PROPAQ® CS

Vital Signs Monitor

Directions for Use

Models 242, 244, 246
Software Version 3.1X

Please check for Updates in the back pocket of this manual.

CE 0123

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PROTOCOL® SYSTEMS, INC.
The Flexible Monitoring® Company

Contents

1 – General Information

Intended Use, Symbols, and Safety Information

Intended Use

The Propaq CS monitor is intended to be used by skilled clinicians for multiparameter vital signs monitoring of neonatal, pediatric, and adult patients in health care facility bedside applications. It is also intended for intra-facility and ambulance transport.

The ECG channel is intended for five-lead or three-lead ECG monitoring.

The Respiration (RESP) channel is intended to detect the rate or absence of respiratory effort, deriving the signal by measuring the ac impedance between selected terminals of ECG electrodes.

The Invasive Pressure (IBP) channel is intended for measuring arterial, venous, and intracranial pressures (and umbilical artery and vein pressures for neonates) using invasive transducers.

The Noninvasive Blood Pressure (NIBP) channel is intended for indirectly measuring arterial pressures using an inflatable cuff. If ECG is also monitored, the Propaq CS Smartcuf™ software algorithm automatically synchronizes the NIBP measurement process to the occurrences of the R-wave, increasing accuracy in cases of extreme artifact and diminished pulses. The operator may disable or enable the Smartcuf algorithm in the NIBP Menu.

The Temperature (TEMP) channel is intended to measure temperature using an attachable probe.

The Pulse Oximetry (SpO_2) channel is intended to noninvasively measure oxygen saturation of arteriolar hemoglobin at a peripheral measurement site.

The Capnography (CO_2) channel is intended to noninvasively measure the following vital signs or events: End-tidal CO_2 ($ETCO_2$), Inspired CO_2 ($INCO_2$), Breath Rate, and Apnea.

This guide was written for clinicians. Although this guide may describe some monitoring techniques, Protocol Systems expects that you are a trained clinician who knows how to take and interpret a patient's vital signs. This monitor has been designed as a quality monitor; however, inherent limitations require that good clinical judgment always prevails.

Symbols

Warning

WARNING statements in this manual identify conditions or practices that could result in personal injury.

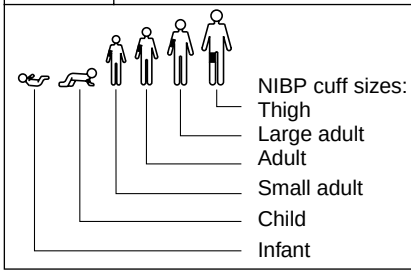
Caution

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

Note

NOTE statements provide additional important information.

The following symbols may appear on the Propaq CS monitor or accessories. They are defined by the International Electrotechnical Commission, IEC 878 and IEC 417A.

	Off (Standby)		Two way communication port
	On		Input port
	For continued fire protection, use only the specified fuse		Output port
	Direct current		Alternating current[1]
	Direct current or alternating current		Separate batteries from other disposables for recycling.
	Caution: Refer to Directions For Use and accompanying documentation	IPX1	Enclosure Protection Drip proof: Classification IPX1 per IEC Publication 529
	Battery charging when green indicator illuminated		Temperature sensor input
	Patient connections are Type CF, isolated for direct cardiac application, and protected against defibrillation		Transformer meets requirements of a short-circuit-proof safety-isolating power transformer[1]
	Patient connections are Type BF, and protected against defibrillation		For indoor use only (on power adapter only)
	Patient connections are Type B	CE	Signifies the device has met all essential requirements of European Medical Device Directive 93/42/EEC for a Class 1 product[1]
CE 0123	The CE Mark and Notified Body Registration Number signify the device has met all essential requirements of European Medical Device Directive 93/42/EEC	NRTL/C Evaluated to CSA 601-1 and UL2601-1	The Canadian Standards Association has evaluated this device according to CSA 601-1 and Underwriters Laboratory Standard UL 2601-1[1].
	Urgent alarm notification (output to Nurse Call system)	C US	This device has been tested and certified by the Canadian Standards Association International to comply with applicable U.S. and Canadian medical safety standards.
			Apply the NIBP cuff as shown.
			Single-use only (not reusable).

1. This symbol is on the Universal Power Adapter.

General Warnings and Cautions

Familiarize yourself with all warnings and cautions before using the Propaq CS monitor. In addition to the following, other warnings and cautions appear throughout this manual.

Warning

Safe interconnection between the Propaq CS monitor and other devices must comply with applicable medical systems safety standards such as IEC 601-1-1.

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.

Before you use a Propaq CS monitor on a new patient, always turn off the monitor for a few seconds, then turn it on again. This clears the prior patient's trend values, alarm limit settings, and NIBP cuff inflation target.

Always check the patient mode when monitoring a new patient. The patient mode determines default alarm limits, maximum cuff inflation pressure, and internal algorithm settings.

The monitor may not meet its performance specifications if stored or used outside the specified temperature and humidity ranges.

Place the Propaq CS monitor and accessories in locations where they cannot harm the patient if they fall from their shelf or mount.

Do not connect more than one patient to a monitor. Do not connect more than one monitor to a patient.

Inspect the power adapter cord periodically for fraying or other damage, and replace the adapter as needed. Do not operate the apparatus from ac power with a damaged power adapter cord or plug.

Make frequent electrical and visual checks on cables, sensors, and electrode wires. All cables, sensors, and electrode wires must be inspected, properly maintained, and in proper working order to allow the equipment to function properly and protect patient safety.

Avoid electrosurgery burns at monitoring sites by ensuring proper connection of the electrosurgery return circuit so that the return paths cannot be made through monitoring electrodes and probes.

During defibrillation, keep the discharge paddles away from ECG and other electrodes, as well as other conductive parts in contact with the patient. Avoid contact with any accessories connected to the monitor's left side panel.

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.

Electronic equipment that emits strong electromagnetic or radio frequency signals can cause electrical interference with ECG monitor operation. This interference may distort the displayed or recorded ECG signal, thereby preventing accurate rhythm analysis. Avoid operating this device near equipment of this type.

To help protect against electrical shock due to leakage current, use only monitor ac power adapters recommended in the Protocol Systems *Products and Accessories* booklet (P/N 810-0409-XX).

For best product performance and measurement accuracy, use only accessories supplied by Protocol Systems or recommended in the Protocol Systems *Products and Accessories* booklet. Use accessories according to your facility's standards and the manufacturer's recommendations. Always refer to the manufacturer's Directions for Use.

