
DC Input	+	-.3 to +30V

Storing the Monitor

Whenever possible, store the Propaq at room temperature in a dry environment. See Table B-10, Monitor Environmental Specifications, on page B-21. Table B-10 on page B–21

WARNING

The monitor may not meet its performance specifications if stored or used outside the specified temperature and humidity ranges listed in the specification tables in Table B-10 on page B–21.

Extended Storage Precautions

Storing the Propaq for extended periods (more than one month) without being connected to the ac power adapter can cause damage to the battery. Even when the Propaq is turned off, a very small amount of current is drawn from the battery. If the Propaq is not connected to the ac power adapter, continual current draw can damage the battery if the battery voltage falls below 7.0 volts. For long-term storage, remove the battery from the Propaq. See the *Propaq Service Manual* for procedures on removing the battery.

Environmental Operating and Storage Limits

Operating and storing the Propaq under conditions outside those specified may result in poor monitor performance.

See Table B-10 on page B–21.

Power Sources

For in-hospital operation and recharging from ac mains, a small ac power adapter plugs into the monitor. Use only a Protocol Systems ac power adapter to ensure protection against risk (leakage) current hazards.

The Propaq can also be powered and recharged from a 12-28V dc source capable of continuously supplying 10.5W. For CO_2-equipped models, the input power requirement is 25W and they use a unique connector.

With the appropriate Protocol ac power adapter, the Propaq can be powered from the ac mains sources listed in Table B-14 on page B–27.

Battery Care

The Propaq's battery will be charged while connected to an appropriate power source (see above) whether or not the Propaq is turned on. This ensures full battery charge when it is necessary to operate the monitor on the battery.

CAUTION

Leaving the monitor's lead-acid batteries in a completely discharged state may result in permanent battery damage. The batteries should be kept fully charged.

After 8 hours of recharging, the battery is at full capacity, if the monitor remains off during recharging. After extended use on battery, the Propaq displays a message to inform you of its low battery voltage. The Propaq automatically turns itself off when the battery voltage gets too low. Turning itself off prevents damage to the battery pack. You should connect the Propaq to the ac power adapter to recharge the battery as soon as possible after the monitor has turned itself off.

In most instances, most monitor functions are usable immediately following plugging in the ac power adapter and cycling the power switch. More charging time may be required before the cuff, CO_2, and printer can be operated.

The amount of time you can run the Propaq on each battery charge depends upon many factors, but mostly on use of the backlight (LCD versions only) and how often you take blood pressure readings with the cuff. See **Battery Operation** on page 1-14. If the battery power becomes too low to accurately take cuff measurements, the Propaq warns you of the condition and prevents further use of the cuff channel.

Battery Voltage Effects on Operation

Normal battery voltage during operation ranges from approximately 10V to 8V. As battery voltage decreases, the Propaq displays different messages to notify you of its current battery condition and automatically switches to different operating modes to extend operating time as long as possible. Table 5-4 summarizes the effects of low battery operation.

Table 5-4: Battery Voltage Effects on Operation

Voltage Level	Description	Approximate Operating Time at 25° C [a]
≥ 7.8V	Normal.	5.3 hours
< 7.8V	Flashing LOW BATT caution message.	1.2 hours
< 7.6V	Equipment alerts; cuff channel and printer are inhibited. [b]	30 minutes
< 7.4V	Equipment alert VERY LOW BATTERY generated	
< 7.3V	Equipment alert; CO_2 channel, cuff, and printer disabled.	3 minutes
= 7.0V	Unit Shutdown.	

[a] With backlight ON and cuff set to AUTO with 15 minute intervals.
[b] If a cuff measurement or printout is in progress when battery voltage falls below 7.6V, these operations will be allowed to finish, unless the voltage falls below 7.3V.

When the battery voltage falls below 7.3V, the Propaq automatically switches the backlight mode to OFF (LCD versions only). An equipment alert message also appears (see Chapter 3 for information on equipment alerts). If the display mode was previously set to ON, the Propaq switches back to ON when the battery voltage rises above 7.4V. The equipment alert tone continues until the battery voltage rises above 7.4V. Cuff and CO_2 channels and printer are useable after battery voltage rises above 7.8V.

Checking Battery Voltage

The Propaq's battery voltage is conveniently displayed on the initial start-up screen.

When the PROGRAM or TIME/DAY button is pressed, or when one of the Service Menu functions is selected, the battery voltage also appears along with other information relating to the selected function.

Printer Maintenance

Loading Paper

Paper is loaded through the bottom of the Printer. Use only paper purchased from or recommended by Protocol Systems, Inc. See the *Products and Accessories* book for ordering printer paper.

CAUTION

Use only low-debris printer paper specified by Protocol Systems. Use of other paper will cause unclear printing of patient data, damage to printing head, and eventual printer failure. Store all paper (including a monitor loaded with paper) in an environment that meets the paper storage specifications listed in Table B-12 on page B–24. Failure to properly store paper can result in paper discoloration and damage to the printer.

7 Lay the monitor on its back to gain access to the bottom of the printer.

8 Squeeze the locks on the paper door toward each other and pull the door toward you to open it.

9 Lift the paper roll from the holder and pull out any paper remaining in the printing mechanism.

10 Place the new paper roll onto the holder and pull out several inches of paper as shown in Figure 5-2 on page 5-13.

11 Slide the end of the paper into the slot of the printing mechanism until it extends out of the paper exit slot (Figure 5-3 on page 5-13).

12 Close the paper door.

13 Place the monitor on its feet.

14 Hold down the PAPER FEED button and press START/STOP to produce a test print. Compare the printout to Figure 5-4 on page 5-14.

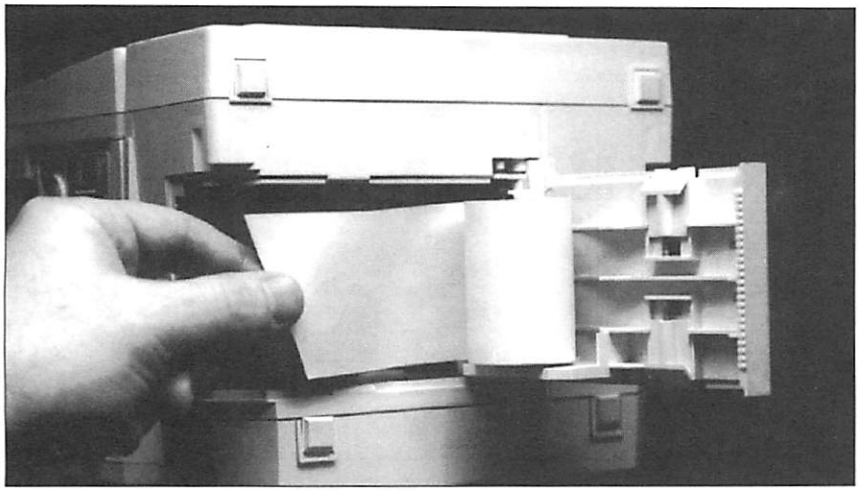


Figure 5-2. Loading printer paper

Load the new paper roll onto the spindle on the door.

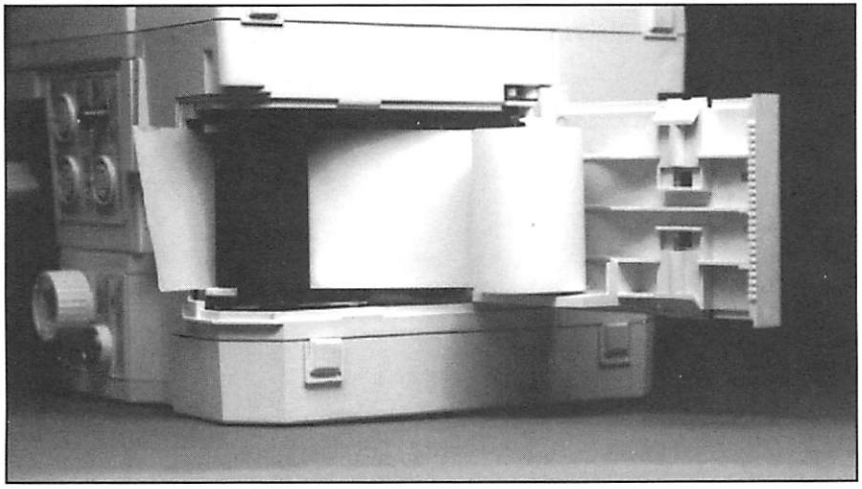


Figure 5-3. Printer paper feed

Feed the paper through the printer mechanism.

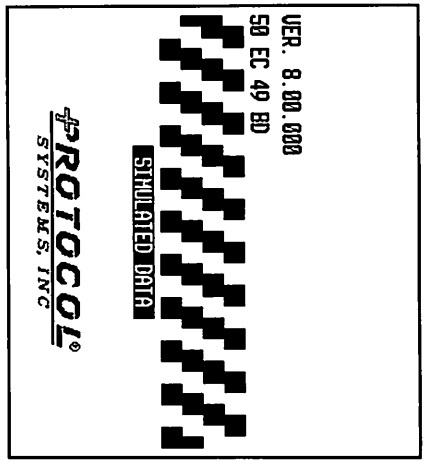


Figure 5-4. Test print

Test the print quality by pressing the PAPER FEED and START/STOP buttons on the printer front panel. This test strip should be the result.

Customer Services

Ordering and Customer Service

For ordering information, for the location of your nearest Protocol Systems sales representative or service center, or for more information on other Protocol Systems products, contact:

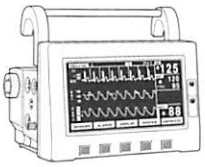
Protocol Systems, Inc.
8500 SW Creekside Place
Beaverton, OR 97005-7107 USA
Worldwide: (503) 526-8500
In the USA, toll-free (800) 289-2500
FAX (503) 526-4300

Technical Service

If you need technical assistance on troubleshooting, are interested in customer technical training on Protocol products, or help with ordering replacement parts, contact Protocol's Technical Services Department toll-free in the U.S.A. at (800) 289-2501; facsimile (503) 526-4300.

Re-packing

Always re-pack the Propaq in a Propaq shipping container before shipping the monitor. The container was designed to minimize shock and protect the monitor. A shipping container can be purchased from Protocol, if necessary. Refer to the *Products & Accessories* book for container ordering information.



6

Additional Features

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HP-Connectors

This section describes the difference that you will notice with the Hewlett-Packard Connector-Compatible option for the Propaq. Only the Propaq's left side panel is affected by this option.

The Hewlett-Packard Connector-Compatible option makes the Propaq compatible with many Hewlett-Packard accessories used in the Hewlett-Packard Component Monitoring System. For a list of compatible accessories, see the *Products & Accessories* book. For a list of approved invasive pressure transducers for this option, see Table 6-1 on page 6-5.

The Hewlett-Packard Connector-Compatible option replaces the standard Propaq left side panel. The new side panel contains all the same vital sign parameters connections as the standard Propaq, except the 102 and 104 models include only one temperature probe connector.

Patient Connections

Figure 6-1 on page 6-4 shows the left side panels for the Hewlett-Packard Connector-Compatible option. These side panels replace the side panels in the standard Propaq monitor.

Only the Propaq's left side panel is affected by this option. The connectors for SpO_2 and CO_2 remain in their standard forms.

note...

The HP 1290A and other 40 μV/V/mmHg invasive pressure transducers are not compatible with the Propaq Hewlett-Packard Connector-Compatible option. Using such transducers will cause an equipment alert. See Table 6-1 on page 6-5 for a list of compatible transducers.

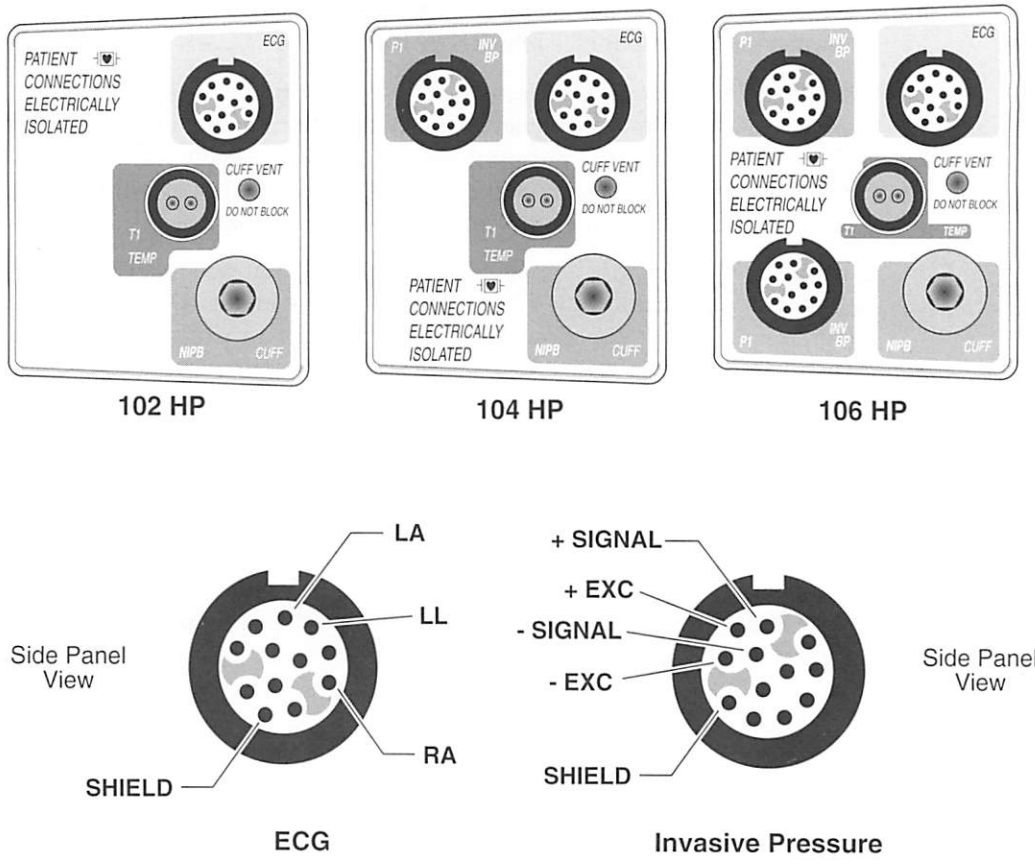


Figure 6-1. The HP side panels and their external connector-pinouts

The Hewlett-Packard Connector-Compatible option side panels offer all the vital sign monitoring capabilities as the standard Propaq, except there is only one temperature channel.