If a product has been dropped or severely abused, send it to a qualified service person to confirm proper operation and acceptable risk (leakage) current values.

Some or all NIBP safety functions are disabled in the NIBP TEST screen in the Service Menu. Do not attempt to conduct NIBP TEST when the cuff is attached to a patient.

Do not use the Propaq CS monitor in a Magnetic Resonance Imaging (MRI) suite or a hyperbaric chamber. Such use can cause fire or explosion resulting in patient injury and monitor damage.

Impedance pneumography and CO_2 monitoring may not operate properly when used in conjunction with high-frequency jet ventilation or high-frequency oscillatory ventilation.

Caution

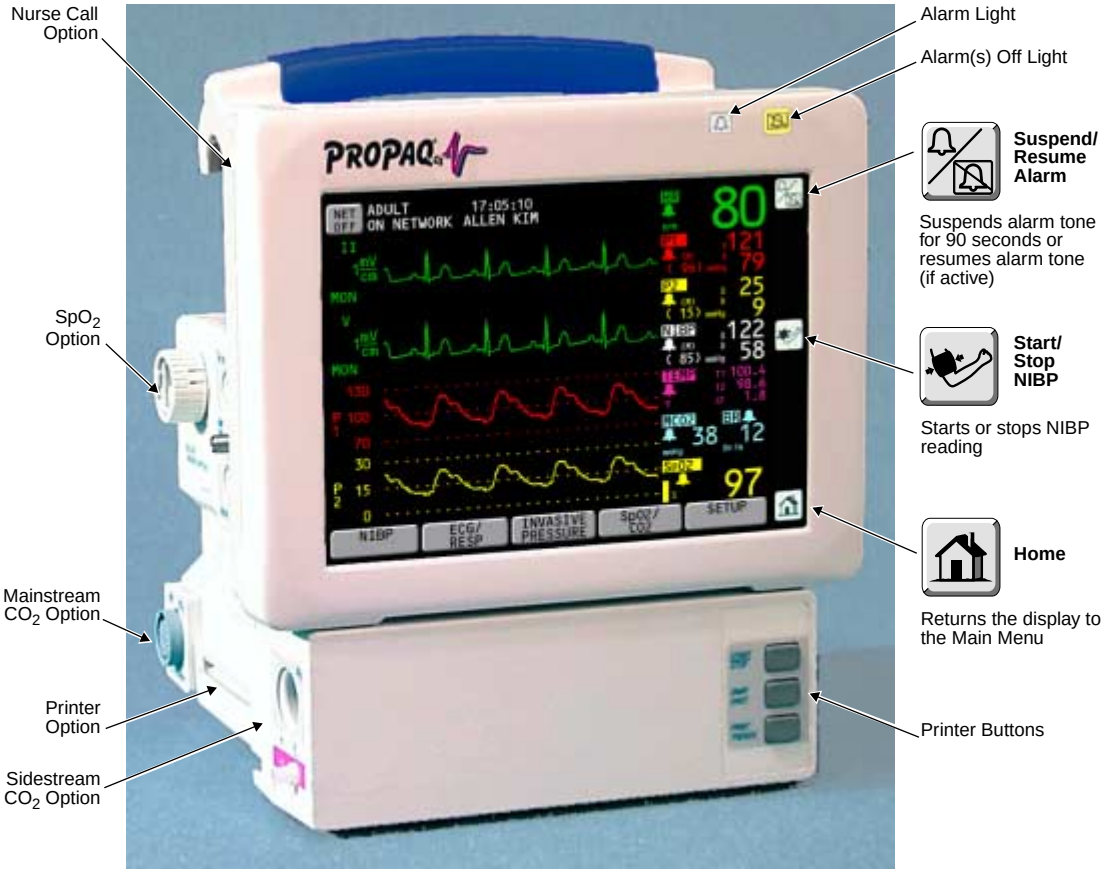
Do not autoclave the Propaq CS monitor. Autoclave accessories only if the manufacturer's instructions clearly approve it. Many accessories can be severely damaged by autoclaving.

Federal USA law restricts this device to sale, distribution, or use by or on the order of a licensed medical practitioner.

It is possible for the monitor to detect a problem that prevents the monitor from operating properly. If this occurs, the monitor displays an error message and error number. Report such errors to Protocol Systems.

The Propaq CS monitor should be serviced only by a Protocol Systems service technician while under warranty. The *Propaq CS Service Manual* (P / N 810-1101-XX) is available from Protocol Systems to assist the biomedical engineer during post-warranty period service.

Controls and Connectors



Touch-Screen Controls

The front panel touch-screen provides five softkeys along the bottom and three icon-labeled keys along the right side. An Acuity **NET OFF** key is displayed in the upper left corner if the monitor is connected to an Acuity system. These keys allow control of all monitoring and setup functions.

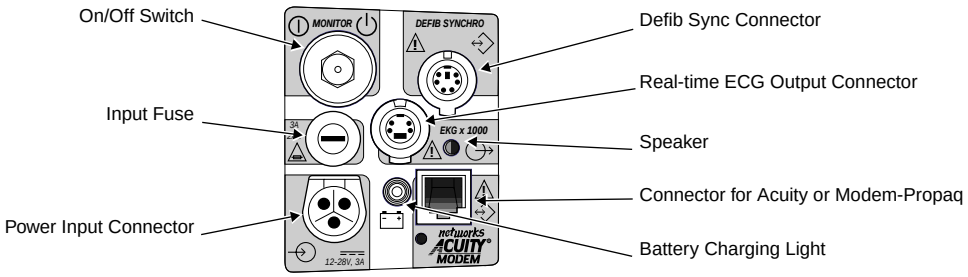
Note

Avoid pressing more than one touch-screen key at a time. Touching more than one key area at a time can cause the touch-screen to misinterpret the command and respond to the wrong key.

Caution

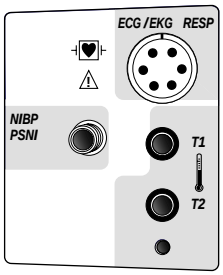
Do not touch the screen with a sharp object such as a pen or pencil. Sharp objects can damage the touch-screen. Use your finger to press the touch-screen keys.

System Control and Connectors (Right Side Panel)

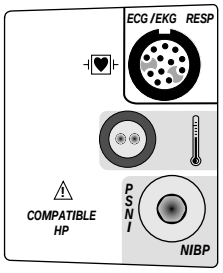


Patient Connectors (Left Side Panel)

Model 242
ECG
NIBP
Temperature (two channels)*

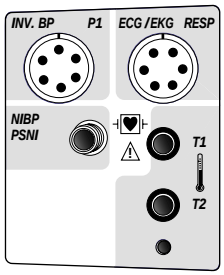


Propaq CS Model 242

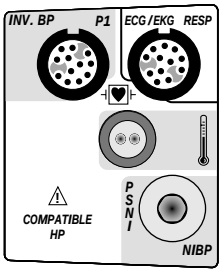


HP Model 242*

Model 244
ECG
Invasiv Pressure (one channel)
NIBP
Temperature (two channels)*

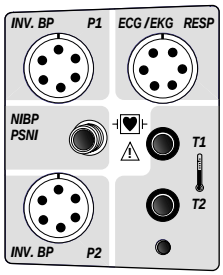


Propaq CS Model 244

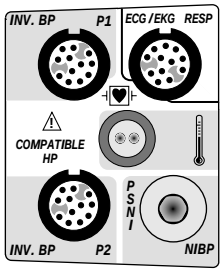


HP Model 244*

Model 246
ECG
Invasive Pressure (two channels)
NIBP
Temperature (two channels)*



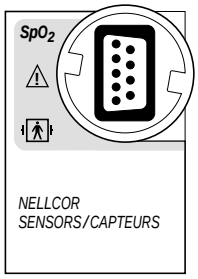
Propaq CS Model 246



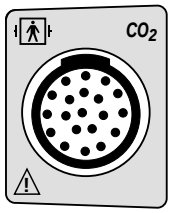
HP Model 246*

*The HP (Hewlett-Packard) side panels provide only one temperature connector.

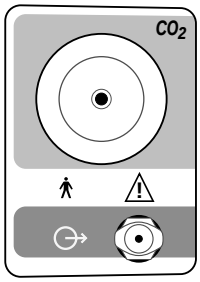
Option Connectors



SpO_2 Connector



Mainstream CO_2 Connector

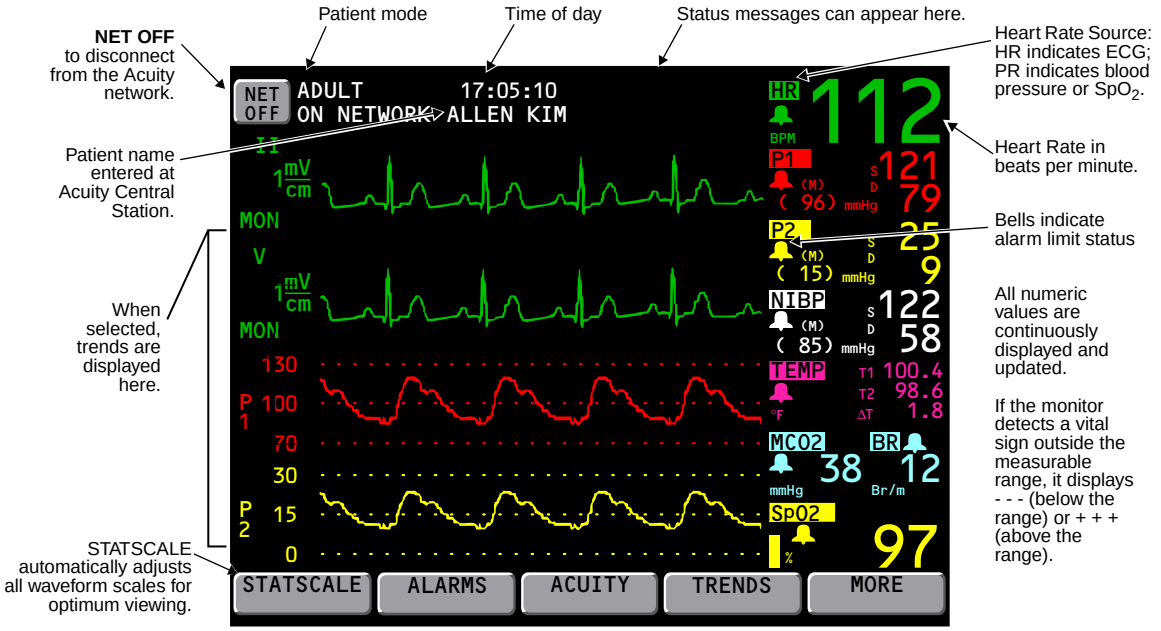


Sidestream CO_2 Connector

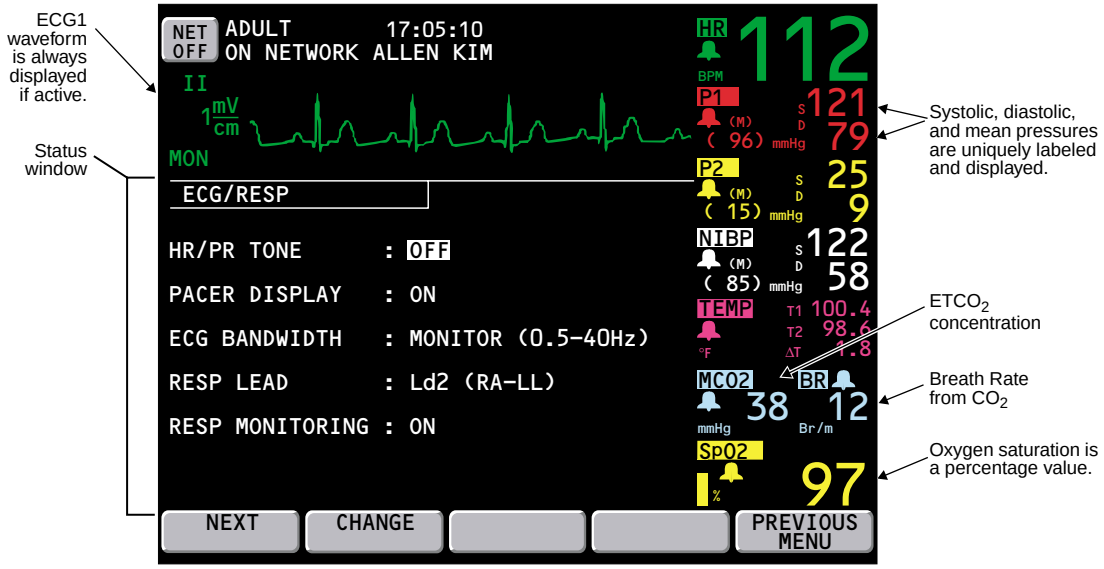
Nurse Call Connector

Display

You can select up to four waveforms to be shown on the Propaq CS monitor. When only one waveform is selected, a trend window automatically appears beneath the waveform.