Table 6-1: Approved Invasive Pressure Transducers for Hewlett-Packard Connector-Compatible Propaq

Manufacturer	Transducer	Cable #
Abbott Critical Care Salt Lake City, UT (800) 222-6883 (708) 937-1760	Disposable Transpac III Disposable Transpac II	42661-04-27 42655-04-27
Concord-Portex (Telos) Keene, NH (800) 258-5361 (603) 352-3812	Reusable R0001 Disposable T6003 Disposable T6000	R1056 T65-1056 T65-1056
COBE Laboratories, Inc. Lakewood, CO (800) 525-2623 (303) 232-6800	Disposable CDXIII Disposable CDXpress	041-702-012 041-702-012
Utah Medical Products, Inc. Midvale, UT (800) 533-4984 (801) 566-1200	Disposable Deltran II 6199 (non-sterile) DPT-200 (sterile)	650-206
Viggo-Spectramed, Inc. Oxnard, CA (800) 235-5945 (805) 983-1300	Disposable DTX, DTX+	TCH-P12
Medex, Inc. Hilliard, OH (800) 848-1757 (614) 876-2413	Disposable MX900	VX900-02
Baxter Healthcare Edwards Division Santa Ana, CA (800) 424-3278 (714) 250-2500	Trantec Disposable 53 Series Disposable 43 Series Disposable 33 Series	 892083002 893206001 895083001
Hewlett-Packard Company (800) 225-0230 (415) 857-2821 (International)	Reusable 1290C HP Quartz	J06

Invasive Pressure Messages

The HP1290A and other 40 μV/V/mmHg invasive pressure transducers are not compatible with the Hewlett-Packard Connector-Compatible option. If such transducers are plugged into the Propaq's side panel, an equipment alert with the message "Incompatible Transducer" is displayed as shown in Figure 6-2 on page 6-7. Use only approved invasive pressure transducers that are listed in Table 6-1 on page 6-5.

WARNING

If you connect the 1290A or other 40 microV/V/mmHg transducer and then press any button as instructed by the equipment alert window, but do not disconnect the transducer from the Propaq, the equipment alert will not occur again. Using such a transducer connected to the Propaq will provide no pressure readings for that channel and may cause erroneous readings to be provided by the other pressure channel even if a compatible transducer is connected to the other channel. Disconnect the incompatible transducer and use a compatible transducer.

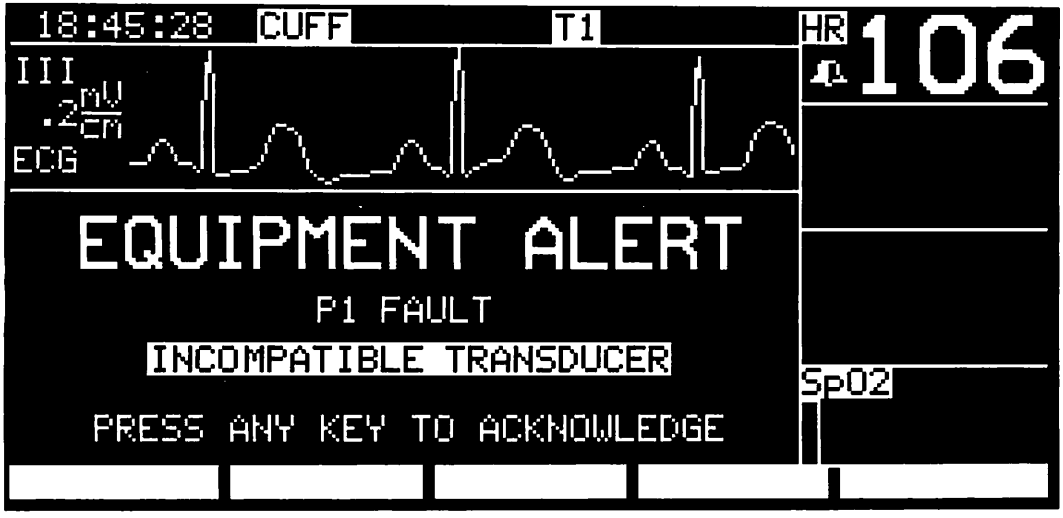


Figure 6-2. Incompatible Transducer Equipment Alert

Using a 40 µV/V/mmHgtransducer will result in the above equipment alert.

Defibrillator Synchronization

The Defibrillator Synchronization (Defib Sync) feature provides ECG synchronization to LIFEPAK®5 and LIFEPAK®6s defibrillators manufactured by Physio-Control Corporation. The Defib Sync feature is designed to operate only with the LIFEPAK 5 and LIFEPAK 6s defibrillators. On the LIFEPAK 6s, the Defibrillator Sync Connector/Cover (Physio-Control part number 801297-00) must be installed before you can interface it to the Propaq monitor.

Protocol Systems provides a Defib Sync cable for connecting the LIFEPAK 6s to the Propaq. For connecting a LIFEPAK 5 to a Propaq, Protocol manufactures a special interface and cable. Table 6-2 lists the Protocol part numbers for the Defib Sync cables/interface. Defib Sync requires a special connector on the Propaq's right side panel as shown in Figure 6-3.

Table 6-2: Defibrillator Synchronization Cables/Interface

Defibrillator Application	Protocol Part Number
LIFEPAK 6s	008-0154-00
LIFEPAK 5	008-0136-00

WARNING

The instructions in this booklet provide general guidelines for the use of the Defib Synchronization feature for performing synchronized cardioversion. These instructions are not intended to replace existing hospital procedures and protocols relative to the provision of cardiac electrical therapy and the operation of the specific models of the defibrillators. Use all safety standards and clinical protocols as defined by your institution.

Defib Synchronization Connector and Cables

The Propaq's right side panel must contain the DEFIB SYNC connector as shown in Figure 6-3. One end of the Defib Sync cable connects to this connector.

WARNING

Use only the correct Protocol part with the LIFEPAK 5 or LIFEPAK 6s. Use of any other cable will result in incorrect operation. Refer to Table 2, "Defibrillator Synchronization Cables/Interface," on page 6-8, or in the *Products & Accessories Book*.

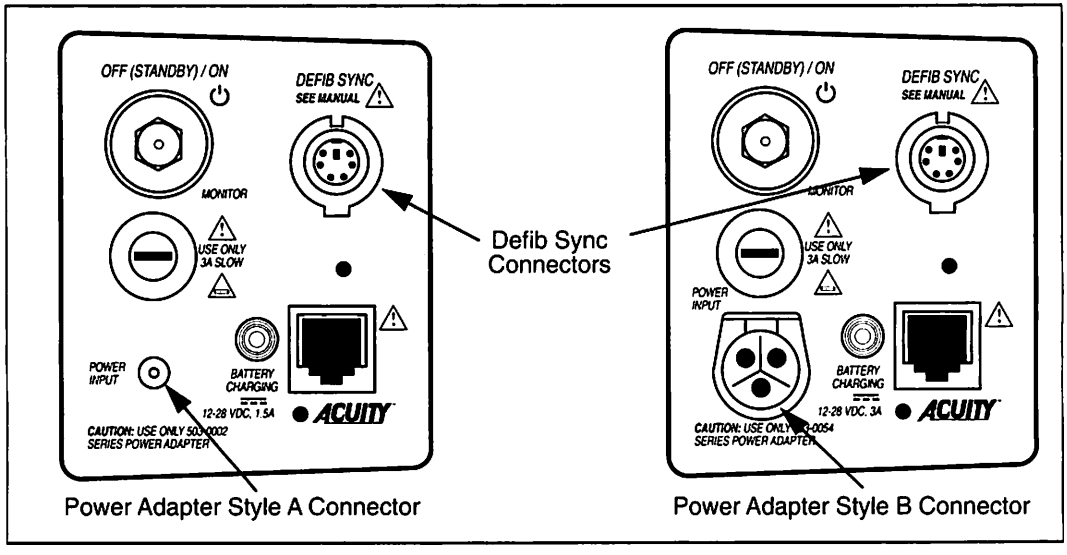


Figure 6-3. The Defib Sync connector

The DEFIB SYNC connector allows the Propaq to be connected to LIFEPAK 5 and LIFEPAK 6s defibrillators. Special cables must be used.

Synchronized Cardioversion Using the LIFEPAK 5

The Propaq Defib Synchronization interface provides signal transmission between the Propaq and the LIFEPAK 5. The interface connects to the LIFEPAK 5 along the left side of the defibrillator. Use the following instructions to install and remove the interface.

Installing the Defib Synchronization Interface

1 Before installing the interface, check that the contacts on the left side of the LIFEPAK 5 (Figure 6-4) are clean in order to ensure signal transmission between the LIFEPAK 5 and the Propaq.

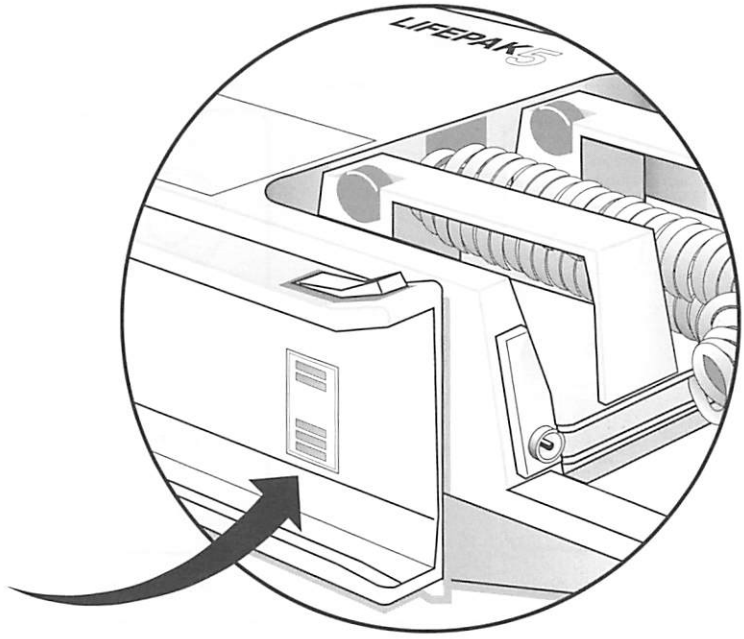


Figure 6-4. The LIFEPAK 5 contacts

The contacts on the LIFEPAK 5 must be clean in order to ensure data transmission between the LIFEPAK 5 and the Propaq.

2 Slide the Propaq Defib Sync interface onto the left side of the LIFEPAK 5 as shown in Figure 6-5 until it snaps in place.

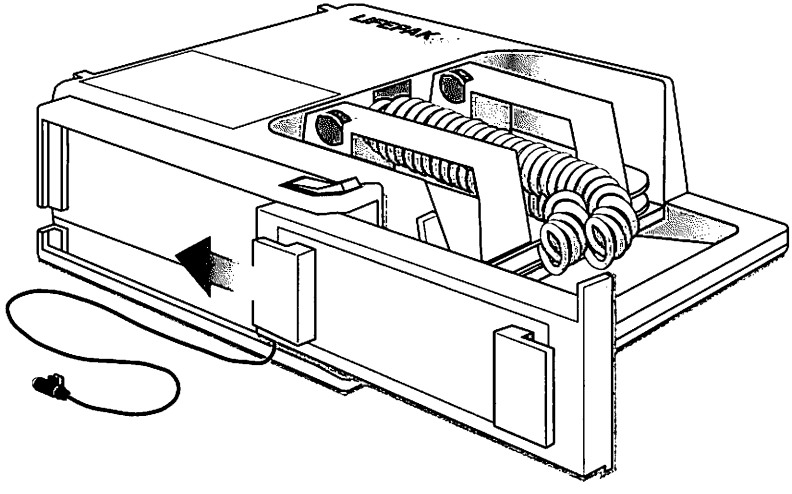


Figure 6-5. The LIFEPAK 5 interface

Install the interface onto the LIFEPAK 5 by sliding it onto the left side.

3 Connect the cable end to the Propaq's DEFIB SYNC connector on the right side panel (Figure 6-6 on page 6-12).

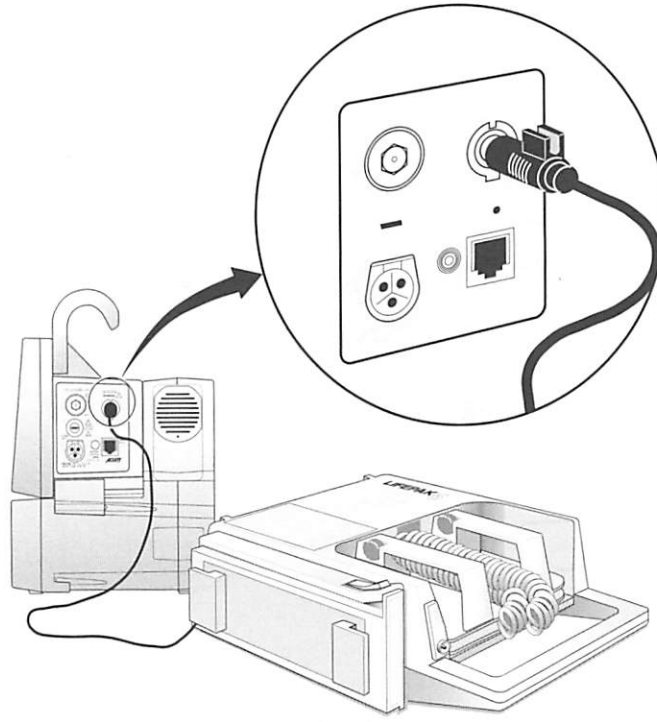


Figure 6-6. The Defib Sync interface cable

The Defib Sync interface cable connects to the Propaq's right side panel.

Removing the Defib Synchronization Interface

1. To remove the interface, disconnect the cable-end from the Propaq.

2. Press the lever on the side of the LIFEPAK (Figure 6-7) and slide the interface forward until it is free from the defibrillator.