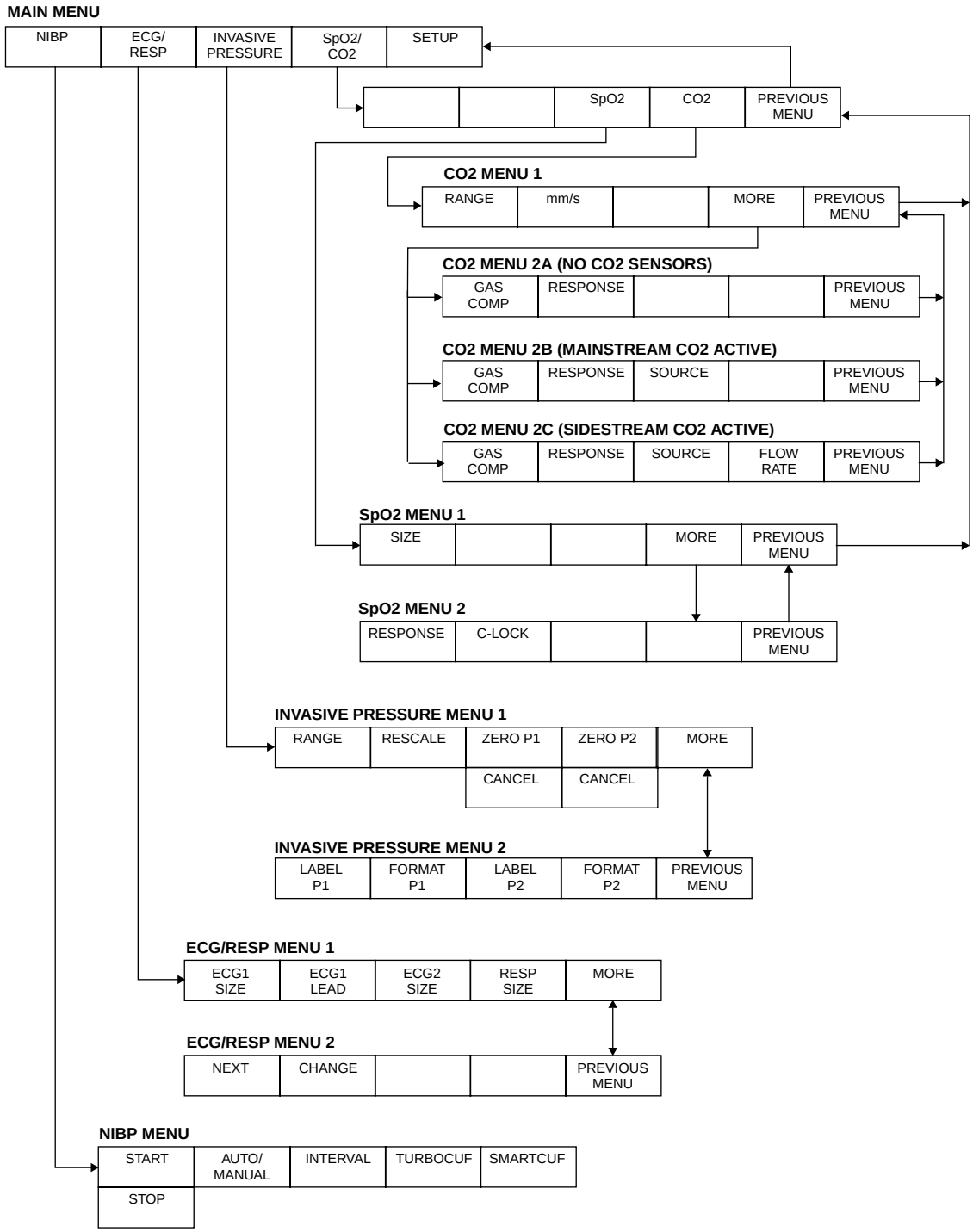
While changing monitor settings, a status window may appear below the waveform:



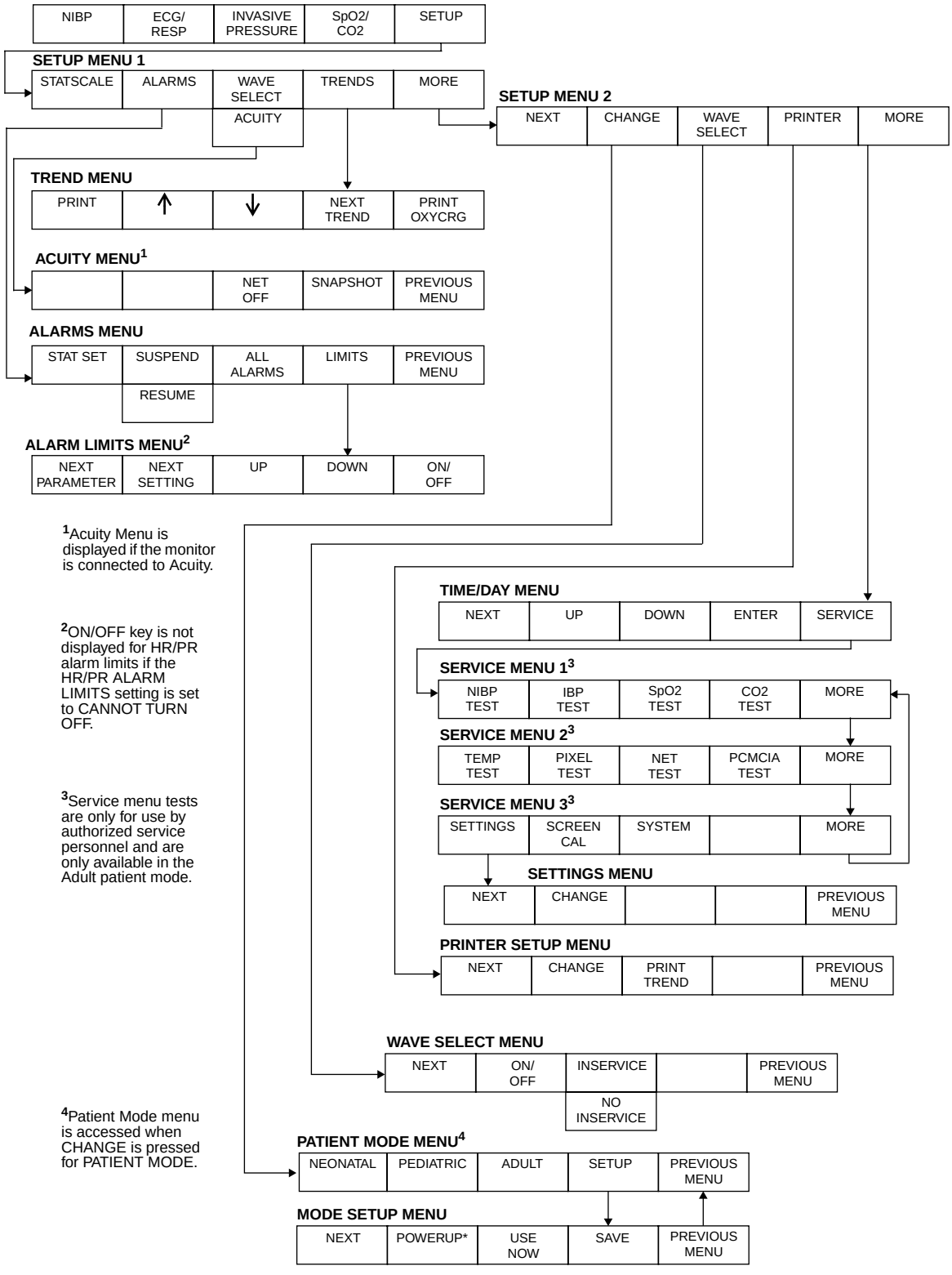
Menus

Menus for some patient vital signs are displayed only if the option is included in your Propaq CS monitor.

Main Menu



Setup Menus


NIBP
ECG/ RESP
INVASIVE PRESSURE
SpO2/ CO2
SETUP
SETUP MENU 1
STATSCALE
ALARMS
WAVE SELECT
TRENDS
MORE
ACUITY
SETUP MENU 2
NEXT
CHANGE
WAVE SELECT
PRINTER
MORE
TREND MENU
PRINT
NEXT TREND
PRINT OXYCRG
ACUITY MENU1
NET OFF
SNAPSHOT
PREVIOUS MENU
ALARMS MENU
STAT SET
SUSPEND
ALL ALARMS
LIMITS
PREVIOUS MENU
RESUME
ALARM LIMITS MENU2
NEXT PARAMETER
NEXT SETTING
UP
DOWN
ON/ OFF
1Acuity Menu is displayed if the monitor is connected to Acuity.
2ON/OFF key is not displayed for HR/PR alarm limits if the HR/PR ALARM LIMITS setting is set to CANNOT TURN OFF.
3Service menu tests are only for use by authorized service personnel and are only available in the Adult patient mode.
4Patient Mode menu is accessed when CHANGE is pressed for PATIENT MODE.
TIME/DAY MENU
NEXT
UP
DOWN
ENTER
SERVICE
SERVICE MENU 13
NIBP TEST
IBP TEST
SpO2 TEST
CO2 TEST
MORE
SERVICE MENU 23
TEMP TEST
PIXEL TEST
NET TEST
PCMCIA TEST
MORE
SERVICE MENU 33
SETTINGS
SCREEN CAL
SYSTEM
MORE
SETTINGS MENU
NEXT
CHANGE
PREVIOUS MENU
PRINTER SETUP MENU
NEXT
CHANGE
PRINT TREND
PREVIOUS MENU
WAVE SELECT MENU
NEXT
ON/ OFF
INSERVICE
PREVIOUS MENU
NO INSERVICE
PATIENT MODE MENU4
NEONATAL
PEDIATRIC
ADULT
SETUP
PREVIOUS MENU
MODE SETUP MENU
NEXT
POWERUP*
USE NOW
SAVE
PREVIOUS MENU

Learn Propaq CS Operation with In-Service Mode

You can practice using the Propaq CS monitor with the in-service mode of operation.

The in-service mode cannot be activated while you are monitoring a patient. During in-service mode, the monitor display and all printouts include the message SIMULATING or SIMULATED DATA.

To practice with your Propaq CS monitor:

1. Disconnect all patient cables connected to the monitor. You can leave the NIBP cuff connected to the monitor so you can take NIBP measurements.

2. If you have been monitoring a patient, turn off the monitor and turn it back on.

   If your monitor is programmed so that the NIBP Automatic Mode is selected at powerup, select one of the Factory Patient Modes as the powerup patient mode (see page 23). Then turn the monitor off and turn it back on. (The in-service mode is not available if the NIBP Automatic Mode has been selected.)

3. From the Main Menu, press **SETUP, WAVE SELECT, INSERVICE**.

   The Propaq CS monitor has two sets of simulated patient information. To change between the sets, from the Main Menu press **SETUP, WAVE SELECT,** and **INSERVICE** again.

   While in the in-service mode, you can press any monitor keys (except the **AUTO/MANUAL** key in the NIBP Menu) to change a function setting. For example, you can change ECG and RESP waveform sizes, set alarm limits, or set custom settings.

   You can also apply the NIBP cuff to yourself and take NIBP measurements.

4. To exit the in-service mode, turn off the monitor.

   If you changed the powerup patient mode in step 2, be sure to restore the appropriate powerup patient mode according to your local protocol.

Note

The in-service mode is not available if the monitor detects that a sensor has been connected (except for an NIBP cuff) or the NIBP Automatic Mode has been selected. If the monitor is in in-service mode and you connect a sensor (except for an NIBP cuff) or press the NIBP **AUTO/MANUAL** key, the monitor will turn off power to exit the in-service mode, and then turn on in the normal operating mode.

The pacemaker signal indicators are not displayed in the in-service mode.

2 – Setup

Prepare the Propaq CS Monitor for a New Patient

Warning

Before you use a Propaq CS monitor on a new patient, always turn it off for a few seconds, then turn it on again. This clears the prior patient's trend values, alarm limit settings, and NIBP cuff inflation target.

1. Press the gray recessed MONITOR button on the right side of the monitor to turn the monitor off (if it is on). Press it again to turn the monitor on. The monitor displays the powerup screen for about 10 seconds, then displays the Main Menu. The monitor is in the powerup patient mode with the associated settings.