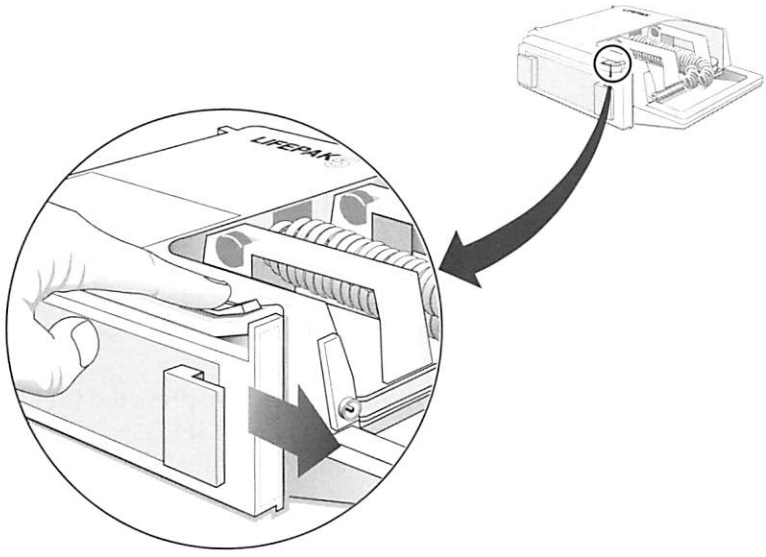


Figure 6-7. The LIFEPAK interface lever

The lever on the LIFEPAK allows you to remove the interface.

3. Store the interface in its static-protected plastic bag when not connected to the LIFEPAK.

Synchronized Cardioversion Procedure

1. Set up the LIFEPAK 5 Defibrillator and any other instrumentation according to institutional protocols and manufacturer's operating instructions. Use the instructions above for installing the Propaq Defib Synchronization interface.

2. Verify the integrity of the ECG patient electrodes and the fidelity of the ECG waveform on the Propaq for tall, distinct R-waves and minimal artifact.

WARNING

The R-wave amplitude must be at least 0.5 mV (5 mm tall when the Propaq ECG sensitivity—SIZE button—is set to 1.0 mV/cm) to guarantee that the defibrillator sync pulse will occur no later than 30 milliseconds after the peak of an R-wave.[1] Reposition the patient electrodes or change the Propaq lead selection as necessary to ensure sufficient ECG waveform amplitude.

3. With the LIFEPAK 5 turned on, press the LIFEPAK's SYNC button on the front-left of the LIFEPAK 5 (Figure 6-8). The button lights when activated. Make sure it lights.

---

[1] As a visual gauge for estimating R-wave amplitude, the 'V' of the mV/cm label to the left of the ECG waveform is about 4 mm in height. With the Propaq ECG sensitivity set to 1.0 mV/cm, compare the letter 'V' with the height of the R-wave, which should be at least 5 mm tall.

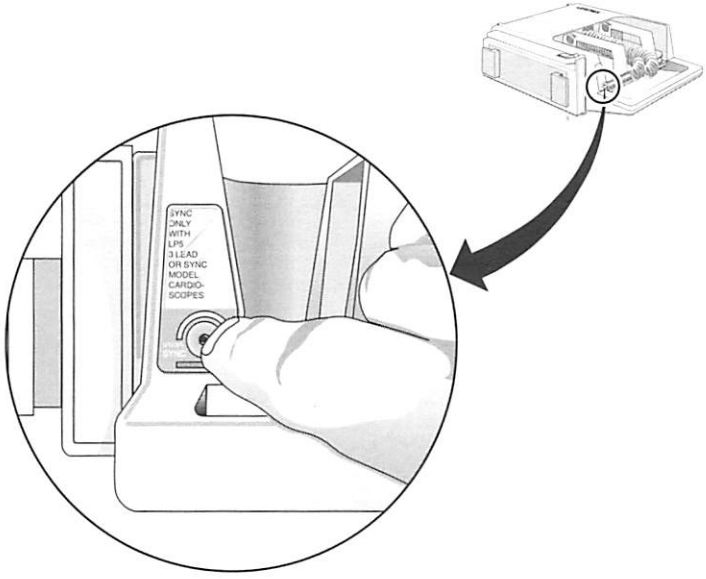


Figure 6-8. The LIFEPAK 5 SYNC button

Press the SYNC button on the front of the LIFEPAK 5 to synchronize defibrillation with ECG R-waves. The SYNC light flashes each time an R-wave is detected.

4 After the SYNC button is activated, check the Propaq display for dashed lines above and below each R-wave, occurring in near synchronization with each R-wave (Figure 6-9 on page 6-16). These are synchronization markers. Check that the LIFEPAK 5's SYNC button also flashes with each R-wave.

note...

A fault in the cable between the Propaq and the defibrillator, or unplugging the cable, will prevent setting the defibrillator to synchronized mode and will prevent showing markers on the Propaq.

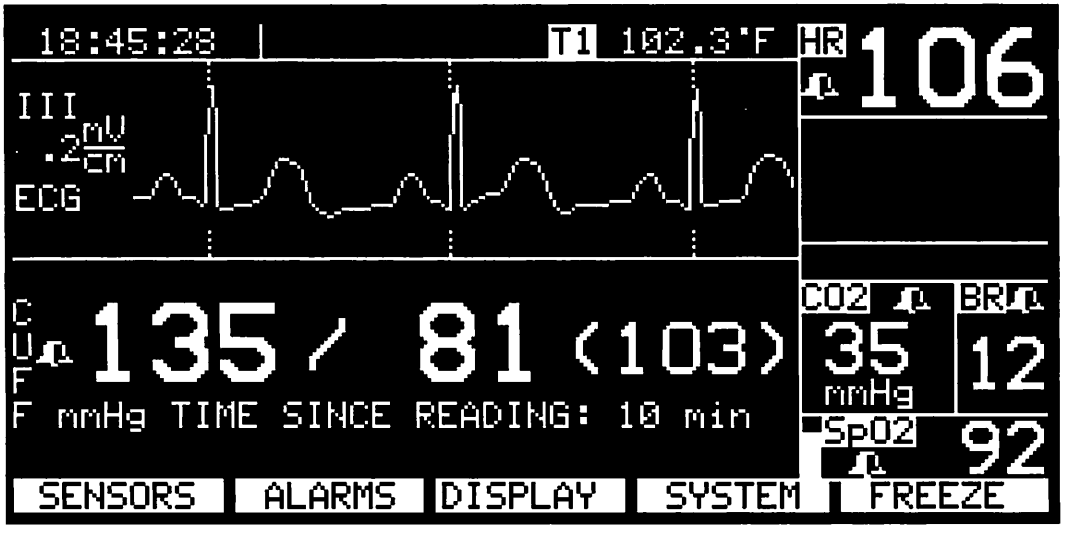


Figure 6-9. The synchronization markers

The synchronization markers must appear in near synchronization with the R-wave before cardioversion is attempted.

WARNING

If the R-wave synchronization markers do not appear to be nearly simultaneous with the R-waves on the Propaq display, do not proceed with synchronized cardioversion.

5 Follow hospital protocols and LIFEPAK 5 instructions for cardioversion.

6 If subsequent cardioversion must be performed, repeat steps 3 through 5.

WARNING

You must press the LIFEPAK 5's SYNC button and check for appropriate synchronization markers on the Propaq before each cardioversion.

Synchronized Cardioversion Using the LIFEPAK 6s

1. Set up the LIFEPAK 6s defibrillator and any other instrumentation according to institutional protocol or manufacturer's operating instructions.

note...

The Physio-Control LP6s Defibrillator Sync Connector/Cover (Physio-Control part number 801297-00) must be installed before you can interface it to the Propaq monitor.

2. Verify the integrity of the ECG patient electrodes and the fidelity of the ECG waveform for tall, distinct R-waves and minimal artifact.

WARNING

The R-wave amplitude must be at least 0.5 mV (5 mm tall when the Propaq ECG sensitivity—SIZE button—is set to 1.0 mV/cm) to guarantee that the defibrillator sync pulse will occur no later than 30 milliseconds after the peak of an R-wave.[1] Reposition the patient electrodes or change the Propaq's lead selection as necessary to ensure sufficient ECG waveform amplitude.

3 Connect the Propaq end of the Protocol Defib Sync cable to the Propaq's right side panel DEFIB SYNC connector.

4 Connect the other end of the cable to the LIFEPAK 6s SYNC connector at the top rear of the defibrillator (Figure 6-10).

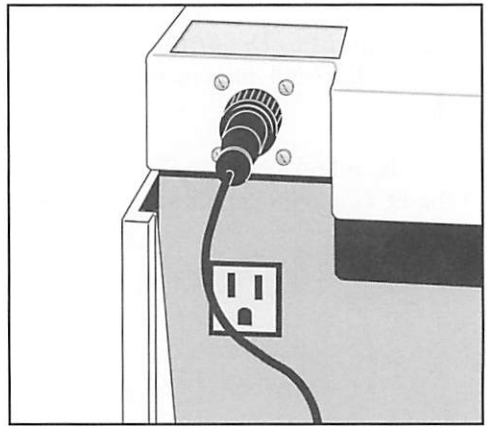


Figure 6-10. The LIFEPAK 6s Sync connector

Plug the Defib Sync cable into the LIFEPAK 6s Sync connector on the rear panel.

[1] As a visual gauge for estimating R-wave amplitude, the 'V' of the mV/cm label to the left of the ECG waveform is about 4 mm in height. With the Propaq ECG sensitivity set to 1.0 mV/cm, compare the letter 'V' with the height of the R-wave, which should be at least 5 mm tall.

5 With the LIFEPAK 6s turned on, press the LIFEPAK 6s SYNC button on the front control panel (Figure 6-11). The button lights when activated.

note...

A fault in the cable between the Propaq and the defibrillator, or unplugging the cable, will prevent setting the defibrillator to synchronized mode and will prevent showing markers on the Propaq.

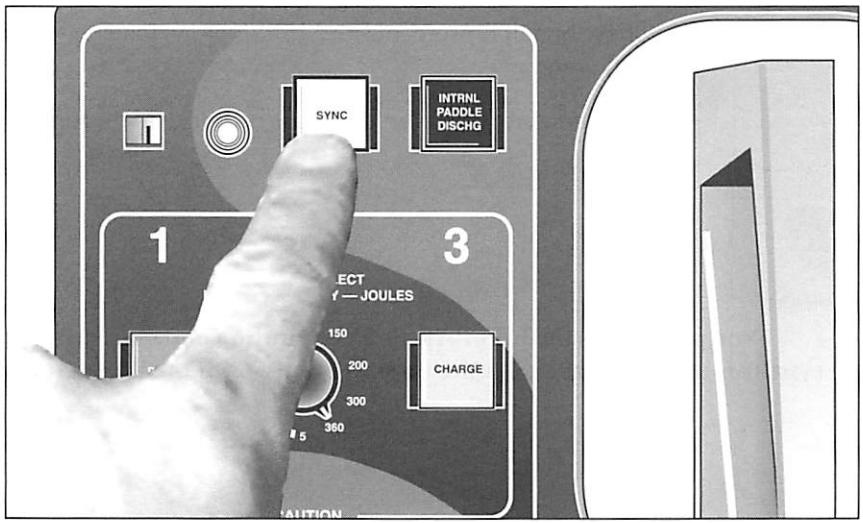


Figure 6-11. The LIFEPAK 6s SYNC button

Press the SYNC button on the LIFEPAK 6s to activate R-wave synchronization.

6 After the SYNC button has been activated, check that dashed lines appear above and below each QRS on the Propaq display (Figure 6-9 on page 6-16). The LIFEPAK 6s SYNC button will flash with each QRS.

WARNING

If the R-wave synchronization markers do not appear to be nearly simultaneous with the R-waves on the Propaq display, do not proceed with synchronized cardioversion.

7 Follow hospital protocols and LIFEPAK 6s instructions for cardioversion.

8 If subsequent cardioversion must be performed, repeat steps 5 through 7.

WARNING

You must press the LIFEPAK 6s SYNC button and check for appropriate synchronization markers on the Propaq before each cardioversion.

Power Adapters

Different power adapters are available to be shipped with the Propaq depending upon the ac mains rating of the country to which it is shipped. A higher-output power adapter is required for all units equipped with the CO_2 option.

Intended Use

Protocol power adapters are intended to be used only with Propaq monitors, and Propaq monitors are intended to be recharged using only a Protocol power adapter with a mating plug and rated for your ac mains.

The power adapter contains symbols on its labelling. For definitions of these symbols, see **Symbols** on page xxi at the front of this manual.

CAUTION

Use of other than Protocol power adapters with the appropriate plug rated for your ac mains can damage the Propaq monitor and may require fuse replacement in the power adapter.

Do not autoclave the power adapter.

Do not operate the power adapter with a damaged mains power cord or plug.

Verify that the "Universal Power Adapter" is set for the proper mains voltage (see page 6-24) prior to plugging it into the Propaq.

Inspect the adapter power cords periodically for fraying or other damage, and replace the adapter or the mains power cord as necessary. (The power adapter is not a serviceable part; however, the detachable mains power cord is separately replaceable.)

WARNING

Explosion risk. Do not operate this product in the presence of flammable anesthetics. This product must only be operated in strict conformance with local fire prevention regulations. Place the power adapter where it cannot fall and harm someone.

Verifying the Propaq Right Side Panel

The right side panel contains the power adapter connector. There are two different connectors (Figure 6-12). Style A connector appears on monitors requiring approximately 10.5 Watts for recharging. Style B connector appears on monitors requiring approximately 25 Watts for recharging. Use only a Protocol power adapter that is equipped with the appropriate connector and rated for your ac mains.

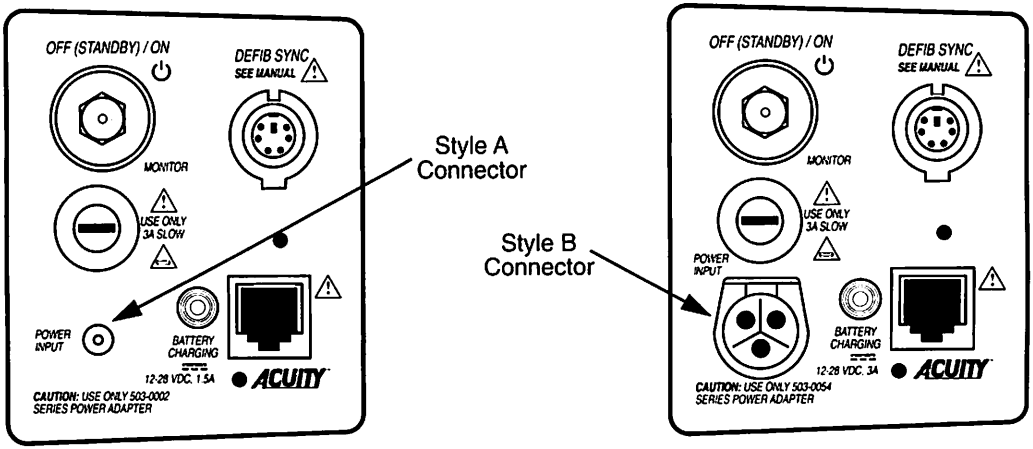


Figure 6-12. The power adapter connectors

·You can identify which power adapter your Propaq uses by looking at the right side panel dc power connector.

Power Adapter Configurations

Table 6-3 lists the power adapter part numbers according to their rated input, fuse, output, and applicable usage. Check to be sure you are using the correct power adapter for your mains power source by comparing the part number on the power adapter to Table 6-3. Always replace fuses with the correct fuses rated for the power adapter.

Table 6-3: Power Adapter Ratings

Part Number/ Connector Style	Rated Input Voltage	Rated Serviceable Fuses	Rated Output	Application
503-0054-00 UPA/Style B	100V-120V ac, 500 mA, 50/60 Hz	T800 mA/250V Time-Delay 5 x 20 mm	16-24V dc 25 VA	25 Watt requirement in countries with 100V-120V power systems.
503-0054-01 UPA/Style B	200V-240V ac 250 mA, 50/60 Hz	T400 mA/250V Time Delay 5 x 20 mm	16V-24V dc 25 VA	25 Watt requirement in countries with 200V-240V power systems.
503-0002-00 North American/ Style A	120V ac, 60 Hz, 0.2A	Not Serviceable	15V dc, 0.7A 10.5 VA	10.5 Watt requirement in North America
503-0002-02 UPA/Style A	100V-120V ac, 50/60 Hz, 500mA	T800mA/250V Time-Delay 5 x 20 mm	16V-24V dc, 25 VA	10.5 Watt requirement in countries with 100V-120V power systems. [a]
503-0002-04 UPA/Style A	200V-240V ac, 50/60 Hz, 250mA	T400mA/250V Time-Delay 5 x 20 mm	16V-24V dc, 25 VA	10.5 Watt requirement in countries with 200V-240V power systems. [a]
503-0002-20 International/ Style A	220V-240V ac, 50 Hz, 0.12A	Not Serviceable	15V dc 0.7 A	10.5 Watt requirement in countries with 220V-240V power systems.
503-0002-22 International/ Style A	200V-240V ac, 50 Hz, 0.12A	T200mA/250V Time-Delay 5 x 20 mm	15V dc, 0.7A	10.5 Watt requirement in countries with 220V-240V power systems.

[a] To date, all Propaqs with Style A power input connector limit battery charging current to levels a 10.5W adapter can deliver. Propaqs with options requiring more power use the Style B input connector and increase their charging current limit.

Verifying Proper "Universal Power Adapter" Configuration

The "Universal Power Adapter" shown in Figure 6-13 is configurable. Prior to using the power adapter, check it for proper configuration. To check the configuration, look in the small window indicated in Figure 6-13. If the number in the window does not match your ac mains source voltage (100-120 or 200-240), the adapter should be reconfigured. Your biomedical technician can change the voltage setting and fuse on the "Universal Power Adapter;" and can verify that your facility is using the correct power cord.

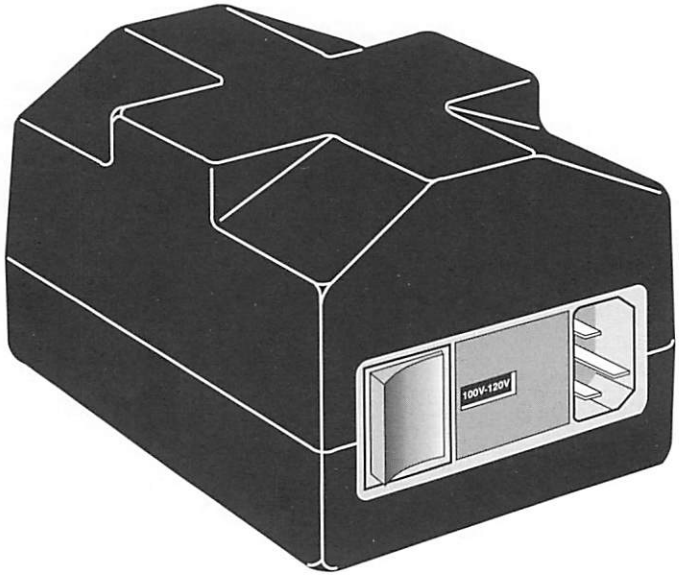


Figure 6-13. The "Universal Power Adapter"

Replacing the "Universal Power Adapter" Fuses

The "Universal Power Adapter" contains two fuses that can easily be replaced by service personnel if necessary. The adapter can contain spare fuses in the fuse carrier.

WARNING

Only qualified service personnel should replace the fuses.

CAUTION

Replace each fuse only with the specified type as listed in Table 6-3 on page 6-23.

Procedure

1. Turn off the power adapter power switch.
2. Unplug the power adapter from the ac mains outlet and from the Propaq.
3. Turn the power adapter so you can see the window that indicates the voltage setting (see Figure 6-14 on page 6-26).

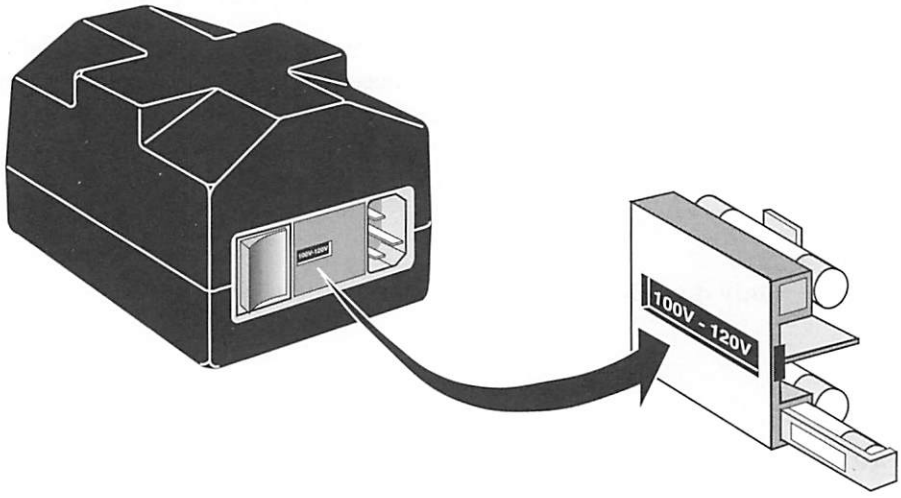


Figure 6-14. Voltage indicator window

Check the window for the voltage setting. The number should be the same as your ac mains power source.

4 Disconnect the ac mains cord from the power adapter.

The fuse carrier is located between the power adapter's ac mains carrier and the power switch (see Figure 6-14). The voltage indicator window is contained within the fuse carrier.

5 Using a small, flat-blade screwdriver, carefully pry the fuse from the spring clip as shown in Figure 6-15.

note...

Both fuses should be replaced at the same time, even if only one fuse has opened due to an overcurrent situation. What blew one fuse may have weakened the other.

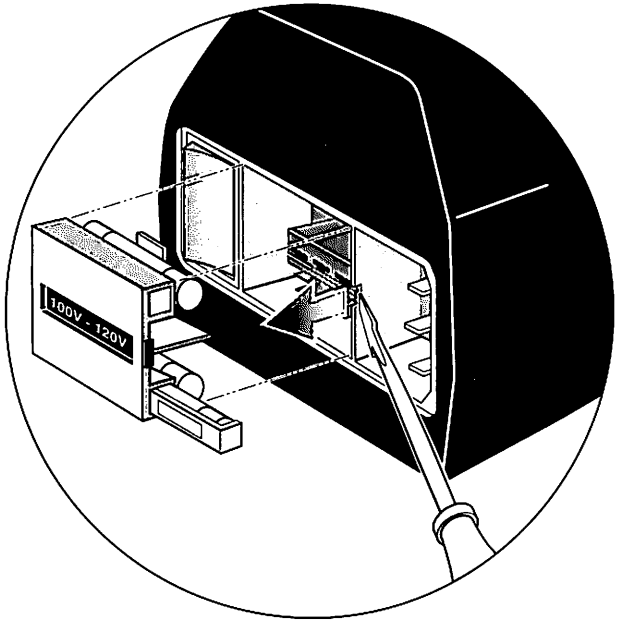


Figure 6-15. Removing the fuse carrier.

6 Holding the fuse carrier, rotate it so you can see the fuses (see Figure 6-16).

7 Remove both fuses from the carrier by lifting them out with your fingers.

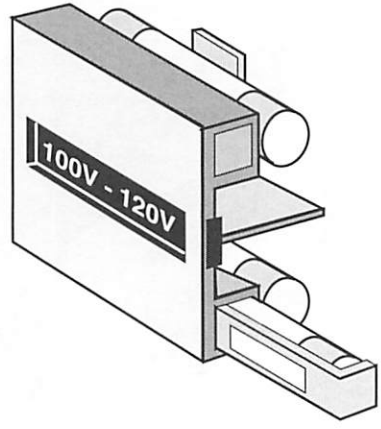


Figure 6-16. The fuses in the fuse carrier.

CAUTION

Spare fuses are contained in housings above the fuses in the carrier as shown in Figure 6-16. Between the fuses is a small printed-circuit board (PCB) that sets the power adapter to the desired ac mains voltage. This PCB may slide out of the carrier when handling the housing. The PCB is easily replaced in the following steps.

8 Remove the spare fuses from the carrier by pushing on one side of the spare fuse housing to slide the housing out. Repeat for the other fuse.

9 Check the fuse type and rating and compare it to Table 6-3. Verify that you are installing the correct fuse.

10 Install the fuses in the carrier between the clips from which you removed the open fuses.

11 If desired, refill the empty spare fuse housing with identical fuses.

12 If the small PCB between the fuses has slid out of place, slide it back into place in the carrier, verifying that the voltage setting indicated in the window on the carrier is correct.

CAUTION

Be sure that the window shows the voltage setting for your ac mains source (100-120 Volts or 200-240 Volts). Do not install the carrier unless the correct voltage setting appears in the window.

13 If the voltage setting is incorrect, simply slide the PCB out of the carrier, rotate it 180° and slide it back into place.

14 Refit the fuse carrier into the power adapter, orienting it so the voltage setting window is nearest the power switch. The carrier securely snaps into place.

15 Connect the ac mains cord to the power adapter.

16 Plug the power adapter cords into the ac mains.

CAUTION

Do not plug the dc power cable into the Propaq until you have verified the power adapter operation in the next steps.

17 Turn on the power adapter and check that the power indicator light next to the dc power cable is lighted.

18 If the indicator does not light, turn off the power adapter's power switch, unplug it from ac mains, and verify the fuses and proper orientation of the voltage setting PCB (see step 13 above).

19 If the power indicator lights, plug the dc power cable into Propaq.

Replacing the Fuses in the 503-0002-22 Power Adapter

This power adapter has two replaceable fuses housed in a small fuse carrier located next to the power cord connector. Whenever you need to replace a fuse, always replace both fuses with fuses of the specified rating.

WARNING

Only qualified service personnel should replace the fuses.

Procedure

1 Unplug the power adapter from the Propaq and the ac mains outlet.

2 Disconnect the ac mains cord from the power adapter.

The fuse carrier is located next to the power adapter's ac mains carrier.

CAUTION

Replace each fuse only with the specified type as listed in Table 6-3 on page 6-23.

3 Using your fingers, pinch the fuse carrier clips together and lift out the carrier (Figure 6-15).

note...

Both fuses should be replaced at the same time, even if only one fuse has opened due to an overcurrent situation. What blew one fuse may have weakened the other.

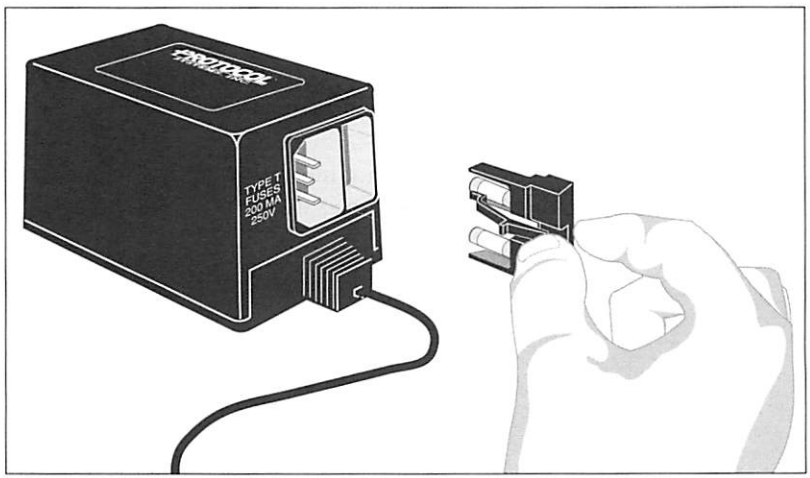


Figure 6-17. Removing the fuse carrier.

4 Remove both fuses from the carrier by pulling them out with your fingers.

5 Check the replacement fuse type and rating and compare it to Table 6-3. Verify that you are installing the correct fuses.

6 Install the fuses in the carrier.

7 Refit the fuse carrier into the power adapter. The carrier securely snaps into place.

8 Connect the ac mains cord to the power adapter.

9 Plug the power adapter cords into the ac mains.

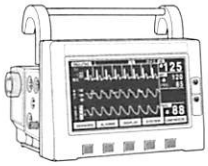
CAUTION

Do not plug the power adapter cord into the Propaq until you have verified the power adapter in the next step.

10 Check that the power indicator light is lighted.

If the indicator does not light, unplug the power cord from the ac mains and check the fuses again.

11 If the power indicator lights, plug the dc power cord plug into the Propaq.



A

Glossary

ΔT
Difference temperature. The difference between T1 and T2.