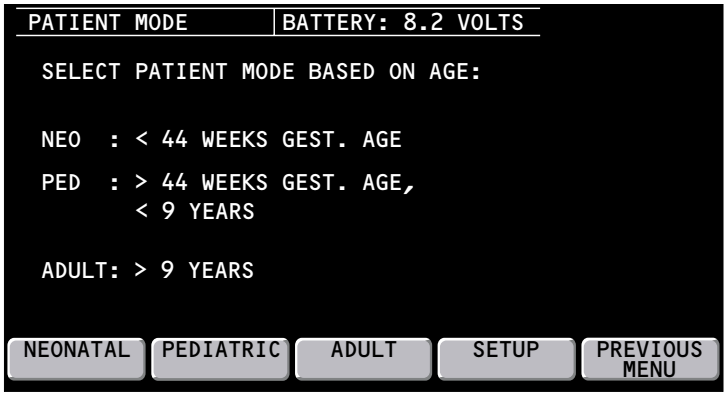
2. Confirm that the monitor emits a tone. If the monitor has SpO_2, listen for two tones and confirm both speakers are working.

Note

Check the battery voltage level on the powerup screen (or check it on the Time/Day window: **Home, SETUP, MORE, MORE**). If the battery voltage is 7.4V or less or a low battery message is displayed, connect the monitor to an ac power adapter to recharge the battery (see page 24). Connecting the adapter does not interrupt patient monitoring.

Home

3. Confirm the monitor is in the correct patient mode according to the patient's age. If the patient mode is not correct, from the Main Menu press **SETUP, MORE, CHANGE** to access the Patient Mode window:



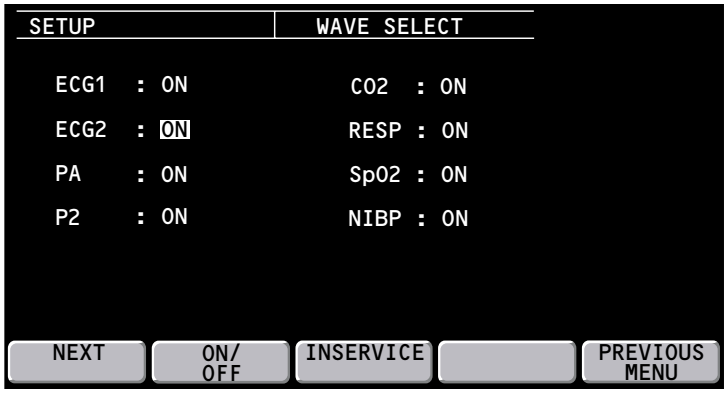
4. Based on the patient's age, press **NEONATAL**, **PEDIATRIC**, or **ADULT**. When the confirmation window appears, press **YES** to confirm your selection.

   Whenever you change the patient mode, the alarm limit settings, maximum NIBP cuff inflation pressures, and internal computations are automatically changed to the defaults for that patient mode. See page 23 for information about preset Factory patient modes or programmable Custom patient modes.

Note

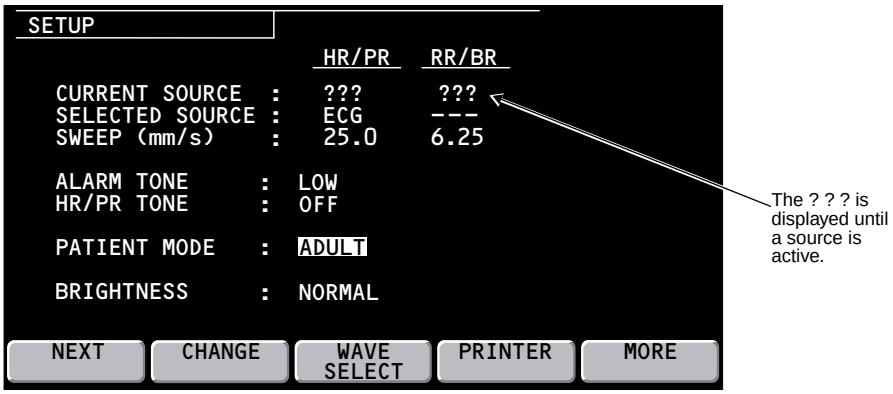
If you change the patient mode, the CO_2 alarm limits in the new mode might vary slightly from the originally-programmed CO_2 alarm limits for the new mode. Check the CO_2 alarm limits.

5. To select which vital sign waveforms will display, from the Main Menu press **SETUP, MORE, WAVE SELECT.** Use **NEXT** and **ON/OFF** to turn on the desired waveforms in the Wave Select window.



You can turn on all waveforms, but only the first four waveforms selected as ON in the Wave Select window are displayed. You cannot turn off the ECG1 waveform.

6. To set the HR/PR source, display sweep speed, tone volumes, and display brightness, from the Main Menu press **SETUP, MORE** to access Setup Menu 2. Use **NEXT** and **CHANGE** to select settings.



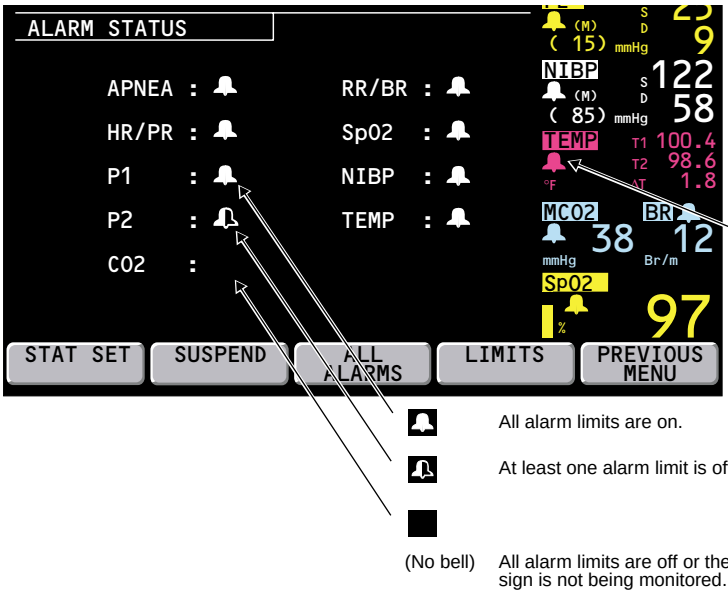
CURRENT SOURCE	When the selected HR/PR source is no longer available, the current source is the active source with highest priority. The RR/BR source cannot be manually selected. It is always CO_2 if CO_2 is active. Otherwise, it is ECG/RESP.
SELECTED SOURCE	The user-selected HR/PR source is displayed along with the HR/PR source currently used by the monitor.
SWEEP (mm/s)	Selectable sweep speeds for HR/PR: 12.5, 25, 50 mm/sec. Selectable sweep speeds for RR/BR: 3.13, 6.25, 12.5 mm/sec.
ALARM TONE	Sets the Alarm Tone volume to HIGH, MEDIUM, or LOW.
HR/PR TONE	Sets the Heart Tone volume to HIGH, MEDIUM, LOW, or OFF.
BRIGHTNESS	Sets the display brightness to NORMAL or LOW.