AAMI
Association for the Advancement of Medical Instrumentation (United States of America)

AC Power Adapter
The device that plugs into the 12-28V dc receptacle on the Propaq's side panel to allow operation and battery charging from ac mains.

Acuity
Protocol's trade name for its central station patient monitoring system.

Alarm Status Window
The window that appears when the ALARMS button is pressed. This window shows the alarm limits status of the vital sign parameters. A dark bell indicates that all alarm limits are set and turned on. A half-dark bell indicates that some alarm limits are off.

Alarms Parameter Window
The window that appears when the LIMITS button is pressed. This window lists all alarm limits by vital sign parameter. Alarm limits adjustment is done in this window.

Algorithm
A formula used in calculations. Certain algorithms are used to determine preset alarm limits using the STAT SET and PARAM SET buttons. Other algorithms identify QRS complexes in ECG, etc.

Altimeter
A sensor, internal to the Propaq, that measures absolute atmospheric pressure, and is used to correct CO_2 numerics for varying altitudes.

Analog Output
The connector on some Propaqs' right side panels that outputs analog signals of ECG and P1.

ANSI
An acronym for American National Standards Institute

Apnea
Condition of no respiration occurring during a prescribed time interval.

Arterial Blood Gas Measurements
Laboratory value reporting acid-base, oxygenation and ventilation status. Normal values are:

pH	7.35-7.45
PaO_2	80-100 mmHg
$PaCO_2$	35-45 mmHg
HCO_3	23-25 mEq/liter

Artifact
An unwanted disturbance to or by the patient or attached sensors that adds errors (usually erratic) to the measured parameters, e.g., muscle motion or shivering, electrical interference, vibration of the cuff, etc.

Auto Interval (cuff)
The interval at which cuff measurements are initiated when operating in the automatic mode.

Bell
The symbol that appears in a window to indicate alarm limits status. When a bell appears, alarm limits are set. See also Alarm Status Window.

BP
An acronym for blood pressure.

Blood Pressure Numerics Windows
The two larger windows below the heart rate. These windows can display invasive pressures and cuff pressures.

BR
An acronym for breath rate.

Buttons
The five buttons along the bottom-front of the Propaq. A label can appear above each button identifying what each button will do when pressed.

Capnogram
Hard copy of the $ETCO_2$ waveform over time.

Capnometer
Analyzer used to measure CO_2, specifically $ETCO_2$.

Channel
See Patient Channel.

C-Lock
A processing scheme used in SpO_2 that uses QRS timing to improve the noise tolerance of SpO_2 measurements.

CO_2
By-product of respiration. Exhaled by the lungs.

Configuration
The patient channels included with each Propaq model. A table in Chapter 1 lists the configuration of each Propaq model.

Continuous Programming
Whenever the user changes certain control settings like decimal indicator, date format, ECG filter, measurement units, etc., the Propaq automatically programs the change so it will still be present after cycling the power.

Cuff Status Window
The window that appears when the CUFF button is pressed. This window displays cuff information.

Cursor
The highlighted block in a status window that indicates the selection you make by pressing the NEXT button.

DC Offset
The usually small voltage that occurs with the ECG signal causing the waveform to move vertically on the Propaq's display.

Difference Temperature
The difference between T1 and T2. Also called delta T (ΔT).

Digital Filter
A computer program in the Propaq that removes unwanted noise that can be induced into the ECG signal from ac mains.

EL (Electroluminescent) Display
One of the display screens used in the Propaq. The other is the Liquid Crystal Display.

EMI
An acronym for Electromagnetic Interference.

Endotracheal Tube
Plastic breathing tube placed into the patient's windpipe.

Equipment Alert
Occurs when the Propaq detects an equipment condition requiring operator assistance. A message describing the condition is displayed.

Equipment Alert Window
The window that appears during an equipment alert.

Error Message
The message that appears when the monitor detects a malfunction requiring factory service.

Error Message Window
The window that appears when the monitor detects a malfunction requiring factory service. This window contains error messages and numbers.

Error Number
The number that identifies the problem encountered during operation.

ESD
An acronym for Electrostatic Discharge (from static electricity).

ESIS
An acronym for Electrosurgery Interference Suppression.

$ETCO_2$
An acronym for end-tidal CO_2. Amount of CO_2 breathed out at the end of an exhalation.

Factory Default Settings
The current values for all Propaq settable functions when the monitor was shipped from the factory. These settings can be changed using the CURRENT button and reset using the DEFAULT button.

Freeze
The action taken by the FREEZE button. If three waveforms are displayed, all waveforms are frozen. If less than three waveforms are displayed, the current waveforms are frozen and the top waveform is also shown in real-time.

Gas Comp
A correction factor required to obtain accurate CO_2 readings when elevated levels of O_2 or N_2O are present in respired gases.

Graphical Trends
Trend plots in graphical form. Graphic trends represent the accumulation of five hours of data averaged at two-minute intervals.

Heart Rate Source
See Heart Rate/Pulse Rate Source.

Heart Rate/Pulse Rate
The heart rate derived from the heart rate/pulse rate source. See also Heart Rate/Pulse Rate Source.

Heart Rate/Pulse Rate Source
The source from which heart rate/pulse rate is derived. This source can be ECG, any pressure, including cuff, or SpO_2. When the monitor is first turned on, the Propaq determines the most likely source for heart rate: ECG (first), P1 (second), SpO_2 (third), P2 (fourth), and cuff (last).

Highlight
The method of identifying a selected item on the display. Highlighted selections appear as light characters on a dark background or dark characters on a light background. See also Cursor.

Horizontal Axis
The time axis of graphical trends.

HR
An acronym for heart rate. This is displayed when the heart rate/pulse rate source is ECG.

$INCO_2$
An acronym for inspired CO_2. The amount of CO_2 measured during inhalation.

In-service Mode
A user training aid built into all Propaqs that provides simulated signals for all patient parameters so that function of the display, alarms, and printer can be explored easily. The in-service mode is activated by the INSERV button.

Invalid
When a channel, parameter, or alarm can no longer provide accurate information or is no longer used.

Invasive Pressure Label
The two or three-character label that appears in the Invasive Pressure Numerics Window identifying the source of blood pressure.

Labels
The names appearing above the buttons.

Last-viewed
The trend, parameter, graph, or window that was last to appear on the display.

LCD (Liquid Crystal Display)
One of the display screens used in the Propaq. The other is the EL display. The LCD is a low power display and relies on available light or an adjustable backlight for viewing.

Mainstream
A respiratory CO_2 measurement technique which uses a noninvasive sensor located at the endotracheal tube. This technique avoids signal delays and fluid problems associated with other techniques.

Menu
A group of labels above the buttons.

Numerics
The numbers that appear along the top and right side of the display for heart rate, blood pressure, temperature, alarm limits, etc.

P1
A generic label for invasive pressure channel one.

P2
A generic label for invasive pressure channel two (Model 106 only).

Parameter
See Vital Sign Parameter.

Patient Alarm
The condition that exists when a vital sign parameter numeric violates an alarm limit.

Patient Channel
ECG, P1, P2, T1, T2, SpO_2, CO_2, and Cuff.

Pinout
The signal descriptions for each pin of a connector.

Polarization
The activity that occurs when dissimilar metals between ECG electrodes and leads meet. This can cause dc offset and other signal problems.

PR
An acronym for pulse rate. This is displayed when the heart rate/pulse rate source is from a pressure channel or SpO_2.

Pressure Label
See IBP Label.

Pulse Rate
The heart rate determined from either a pressure channel, SpO_2, or Cuff.

Pushbutton
See Buttons.

Range Mode
The method used in invasive pressure display to show two waveforms against the same pressure scale.

Recover
See Trace Recovery.

Rescale Mode
The method used in invasive pressure display to show each waveform against its own scale. The scale is automatically selected for best viewing of the entire waveform.

Respiration
The exchange of oxygen and carbon dioxide in the lungs and with the cells of the body.

SpO_2
The standard term assigned to measuring oxygen saturation using a pulse oximeter. The SpO_2 patient channel noninvasively measures oxygen saturation of arteriolar hemoglobin at a peripheral measurement site, such as a finger, toe, or the bridge of the nose.

Self Tests
Internal tests the Propaq initiates whenever it is turned on. If a fault is encountered during testing, an error message window, error message, and error number appear.

Sensors
The electrodes, transducers, probes, etc. used to obtain patient information.

Serial Number
The unique number assigned to the monitor. It is located on the rear panel label.

Software Version Number
The unique number assigned to the version of the Propaq's internal programming. This number appears in the Startup window.

Startup Window
The information window that appears while the monitor performs its power-up test just after you turn on the Propaq. This information includes the Propaq model number and software version number.

Status Window
A window that appears and contains information about the Propaq.

SYNC
Short for synchronization. Two uses apply:

1. A digital output pulse from the right side panel that starts within 30 msec of the peak of a QRS complex and is used for cardioversion.

2. A message in the SpO_2 display indicating successful C-Lock.

Tabular Trend
A tabular format for the cuff trend display.

Temporary Patient Alarm
An alarm limit violation that occurred and was corrected without operator intervention.

Trace Recovery
The method used to quickly return an ECG waveform on screen when a large dc offset has been sensed.

Trend
The accumulation of several hours of data averaged at two-minute intervals.

Trend Parameter
Heart Rate/Pulse Rate, P1, P2, SpO_2, temperature, and cuff.

Turbocuf Mode
The mode used to acquire as many cuff measurements as possible in five minutes.

Valid
When a patient channel is properly connected and ready to acquire patient data.

Vertical Axis
The scale of a graphical trend.

Viewing Angle (LCD displays only)
The best angle at which the LCD can be viewed. Viewing angle is adjusted with the CONTRAST button.

Vital Sign Parameter
The measurements obtained from patient channels (such as, heart rate, systolic, diastolic, mean, pulse rate, O_2, CO_2, etc.).

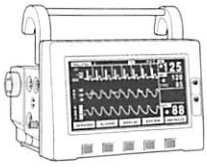
Waveform Window
The area in which waveforms are displayed.

Waveform/Status Window
See Waveform Window or Status Window.

Window
An area on the display screen in which information is displayed.

YSI
An acronym for Yellow Springs Instrument Company.

Zeroing
The process by which an invasive pressure zero reference is obtained so that pressures can be related to atmospheric pressure. This process also nulls out any residual pressure indicated by a transducer with zero pressure applied.



B

Specifications

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ECG

note...

The ECG channel meets the following AAMI Categories for Cardiac Monitors Heart Rate Meters and Alarms. ANSI/AAMI EC13-1983, except for Standardizing Voltage (section 3.2.9.9) and Hysteresis (section 3.2.9.8 part 4). The channel also meets the American National Standard, Safe Current Limits for Electromedical Apparatus (ANSI/AAMI ES1-1985).

Table B-1: ECG Specifications

Characteristic	Specification
Connector	AAMI 6 pin or Hewlett-Packard compatible 12-pin style connector (optional). See Figure B-1 on page B-7.
Selectable Leads	I, II, III
Lead Fault Indicator	LA, LL, RA, MULTIPLE
ECG Size (sensitivity) in mV/cm	4, 2, 1, 0.5, 0.2
Display Sweep Speeds	12.5, 25, and 50 mm/sec
QRS Tone Volume	High, Low, Medium, Off
QRS Tone Frequency	2625 Hertz; variable pitch with SpO_2 option and SpO_2 being monitored
Freeze Buffer	4.25 seconds at 25 mm/sec
Bandwidth	0.5 to 40 Hz
Input Protection	Electrosurgery and defibrillator protected. All \models also include electrosurgery interference suppression.

Table B-1: ECG Specifications

Characteristic	Specification
Lead Fail Sense Current	25 nA dc for active leads 50 nA dc for driven lead
Tall T-wave Rejection	Meets and exceeds AAMI (USA) EC13-1983, section 3.1.2.1, part 3, for 1.2 mV T-wave and 1 mV QRS using AAMI test waveform.
Common Mode Rejection	<1 mV p-p RTI for 10V rms, 50/60 Hz input, input unbalanced, FILTER function OFF <0.1 mV p-p RTI for 10V rms, 50/60 Hz input, input unbalanced, FILTER function ON
Input Impedance	>2.5 MΩ differential @ 60 Hz
Input Range (ac)	±5 mV
Input Range (dc)	Up to ±300 mV
QRS Detector	Width Range: 25 to 120 ms Amplitude Range: 0.3 to 5 mV (RTI)
Heart Rate Counter Range	25 to 250 bpm
Heart Rate Meter Response Time	Responds to change in heart rate within 5 to 9 seconds depending on physiological waveform. (Including AAMI 3.1.2.1 parts 6 and 7 waveforms.) Includes 1 second readout update interval.

Table B-1: ECG Specifications

Characteristic	Specification
HR Accuracy	±3 bpm or 3%, whichever is greater NOTE: AAMI Test 4.1.4 part 6: Accuracy is affected (i.e., rate drops) when QRS and pacer spikes are nearly simultaneous as occasionally is the case during this AAMI test.
Heart Rate Averaging Method	Heart rate = 60 / latest average interval. For higher heart rates, latest average interval = 7/8ths of previous average interval + 1/8th of latest interval. For lower heart rates, latest average interval = 3/4ths (previous average interval) + 1/4th latest interval. Transition rates for choice of formula include hysteresis and are 70 and 80 bpm.
Drift Tolerance (AAMI Specification EC13-1983, 3.2.6.3)	80 bpm indicated for 80 bpm ECG plus drift waveform
Pacer Display	Pacer indicator shown on screen if PACER function turned on; pacer spike always shown if of sufficient amplitude.