Warning

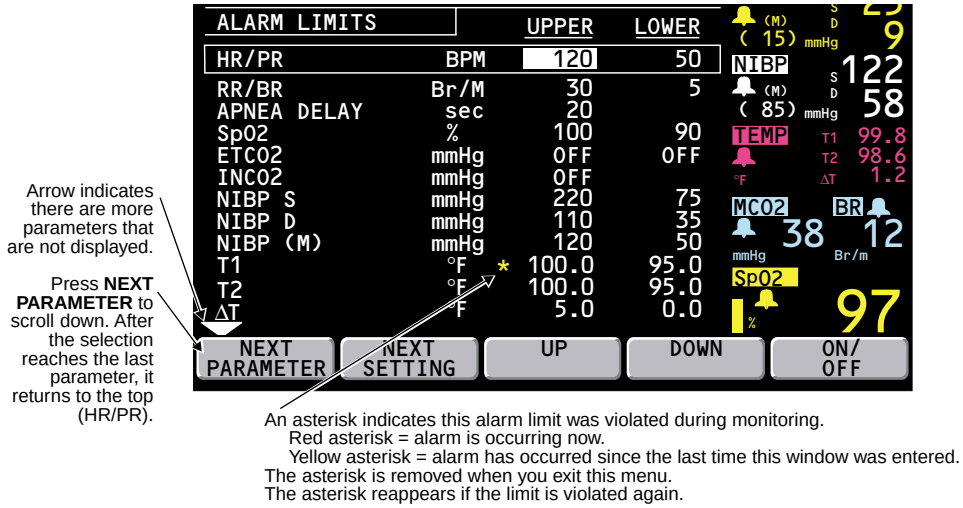
At the highest volume alarm level, the sound pressure level does not exceed safe limits (OSHA HSM 73-1101, 1972). However, additional precautions may be required in patients under treatment with ototoxic medications.

Set Patient Alarms and Alarm Limits

1. From the Main Menu, press **SETUP, ALARMS** to access the Alarms Status Menu:



2. Press **LIMITS** to display the Alarms Limits window:



3. Press **NEXT PARAMETER** to highlight the parameter you want to change, then press **NEXT SETTING** to highlight the limit you want to change.

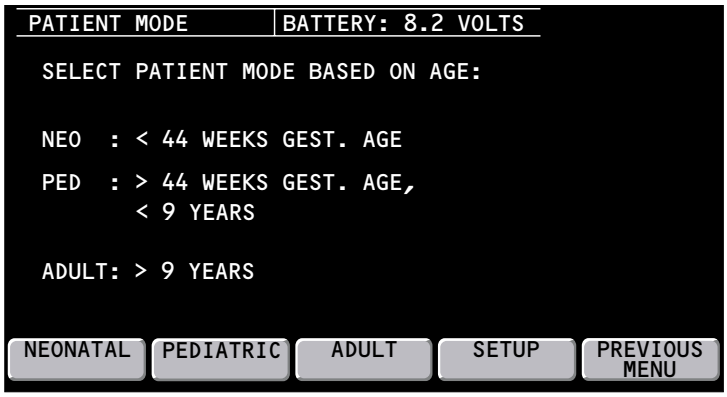
4. Press **UP, DOWN,** or **ON/OFF** to change the limits.

   The apnea alarm cannot be turned off at any time.

5. After setting the desired limits, press **Home** to return to the Main Menu.

Change the Current Patient Mode

1. To change the current patient mode, from the Main Menu press **SETUP, MORE, CHANGE** to access the Patient Mode window:



2. Based on the patient's age, press **NEONATAL**, **PEDIATRIC**, or **ADULT**. When the confirmation window appears, press **YES** to confirm your selection.

   Whenever you change the patient mode, the alarm limit settings, maximum NIBP cuff inflation pressures, and internal computations are automatically changed to the defaults for that patient mode. See page 23 for information about preset Factory patient modes or programmable Custom patient modes.

Note

If you change the patient mode, the CO_2 alarm limits in the new mode might vary slightly from the originally-programmed CO_2 alarm limits for the new mode. Check the CO_2 alarm limits.

Change Powerup Patient Mode or Store Customized Settings

The Propaq CS monitor has standard, preset, default powerup settings and alarm limits for each patient mode: Adult, Pediatric, and Neonatal. These are “Factory Patient Mode” settings (listed on page 97).

You can also choose to customize and store programmable powerup settings and alarm limits for each patient mode. These are “Custom Patient Mode” settings.

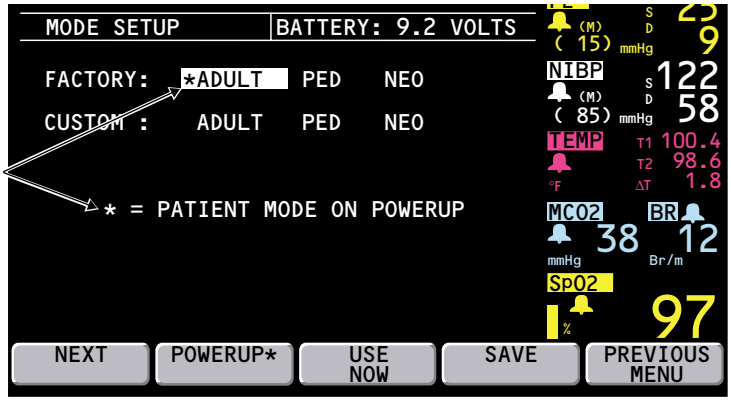
The instructions below describe how to change the powerup patient mode and how to select and store new Custom Patient Mode settings.

Note

When you change patient modes, you also change the alarm limits associated with the new patient mode.

Change the Powerup Patient Mode

1. From the Main Menu, press **SETUP, MORE, CHANGE, SETUP** to access the Mode Setup window.



2. Press **NEXT** to highlight the desired Factory or Custom powerup mode, then press **POWERUP*** and **YES**. The new powerup selection is marked by the asterisk.