Table B-1: ECG Specifications

Characteristic	Specification
Pacer Pulse Rejection	Will not count approximately 95% of pacemaker pulses of 0.1 to 2 ms duration, ±2 mV to ±700 mV, with or without AAMI (EC13 1983) tails of all decay time constants (TC). Tails are 2.5%, maximum 2 mV, TC=25, 50, 75, 100 ms. Pacer detection range (i.e., will show the dashed vertical marker) for 0.1 ms pulses is ±3 mV to ±700 mV, and drops linearly to ±2 mV to ±700 mV for 0.2 to 2 ms pulses.
Response to Irregular Rhythm (AAMI specification EC13-1983, 3.1.2.1. Part 5)	
Ventricular Bigeminy (VB)	77 to 82 bpm (expected)
Slow Alternating VB	63 to 81 bpm (expected)
Rapid Alternating VB	115 to 123 bpm (expected)
Bidirectional Systole	87 to 93 bpm (expected)

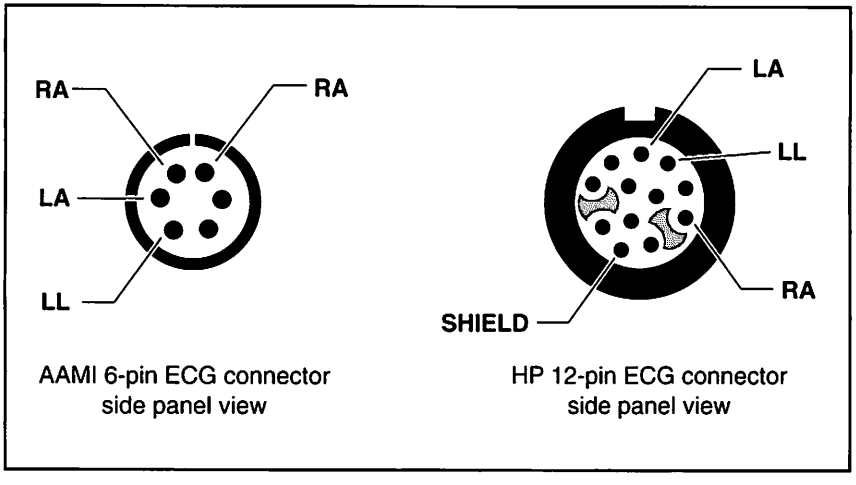


Figure B-1. ECG connectors

The Propaq can be equipped with the standard AAMI 6-pin ECG connector or the optional Hewlett-Packard compatible ECG connector.

Invasive Pressure

note...

Applies only to models 104 and 106. See Figure B-2 on page B-9 for the invasive pressure connector pinouts.

Table B-2: Invasive Pressure Specifications

Characteristic	Specification
Transducer Type	Strain-gauge resistive bridge
Transducer Excitation Impedance Range	200 to 2000 Ω
Transducer sensitivity	5 µV/V/mmHg
Excitation Voltage	5V Pulsed dc @ 181 Hz [a]
Connector	ITT-Cannon plug MS3106F-14S-6P Std. Hewlett-Packard compatible 12-pin connector (optional). See Figure B-2 on page B-9.
Bandwidth	Digital filtered, dc to 25 Hz
Zero Drift	±1 mmHg without transducer drift
Zero Adjustment	±200 mmHg including transducer offset
Numeric Accuracy	±2 mmHg or 2% of reading, whichever is greater, plus transducer error
Pressure range	-30 to 300 mmHg
Pulse range	25 to 250 bpm
Leakage Current	Meets ANSI/AAMI risk (leakage) requirements
Electrosurgery interference suppression	Included in all EL display monitors

[a] Duty factor depends on transducer impedance. For 200 to 900 Ω, duty factor is ≈ 11%. Above 900 Ω, the duty factor increases to ≈ 91%.

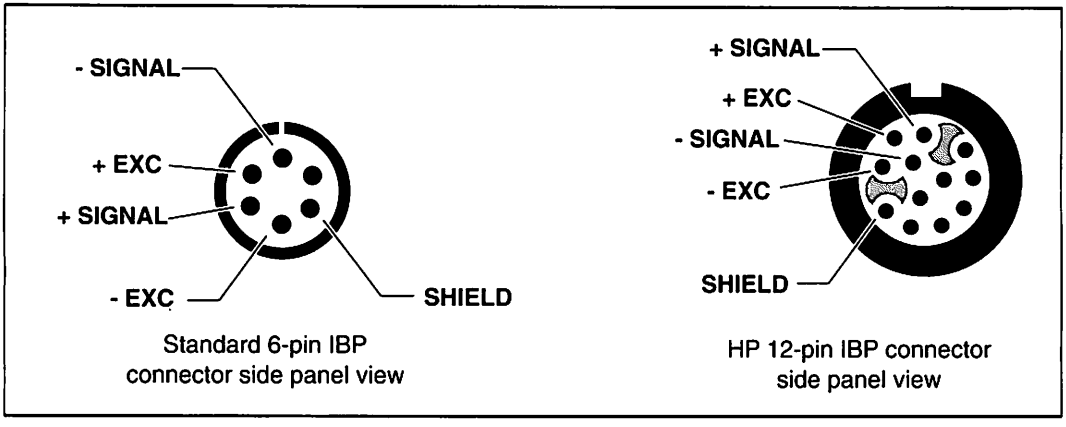


Figure B-2. Invasive Pressure connectors

The Propaq can be equipped with the standard 6-pin connector or the optional Hewlett-Packard compatible connector.

Cuff

note...

Meets AAMI Standard for Electronic or Automated Sphygmomanometers ANSI/AAMI SP10-1987.

Table B-3: Cuff Specifications

Characteristic	Specification
Method	Oscillometric
Control	Automatic and manual measurement control
Auto Intervals	1, 2, 3, 5, 10, 15, 30, and 60 minutes
Turbocuf	Maximum measurements allowable in a 5 minute period
Displayed Pressures	Systolic, Diastolic, and Mean plus on-screen manometer
Cuff Sizes	Adult: 25 to 35 cm; Large Adult: 33 to 47 cm; Thigh: 46 to 66 cm; Child: 18 to 26 cm
Limb Circumference	18 to 66 cm
Hose Connection	Quick connect
Systolic Range	30 to 250 mmHg
Diastolic Range	20 to 230 mmHg
Mean Range	25 to 240 mmHg
Numeric Accuracy	±3 mmHg or 2%, whichever is greater

Table B-3: Cuff Specifications

Characteristic	Specification
Minimum Inflation Pressure	100 mmHg
Default Inflation Pressure	Adult Cuff: 140 mmHg Child Cuff: 120 mmHg
Cuff Overpressure	260 mmHg
Cuff Overpressure Backup (mechanical overpressure valve)	280 to 330 mmHg
Propaq Plumbing Leak Rate	<8 mmHg/min. measured at 250 mmHg after 30 seconds for pressure stabilization
Pulse Rate Range	25 to 160 bpm (without ECG) 25 to 200 bpm (with ECG)
Pulse Rate Accuracy	6 bpm or 6%, whichever is greater
Maximum Determination Time (timeout)	3 minutes
Typical Determination Time	15 to 40 seconds
Typical Determination Time with Artifact	up to 70 seconds
Minimum Time between measurements	25 seconds
Electrosurgery interference suppression	Included in all EL display monitors

Pulse Oximetry (SpO_2)

Table B-4: SpO_2 Specifications

Characteristic	Specification
Range	0% to 100%
Probe Accuracy (specified at 28° to 42° C)	70% to 100% ±2 digits; 0% to 70% unspecified
Pulse Rate Range	20 to 250 bpm
Pulse Rate Accuracy	±3 bpm
Sensor Compatibility	Compatible only with NELLCOR sensors listed in Chapter 2.
Electrosurgery interference suppression	Included in all units, whether EL or LCD.

CO_2 Option

Table B-5: CO_2 Specifications

Characteristic	Specification
CO_2 Sensor	
Sensor Type	Mainstream
Principle of Operation	NDIR single-beam, single path/ wavelength, ratiometric
Warm-up time	20 sec typical, 3 min maximum
Response Time	30 mS typical, 60 mS maximum
Calibration	Verify semi-annually, calibrate only as required
CO_2 Sensor and Cable Dimensions and Weight	
Sensor Height *	1.003 in
Sensor Width *	1.036 in
Sensor Depth *	0.78 in
Sensor Weight *	< .39 oz
Sensor Volume *	0.81 cubic inches (approximately)
Cable Length	10 ft nominal
CO_2 Airway Adapter	
Type	Per ISO 3040, single-use
Size	15 mm ID, (meets ISO specifications)
Material	clear polycarbonate, with sapphire windows
Deadspace	< 5cc

*not including cable

Table B-5: CO_2 Specifications

Characteristic	Specification
CO_2 Display	
Screen Display	CO_2 waveform and $ETCO_2$ and $INCO_2$ (when in alarm) numerics
Measurement Ranges	$ETCO_2$: 0-99 mmHg, 0-13 kPa, 0-23% $INCO_2$: 0-25 mmHg, 0-5 kPa, 0-5%
Display Ranges	$ETCO_2$: 0-99 mmHg, 0-13 kPa, 0-23% $INCO_2$: 0-25 mmHg, 0-5 kPa, 0-5%
Units	mmHg, kPa,%; user-selectable
Sweep Speed	3.13, 6.25, 12.5 mm/sec; user-selectable
Response Modes	**Fast**: 15 sec sampling time period **Normal**: 30 sec sampling time period **Slow**: 45 sec sampling time period
Gas Compensation	**OFF:** CO_2 value = calculated CO_2 value; **O_2 > 50%, No N_2O:** CO_2 value = calculated CO_2 value x 1.03; **N_2O > 50% setting:** CO_2 value = calculated CO_2 value x 0.952
Alarm Limit Ranges	$ETCO_2$: 0-99 mmHg, 0-14 kPa, 0-14% $INCO_2$: N/A-25 mmHg, N/A-5 kPa,%
Resolution	1 mmHg
Accuracy	± 3 mmHg (0-30 mmHg CO_2) ± 10% of reading (31-99 mmHg CO_2)
Waveform Rise Time	130 mS maximum (10% to 90% step change)
Altitude Error	±0.4%/1,000 ft

Table B-5: CO_2 Specifications

Characteristic	Specification
Breath Rate Display	
Screen Display	Numeric
Units	Breaths/Minute
Range	1-99 Br/M
Resolution	±1 Br/M
Accuracy	±1 Br/M or 5%, whichever is greater
Alarm Limits Range	1-99 Br/M
Apnea Alarms and Tickets	
Apnea Ticket	Set to auto print after apnea event and after 1 minute continued apnea
Apnea Alarm Accuracy	± 1 sec
Resolution	5 sec
Alarm Limits Range, Adult and Pediatric	15-30 secs delay, 5 sec. increments
Barometric Pressure	
Pressure Compensation	Automatic
Operating Range	-2,000 to 15,000 ft (817-429 mmHg)
Screen Display	Numeric (CO_2 Status Window)
Units	mmHg
Accuracy	±2.5 % of reading (calibrated at sea level)

Table B-5: CO_2 Specifications

Characteristic	Specification
In-service Values	
$ETCO_2$	initial value: 38, alternate value: 60
$INCO_2$	initial value: 0, alternate value: 8
Breath Rate (BR)	initial value: 12, alternate value: 31
CO_2 Sensor Environmental Specifications	
Sensor Housing Temperature	42°C nominal
Operating Ambient Temperature	10° to 40°C
Storage Temperature	0-50°C
Operating Altitude	-2000 to 15,000 (817-429 mmHg)
Storage Altitude	30,000 ft
Storage Humidity	0 to 95%, noncondensing
Shock	100 g for 4 mSec
Vibration	5-35 Hz, 0.015 in peak-to-peak, 35-100 Hz, 1 g acceleration
Drop	36 inches free fall to floor (tile over concrete, one drop each face, one drop each edge/corner)

Temperature

Table B-6: Temperature Specifications

Characteristic	Specification
Range	17° to 50° C; 62.6° to 122° F
Displays	T1, T2, and ΔT (T1 only on 106)
Probes	Compatible with YSI Series 400 and 700 and Electromedics Series 2100 probes. HP side panel only compatible with YSI 400 and has HP connector.
Units	°C and °F selectable [a]
Accuracy	±0.1° C (±0.2° F) plus probe tolerance
Resolution	0.1 °C or °F
Electrosurgery interference suppression	Included in all EL display monitors

[a.] °C only is available on some overseas models.

Alarms

Table B-7: Alarms Specifications

Characteristic	Specification
Indicators	ALARM light, ALARM(S) OFF light, Audible Tone, Lights continually flash 0.5 seconds on and 0.5 seconds off if an alarm is suspended. Flashing Numerics. Numeric in violation alternates between normal and reverse video with 1 second duration each.
Tone Frequency	2625 Hertz Tone is steady for a patient alarm and sounds for 1 second every 4 seconds for an equipment alert.
Selectable Tone Volume	Low, Medium, High
Limits	Settable on all parameters
Control	Automatic preset or manual settings
Alarm on Tachycardias	Most tachycardias will alarm in less than 8 seconds. These include AAMI 3.1.2.1 part 7 waveforms. Certain multifocal tachycardias may initially alarm as "low rate."
Apnea Alarm Limits Range, Adult and Pediatric	15-30 secs delay, 5 sec. increments

Trends

Table B-8: Trends Specifications

Characteristic	Specification [a]
Model 102 Parameters	CUFF, T1, T2, ΔT, HR (heart rate/ pulse rate), SpO_2, End-tidal CO_2, Inspired CO_2, Breath Rate
Model 104 Parameters	CUFF, P1, T1, T2, ΔT, HR (heart rate/ pulse rate), SpO_2, End-tidal CO_2, Inspired CO_2, Breath Rate
Model 106 Parameters	CUFF, P1, P2, T1, HR (heart rate/ pulse rate), SpO_2, End-tidal CO_2, Inspired CO_2, Breath Rate
Duration	5 hours displayed; 8 hours printed
Resolution	2 minutes
Types	Graphic and tabular
Scales	Selectable depending on parameter

[a.] Assumes SpO_2 and CO_2 functions are present.

Display

Table B-9: Display Specifications

Characteristic	Specification
General	
Matrix	276 X 128 pixels
Active Viewing Area	146.2 mm X 67.8 mm
Pixel Pitch	0.53 mm X 0.53 mm
Character Height	Large: 8.2 mm (0.3 in.) Small: 3.8 mm (0.15 in)
Liquid Crystal Display (LCD)	
Viewing Angle	Horizontal Axis: 38° to 40° Vertical Axis: 35° to 45°
Contrast Ratio	7:1
Backlight	White
Response Time	300 ms (maximum)
Display Window	Laminated Glass
Electroluminescent (EL) Display	
Viewing Angle	>160° Horizontal and Vertical
Contrast Ratio	>100:1 with Contrast Enhancement Filter
Display Window	Contrast Enhancement Filter
Display Color	Amber
Display Background Color	Black

Monitor (Environmental)

See page B-24 for a listing of printer environmental specifications. See page B-16 for a listing of the CO_2 sensor environmental specifications.

Table B-10: Monitor Environmental Specifications

Characteristic	Specification
Operating Temperature	0° to 50° C
Shipping and Storage Temperature	-20° to 60° C
Operating Altitude	-2,000 to 15,000 ft (-610 to 4,572 m)
Shipping and Storage Altitude	-2,000 to 40,000 ft (-610 to 12,192 m)
Operating Relative Humidity	0 to 97%, noncondensing
Shipping and Storage Relative Humidity	0 to 97%, noncondensing
Shock	50 g
Vibration	Random Vibration, $0.02g^2$/Hz from 10 to 300 Hz, ramping down to $0.002g^2$/Hz at 500 Hz. Operating 1 hour per axis, 3 hours per test.
Electromagnetic Interference (EMI)	per FDA Standard MDS-201-0004 (emissions only)
Water Resistance	IPX1 Drip-Proof per IEC Publication 529.

note...

The following standards were used for environmental testing: EMI per FDA MDS-201-0004; temperature humidity and altitude based on MIL-T-28800; vibration shock and transportation based on MIL-T-28800; IEC-801-2 electrostatic discharge requirement Level 4; VDE 0871 Class B EMI (European); water resistant drip-proof based on IEC Publication 601-1.

Monitor (Physical)

Table B-11: Physical Specifications

Characteristic	Specification
Protection Classifications, all Configurations [a]	
Type of Protection Against Electric Shock • Monitor powered by power adapter • Monitor powered by internal batteries only • Monitor powered by external low-voltage dc source	 • Class I, (Protectively Earthed) • Internally Powered Equipment • Class II Equipment [b]
Degree of Protection Against Electric Shock	Type CF Equipment, Defibrillator-Proof
Degree of Protection Against Harmful Ingress of Water	IPX1, Protected against vertically dripping water [c]
Method of Disinfection	Not suitable for autoclaving [d]
Flammable Anesthetics	Not suitable for use with flammable anesthetics
Monitor Only	
Height	6.6 in. (16.8 cm)
Width	8.3 in. (21.1 cm
Depth	4.3 in. (10.9 cm); EL 4.8 in (12.2 cm)
Weight	5.6 lb. (2.5 kg); EL 5.8 lb (2.6 kg)

Table B-11: Physical Specifications

Characteristic	Specification
Monitor with SpO_2 Module	
Height	6.6 in. (16.8 cm)
Width	8.3 in. (21.1 cm)
Depth	6.8 in. (17.3 cm); EL 7.3 in. (18.5 cm)
Weight	8.3 lb. (3.8 kg); EL 8.6 lb. (3.9 kg)
Monitor with Expansion Module (Printer / SpO_2 / CO_2)	
Height	9.8 in. (24.9 cm)
Width	8.3 in. (21.1 cm)
Depth	6.8 in. (17.3); EL 7.3 in (18.5 cm)
Weight with Printer	11.0 lb. (5.0 kg); EL 11.3 lb. (5.1 kg)
Weight with Printer and SpO_2	11.7 lb. (5.3 kg); EL 12.0 lb. (5.5 kg)
Weight with Printer, SpO_2, and CO_2	12.0 lb. (5.5 kg); EL 12.3 lb. (5.6 kg)
Weight with SpO_2 and CO_2 (no printer)	10.1 lb. (4.6 kg); EL 10.4 lb. (4.7 kg)

[a] Per IEC Publication 601-1 unless otherwise stated.
[b] Per special British policy, Class II marking is not applied to the product because this classsification is applicable only when powered by low-voltage dc source.
[c] Per IEC Publication 529.
[d] See Chapter 5 for cleaning instructions.

Printer

Table B-12: Printer Specifications

Characteristic	Specification
Operation	
Operating Modes	Continuous, Snapshot, Freeze Print, Auto Interval Print, Auto Interval Trend, Tabular Trend, Alarm Print, Cuff Ticket, Apnea Ticket
Auto Print Intervals	15 min., 30 min., 1 hour, 2 hours, 4 hours
Auto Trend Shifts	Once Every 8 hours
Number of Waveforms	Up to Three: ECG, P1, P2, SpO_2, CO_2
Grid	5 mm and 1 mm gradations
Annotation	Date, Time, Print Mode, Speed, Heart Rate, Systolic, Diastolic, Mean, SpO_2, Breath Rate, $ETCO_2$, $INCO_2$, Temperature, Pacer Status
Printing Speeds	6.25, 12.5, 25.0 mm/sec, simulated 6.25
Printer Mechanism	
Printing Method	Thermally sensitive dot method
Dot structure	320 dots per line
Printing width	53 mm
Horizontal Dot Pitch	0.165 mm, 6 dots/mm
Vertical Dot Pitch	0.165 mm
Paper Feed Method	Friction Feed
Paper Feed Precision	±2% @ 25° C and 60% Relative Humidity
Paper Width	60 mm
Reliability	30 million pulses/dot

Table B-12: Printer Specifications

Characteristic	Specification
Environmental	
Monitor/Expansion Module	
Operating Temperature	+5° to 40° C
Shipping and Storage Temperature	-20° to 60° C
Operating Relative Humidity	35% to 85% noncondensing
Shipping, Storage Relative Humidity	5% to 90% noncondensing
Shipping and Operating Altitude	-2,000 to 15,000 ft (-610 to 4,572 m)
Storage Altitude	-2,000 to 40,000 ft (-610 to 12,192 m)
Shock	30 g
Vibration	Random Vibration, $0.02g^2$/Hz from 10 to 300 Hz, ramping down to $0.002g^2$/Hz at 500 Hz. Operating 1 hour per axis, 3 hours per test.
EMI	per standard MDS-201-0004 (emissions only)
Paper	
Short-term Storage Environment (up to 7 days)	-20 to 40°C; 5 to 80% noncondensing
Long-term Storage Environment (up to 5 years)	25°C (optimal), 65% noncondensing

Power

Table B-13: Monitor Power Specifications

Characteristic	Specification
Mode of Operation	Continuous
Battery Pack Type	Sealed lead acid
Battery Pack Capacity	Monitor only: 8 volts, 3 Ampere-Hours Monitor with Expansion Modules: 8 volts, 6 Ampere-Hours
Battery Recharger Circuitry	Internal, powered by external power adapter
DC Input Power Required	12 to 28 Volts, 10.5 Watts With CO_2: 25 Watts
Input Fuse Rating [a]	3A/250V, Slow-Blow, Type 2AG (0.57x 0.177 in.)
Operating Times on Battery	Range of 4 hours to 8 hours depending upon product configuration
Battery Recharge Time with instrument and backlight (LCD versions only) on	Range of 8 hours to 12 hours typical, depending upon product configuration
Battery Recharge Time with instrument off	Range of 6 hours to 8 hours depending upon product configuration

[a] Replaceable fuses only with CO_2-equipped monitors or monitors with defib sync feature on right side panel.

Power Adapters

Table B-14: Power Adapter General Specifications

Characteristic	Specification
Protection Classifications, all Adapters [a]	
Type of Protection Against Electric Shock	Class I, (Protectively Earthed)
Degree of Protection Against Electric Shock	Type BF (Floating output meets BF Risk/Leakage Current Limits) [b]
Degree of Protection Against Harmful Ingress of Water	For ordinary, indoor locations only.
Method of Disinfection	Not suitable for autoclaving [c]
Flammable Anesthetics	Not suitable for use with flammable anesthetics
Environmental Specifications, All Adapters	
Operating Temperature	0° to 50° C
Shipping and Storage Temperature	-20° to 60° C
Operating Altitude	-2,000 to 15,000 feet (-610 to 4,572 m)
Shipping and Storage Altitude	-2,000 to 40,000 feet (-610 to 12,192 m)
Operating Relative Humidity	0 to 95%, noncondensing
Shipping, Storage Relative Humidity	0 to 95%, noncondensing
Shock	50 g
Vibration	Random Vibration, $0.02g^2$/Hz from 10 to 300 Hz, ramping down to $0.002g^2$/Hz at 500 Hz. Operating 1 hour per axis, 3 hours per test.
Water Resistance	For ordinary, indoor locations only.

[a] Per IEC Publication 601-1.
[b] BF Classification not marked on North American Standard Output Adapter.
[c] See Chapter 5 for cleaning instructions.

Table B-15: Power Adapter Physical Specifications

Characteristic	Specification
Universal Power Adapter, Part No. 503-0054-00	
Length	5.0 in. (12.7 cm)
Width	3.6 in. (9.1 cm)
Height	3.1 in. (7.9 cm)
Weight	3.1 lb. (1.4 kg)
Rated Input	100V-120V ac, 500 mA, 50/60 Hz
Rated Fuses	T800 mA/250V, Time-Delay, 5x20mm
Rated Output (Continuous)	16-24V dc, 25 VA
Connector	Style B
Additional Features	Detachable power cord, pilot light, mains switch
Universal Power Adapter, Part No. 503-0054-01	
Length	5.0 in. (12.7 cm)
Width	3.6 in. (9.1 cm)
Height	3.1 in. (7.9 cm)
Weight	3.1 lb. (1.4 kg)
Rated Input	200V-240V ac, 250 mA, 50/60 Hz
Rated Fuses	T400 mA/250V, Time-Delay, 5 x 20mm
Rated Output (Continuous)	16-24V dc, 25 VA
Connector	Style B
Additional Features	Detachable power cord, pilot light, mains switch
North American Power Adapter, Part No. 503-0002-00	
Length	3.0 in. (7.6 cm)
Width	2.75 in. (7.0 cm)
Height	1.95 in. (5.0 cm)

Table B-15: Power Adapter Physical Specifications

Characteristic	Specification
Weight	1.0 lb. (0.45 kg)
Rated Input	120V ac, 60 Hz 0.2A
Rated Fuses	No serviceable fuses
Rated Output (Continuous)	15V dc, 0.7A
Connector	Style A
Additional Features	NA
Universal Power Adapter, Part No. 503-0002-02	
Length	5.0 in. (12.7 cm)
Width	3.6 in. (9.1 cm)
Height	3.1 in. (7.9 cm)
Weight	3.1 lb. (1.4 kg)
Rated Input	100V-120V ac, 50/60 Hz, 500 mA
Rated Fuses	T800 mA/250V, Time-Delay, 5 x 20mm
Rated Output (Continuous)	16-24V dc, 25 VA
Connector	Style A
Additional Features	Detachable power cord, pilot light, mains switch
Universal Power Adapter, Part No. 503-0002-04	
Length	5.0 in. (12.7 cm)
Width	3.6 in. (9.1 cm)
Height	3.1 in. (7.9 cm)
Weight	3.1 lb. (1.4 kg)
Rated Input	200V-240V ac, 50/60 Hz, 250 mA
Rated Fuses	T400 mA/250V, Time-Delay, 5 x 20mm
Rated Output (Continuous)	16-24V dc, 25 VA
Connector	Style A

Table B-15: Power Adapter Physical Specifications

Characteristic	Specification
Additional Features	Detachable power cord, pilot light, mains switch
International Power Adapter, Part No. 503-0002-20	
Length	4.8 in. (12.2 cm)
Width	2.7 in. (6.9 cm)
Height	2.6 in. (6.6 cm)
Weight	1.6 lb. (0.7 kg)
Rated Input	220V-240V ac, 50 Hz, 0.12A
Rated Fuses	No serviceable fuses
Rated Output (Continuous)	15V dc, 0.7A
Connector	Style A
Additional Features	Detachable power cord, Mains switch
Alternative International Power Adapter, Part No. 503-0002-22	
Length	4.8 in. (12.2 cm)
Width	2.7 in. (6.9 cm)
Height	2.6 in. (6.6 cm)
Weight	1.6 lb. (0.7 kg)
Rated Input	220V-240V ac, 50 Hz, 0.12A
Rated Fuses	T200mA/250V Time-Delay , 5 x 20 mm
Rated Output (Continuous)	15V dc, 0.7A
Connector	Style A
Additional Features	Detachable power cord, Pilot light

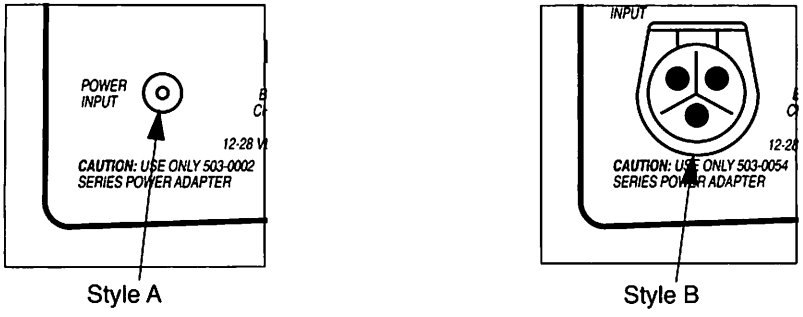


Figure B-3. Style A and Style B connectors

Delayed Analog/Defib Sync

Special cables are required for the delayed analog or defib sync connectors.

Table B-16: Delayed Analog / Defib Sync Signals

Signal	Specification
Sync Output	0 to 5V pulse, 100 ±5mS wide, starts within 35 mS after peak of R-wave. 15 mA short circuit current.
P1 Output (Models 104 and 106 only)	Range = 0V to 2.5V, 0 mmHg = 0V Gain = 9.8 mV/mmHg, delay = 112 mS, DC to 20 Hz, 3.2 kΩ output
ECG Output	Range = -5 to +5V, centered about 0V, Gain = 1000X, noninverting, delay = 112 mS, .5-34Hz, 270Ω output
Marker Input (Defib Sync only)	Normally 0V in, a pulse either + or -5 to ±15V for ≥10 mS puts a marker in ECG trace. 12 kΩ input res.
Shield	Common terminal for other 4 signals

WARNING

Do not use either delayed ECG or delayed P1 as a timing signal for a defibrillator or balloon pump. Their delays are too great.

The sync output does not operate during In-service mode; delayed ECG and P1 do operate then.

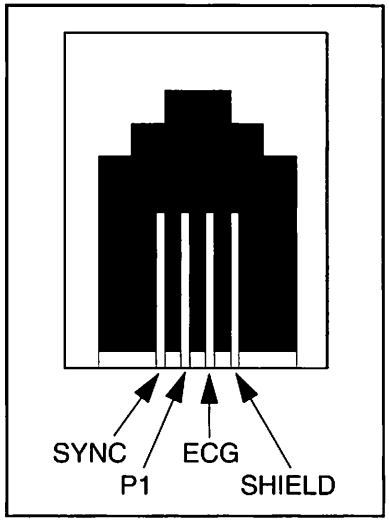


Figure B-4. Analog Output connector side panel view

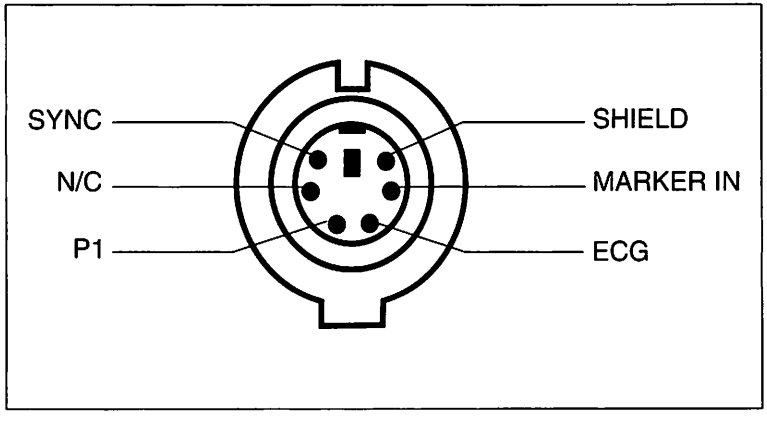


Figure B-5. Defib Sync connector side panel view

Factory Default Settings

Table B-17: Factory Default Settings

Setting	Factory Default
Date	MO/DA/YR This setting is automatically updated whenever it is changed during use.
Decimal	. (Period) This setting is automatically updated whenever it is changed during use.
Contrast	3rd out of 11 Steps. This setting is automatically updated whenever it is changed during use. (LCD Option only)
mm/sec	25 mm/sec
Alarm Tone	MEDIUM
HR/PR TONE	LOW
HR/PR SOURCE	ECG
ECG Size	1 mV/cm
ECG Lead	II
ECG Filter	60 Hz. This setting is automatically updated whenever it is changed during use.
ECG Pacer	ON
IBP Range	0 to 180 mmHg
IBP Rescale	0 to 140 mmHg
IBP Mode	RESCALE

Table B-17: Factory Default Settings

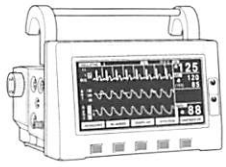
Setting	Factory Default
Invasive Pressure Formats	SDm
Cuff Mode	MANUAL
Cuff Auto Time	15 min
SpO_2 SIZE	2x
SpO_2 C-LOCK	ON
SpO_2 Response	NORMAL
TEMP F/C	Celsius
CO_2 Range	0 to 60 mmHg
CO_2 Sweep	6.25 mm/sec
CO_2 Response	NORMAL
CO_2 Units	mmHg This setting is automatically updated whenever it is changed during use.
CO_2 Gas Compensation	OFF (cannot be programmed)
Display Wave Select	All waves are on except Cuff
Trend Parameter	Cuff
Alarm Limits	All are ON except P2
HR Limits	50, 120 BPM
CUFF Limits	SYS - 75, 240 mmHg
	DIA - 35, 130 mmHg
	MEAN - 50, 140 mmHg

Table B-17: Factory Default Settings

Setting	Factory Default
P1, P2 Limits	SYS - 75, 240 mmHg
	DIA - 35, 130 mmHg
	MEAN - 50, 140 mmHg
SpO_2 Limits	85%, 100%
TEMP Limits	35.0°, 37.8° C
ΔT Limits	0.0°, 2.8° C
$ETCO_2$ Limits	25, 60 mmHg (3, 8 for % and kPa)
$INCO_2$ Limits	N/A, 5 mmHg (0.7 for % and kPa)
Breath Rate (BR) Limits	5, 30 Br/M
Apnea Delay	20 seconds
TREND GRAPH SETTINGS	
HR	25 to 125 bpm
CUFF	Tabular
IBP	30 to 180 mmHg
SpO_2	80% to 100%
TEMP	25° to 45° C
CO_2	0 to 60 mmHg
BR	0 to 50 Br/M
PRINTER SETTINGS	
Printer Alarm Print	OFF

Table B-17: Factory Default Settings

Setting	Factory Default
Printer Auto Print	OFF
Printer Cuff Ticket	OFF
Printer Apnea Ticket	ON
Printer Print Speed	25 mm/sec
Printer Auto Trend	OFF: 7-15-23
Printer Trend Selections	All ON



C

Pre-Service Inspection

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General Information

The procedures in this appendix can be used to unpack and verify the functionality of the Propaq when you first receive it. The functional check procedure requires a patient simulator and should be performed by a biomedical engineer or technician. Once you've completed the procedure and the Propaq meets all requirements, the Propaq can be placed in service.

note...

This functional checkout does not verify calibration of the Propaq. To verify calibration, refer to the *Propaq Service Manual*.

Unpacking

1. Before unpacking the monitor, check the shipping carton for damage.
2. If damage is apparent, stop unpacking the carton and contact the shipping company for further instructions. If the carton is intact, unpack the Propaq.
3. Check the contents of the box against the packing list. If an item is missing, first check with your receiving department. Also recheck the carton to eliminate the possibility that something might have fallen out of the carton. If necessary, contact Protocol Systems, Inc. at the address and phone number listed in **Customer Services** on page 5-15.
4. Check the Propaq for any signs of physical damage, such as cracks or scratches in the case. Any damage should be reported to the shipping company.

Functional Check

Preparation

The Propaq is controlled by an internal program (software) that completely checks itself when you first turn on the Propaq. If a problem is detected within the software, the Propaq notifies you with a message. If such an error is detected, the Propaq will need to be serviced. It should be returned to Protocol Systems.

The following functional checkout verifies the systems in the Propaq that are not checked by the software. The procedure does not check the accuracy of the systems, but merely that they are functioning. For a more calibrated measurement, you will need to follow procedures provided in the Propaq *Service Manual*, which you can purchase from Protocol Systems.

Table C-1 on page C-5 lists the equipment you need to perform the following functional checkout. Any parts of the checkout that fail require attention. Contact Protocol Systems Technical Services at (800) 289-2501 or (503) 526-8500.

Table C-1: Required Equipment for Functional Checkout

Equipment	Suggested Model or Equivalent
Mercury-column Manometer with Bulb (400 mmHg)	Baumanometer 14-383 wall mount Manometer or equivalent.
Stethoscope	
Patient Simulator	Dynatech/Nevada 213A, 215A, or 217A with Temperature and ECG Cable/Leads [a]
Invasive Pressure Simulator, 5 µV/V/mmHg	Fogg Systems BP48C, BP28, or MDE Datasim 6000 with Inv. Prs. cables
NIBP Cuff	Protocol Cuff (provided with monitor)
AC Mains Adapter	Protocol Power Supply Adapter (provided with monitor)
Safety Analyzer	Dynatech/Nevada (formerly Neurodyne-Dempsey), 431F-1D

a. If using one of these simulators, don't monitor ECG and invasive pressure simultaneously. There is an incompatibility between Propaq and Dynatech in this mode. Monitor separately or use another simulator.

Procedure

1. Before turning on the Propaq, remove the power supply adapter from the shipping carton.
2. Check that the power supply is labelled with the input voltage ratings for your ac mains power source. If the Universal Power Adapter was received with your Propaq, refer to **Power Adapters** on page 6-21 for other important information.
3. Plug the power supply adapter into an appropriate ac mains outlet and then into the Propaq.
4. Check that the green CHARGING light on the right side panel lights when the power adapter is plugged into the Propaq.
5. Leave the power adapter plugged in.
6. Turn on the Propaq by pressing the OFF (STANDBY)/ON switch on the right side panel.
7. As the Propaq turns on, it checks the internal software for any problems.
8. If the Propaq detects a problem during the self-test, it displays a message. The monitor requires service.
9. Set the patient simulator for a 1 mV ECG signal at normal sinus rhythm at 80 bpm, and plug the simulator cable into the ECG connector on the Propaq.
10. The Propaq automatically detects the ECG signal and displays the ECG waveform.

11 Check the size setting displayed to the left of the waveform. If it is not 1 mV/cm, press the following buttons: SENSORS and then ECG. Now press the ECG SIZE button until 1 mV/cm is shown to the left of the waveform.

12 Check that the QRS complex is approximately twice as tall 'V' in mV of displayed size setting on the display.

13 Set the patient simulator for an ECG signal with pacemaker signal (any pacer setting is acceptable).

14 If a dashed line does not appear when you turn on the pacemaker signal, press the following buttons on the Propaq: MORE and check that ON is displayed next to PACER. (If you pressed the MAIN MENU button already, press SENSORS and then ECG before you press the MORE button.)

15 If PACER is not ON, press NEXT until the highlight moves next to PACER, and press CHANGE to turn on the pacer indicator.

16 Check that a dashed line appears with every pacemaker signal on the ECG waveform.

17 Press the MAIN MENU button.

18 Press the following buttons on the Propaq: ALARMS and then STAT SET.

19 Set the heart rate to greater than 120 bpm.

20 The alarm tone should sound.

21 Press the following buttons: DISPLAY and then MORE. Use the NEXT and CHANGE buttons to change the alarm tone volume, checking for tone loudness to change from low to medium to high. (You cannot turn off the alarm tone.)

22 Press the MAIN MENU button.

23 Disconnect the ECG cable from the Propaq.

24 When the Propaq notifies you that ECG has been disconnected, press any button.

25 Attach the cuff to the Propaq by screwing the hose onto the cuff connector on the left side panel.

26 Wrap the cuff snugly around your arm and then press the following buttons: SENSORS, then CUFF, and then START. Press CANCEL to stop the process, if necessary. Press START to begin another one.

27 Check that the measurement displayed on the monitor is typical for you, and compare it against a blood pressure reading using a conventional cuff, stethoscope, and manometer.

28 Press MAIN MENU.

29 Use a known temperature transducer simulator, or a temperature probe for approximate measurements, and plug it into one of the Propaq's right side panel temperature connectors. (The Propaq 106 has only one temperature channel—YSI 400 or 700 or equivalent probe connector.)

30 Check that the temperature is displayed above the waveform area.

31 Use another temperature probe or simulator to check the other temperature channel in Propaq 102 or 104.

32 Unplug the temperature probe or simulator from the Propaq.

33 When the Propaq notifies you that the probe has been disconnected, press any button.

note...

Steps 34 through 40 need to be performed only for a Propaq 104 and 106.

34 Set the patient simulator's invasive pressure signal to 0 mmHg.

35 Plug in the invasive pressure cable to a pressure connector on the Propaq's left side panel.

36 If the ZERO button does not automatically appear, press SENSORS, then INV PRS, and then ZERO P1 (or if you plugged into the P2 connector, press SENSORS, then INV PRS, then MORE, and then ZERO P2).

37 After the channel has zeroed (indicated by the appearance of pressure scales to the left of the waveform), set the patient simulator for a normal sinus rhythm with arterial pressure levels.

38 Check that the pressure waveform display appropriately represents the signal from the simulator. (You may have to press MORE and then the RANGE or RESCALE button to view the entire waveform.)

39 Disconnect the pressure cable from the Propaq, and press any button when the message appears alerting you that the cable has been disconnected. Repeat steps 34 through 39 as required for P2.

40 Press MAIN MENU.

note...

Steps 41 through 44 need to be performed only if the Pulse Oximetry option is attached.

41 Plug a NELLCOR pulse oximetry sensor into the Propaq and attach it to your finger.

42 Check that the waveform appears on the display and that the numeric seems appropriate for you.

43 Unplug the sensor from the Propaq.

44 Press any button when the message appears notifying you that the sensor has been disconnected.

note...

Steps 45 through 50 need to be performed only for a Propaq with the Mainstream CO_2 option.

45 Attach the CO_2 sensor to a Protocol airway adapter and plug the sensor into the Propaq's CO_2 connector on the left side panel.

46 Power the Propaq on and use the menu keys to disable the patient alarms. Set the CO_2 measurement units to percent of exhaled gases (%).

47 Allow the monitor and sensor to warm up for a minimum of 15 minutes.

48 After 15 minutes, check the CO_2 reading (of ambient room air) on the Propaq display to be 0.0%, ±0.3%. Possible errors may be caused if the area has high background CO_2 levels. The area should be well ventilated and preferably vacant of any persons to reduce background CO_2 levels.

WARNING

Do not attempt to verify operation of the CO_2 sensor by blowing through it directly. Always blow through an attached airway adapter. Otherwise, a small amount of CO_2 from your breath may enter the CO_2 sensor housing and cause a small shift in the measured CO_2 values. It may take 3-24 hours for the sensor to return to proper calibration.

49 Introduce a flow of **known concentration** of between 9 and 11% CO_2 at a rate of 35-100 cm/min. into the sensor airway adapter. The concentration should be between 9 and 11% but the exact value is not critical. Whatever the value, the accuracy must be known within 0.01%.

50 Check the CO_2 reading on the Propaq display to be within ±0.4% from the known concentration.

Patient Isolation Safety Checks

1 Check leakage currents using a Dynatech/Nevada 431F-1D Safety Analyzer or its equivalent. The source current should not exceed 10 µA rms. The sink current, measured between the isolated patient connections (ECG) and the dc power input connector of the monitor, should not exceed 20 µA rms. See the analyzer's operator's manual for the proper safety check procedure.

Table C-2 lists the proper connections between the monitor, power adapter, and the safety analyzer for each test. Because of the all-insulated construction of the monitor, the Enclosure Leakage Current Test to ground is not performed.

Table C-2: Electrical Connections for Patient Leakage (Risk) Current Safety Tests

Safety Test	Power Adapter	Monitor DC Input	Monitor Cable	Safety Analyzer
Source Current	Plugged into Analyzer Outlet	Connected to Power Adapter	RA LA LL	RA LA LL
Sink Current	Not Used	Connected to Ground Connector on Analyzer	RA LA LL	RA LA LL

If you've completed the above steps and the Propaq has performed appropriately, the monitor can be placed in service.

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