   Changing the powerup mode does not affect the patient mode currently used.

Customize Patient Mode Settings

1. From the Main Menu, press **SETUP**, **MORE, CHANGE, SETUP** to access the Mode Setup window.

2. The patient mode you want to reprogram (ADULT, PED, or NEO) must be currently selected. To make sure it is currently selected, press **NEXT** as needed to highlight the desired mode, then press **USE NOW** and **YES**.

3. Press **Home** to exit the Mode Setup window, then use other menus and keys to set the monitor settings and alarm limits as desired.


Home

   A convenient way to access settings and alarm limits for all functions without connecting cables is to select the in-service mode (disconnect all patient cables, turn the monitor power off and then on, then press **SETUP, WAVE SELECT, INSERVICE** from the Main Menu).


Warning

If any alarms are set to OFF and you select SAVE to store settings for a Custom patient mode, those alarms will be OFF when the monitor powers up in that Custom patient mode or that Custom patient mode is selected. Consider carefully before setting Custom patient mode powerup alarms to OFF.

4. Re-enter the Mode Setup window, press **NEXT** as needed to highlight the desired Custom mode, then press **SAVE** and **YES**.

   If the in-service mode is used, turn off the monitor to exit the in-service mode.

3 – Monitoring

Perform ECG/RESP Monitoring

Warning

Impedance pneumography detects respiratory effort via changes in chest volume; therefore, impedance pneumography can be used to detect central apnea. However, apnea episodes with continued respiratory effort, such as obstructive apnea and mixed apnea, may go undetected. Also, artifact due to patient motion, apnea mattress shaking, or electrocautery use may cause apnea episodes to go undetected. Always monitor and set alarms for SpO_2 when using impedance pneumography to monitor respiratory function.

The Propaq CS monitor automatically rejects cardiovascular artifact. This function is dependent upon accurate ECG R-wave detection. Therefore, always select the ECG lead with the most prominent QRS complex when monitoring respiration via impedance pneumography.

Don't place the Propaq CS monitor with RESP in close proximity to another respiration monitor because the RESP measurement frequencies may interfere with one another.

Because pacemaker pulses in some instances may be falsely counted as breaths, impedance pneumography is not recommended for use on paced patients.

Motion artifact can cause incorrect breath rate or heart rate readings. Minimize patient motion whenever possible.

If a disconnected lead is in too close proximity to other electrical devices, it may cause false heart rate, a failure to detect apnea, or a failure to display a Lead Fail message.

The Propaq CS monitor does not provide arrhythmia analysis. Therefore, arrhythmias are not analyzed and may cause the monitor to display inaccurate heart rates.

The Propaq CS monitor will show + + + for HR numerics between 301-350 beats per minute. Above 350 beats per minute, it may display incorrectly low heart rates, due to intermittent picking of R-waves.

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 surgical site and from the electrosurgical return electrode, (3) using electrosurgical return electrodes with the largest practical contact area, and (4) assuring proper application of the electrosurgical return electrode to the patient.

Verify patient mode. Incorrect patient mode may result in inaccurate heart rates and inappropriate alarm settings.

To help prevent injury, use the provided garment clips to route the ECG cables away from the patient's head.

Use of ECG cables with loose or faulty detachable lead wires may cause erratic behavior of the ECG waveform, SpO_2 (C-LOCK), and NIBP (Smartcuf) due to intermittent ECG lead wire connections.

Use only ECG safety cables that are designed so that they cannot accidently be plugged into an ac mains outlet or make contact with other hazardous electrical potentials including earth ground. To prevent damage during defibrillation, don't use ECG cables without 1 kΩ series resistors.

Before you use a Propaq CS monitor on a new patient, always turn it off for a few seconds, then turn it on again. This clears the prior patient's trend values and alarm limit settings.

Caution

To protect the Propaq CS monitor from damage during defibrillation, for accurate ECG information, and for protection against noise and other interference, use only ECG electrodes and cables specified or supplied by Protocol Systems (these cables have the required current-limiting resistors). Follow recommended application procedures.

- Impedance pneumography (RESP) is not recommended for use with high frequency ventilation.
- Since RESP is derived from the same leads as the ECG channel, the Propaq CS monitor determines which signals are cardiovascular artifact and which signals are a result of respiratory effort. If the breath rate is within five percent of the heart rate or a multiple or sub-multiple of the heart rate, the monitor may ignore breaths and trigger an apnea alarm.
- When monitoring RESP it is highly recommended that you use SpO_2 monitoring as a backup monitoring method.
- The Propaq CS monitor counts as "breaths" respiratory efforts that are larger than two times background cardiovascular artifact.
- Even though the Propaq CS monitor contains fully isolated patient-connected circuitry, it has not been specially designed for direct application on a patient's heart.
- Use only with accessories provided or recommended in the Protocol Systems *Products and Accessories* booklet.
- Severe artifact and interference (such as defibrillation interference) can cause the waveform to move off the display for a few seconds before it is restored.

Prepare for ECG/RESP Monitoring

1. Inspect the ECG cable and replace it if it shows signs of wear, breakage, or fraying.
2. Select the appropriate patient mode. To change patient modes, from the Main Menu press **SETUP, MORE, CHANGE**, then the desired patient mode (**NEONATAL, PEDIATRIC**, or **ADULT**) and then **YES**.
3. Select electrode sites on the patient.

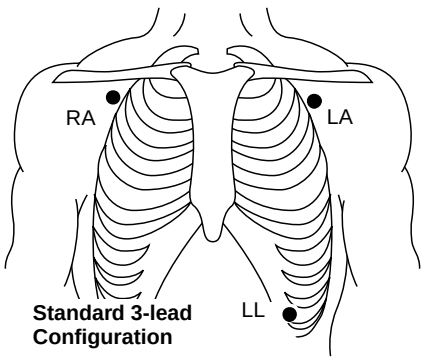
   Choose flat areas; avoid fatty areas and major muscles.
4. Shave or clip hair from electrode sites, thoroughly clean skin, and lightly rub dry.

   You may use soap and water, isopropyl alcohol or special skin preparation pads. To avoid allergic reactions to electrodes, refer to the electrode manufacturer's directions.
5. If you are using pre-gelled electrodes, make sure the electrode date is not expired and the gel is intact and not dried out. For best results, use only silver/silver chloride electrode.

   If you are using non-gelled electrodes, apply a 1/4 to 1/2 inch mound of gel over the electrode contact area.

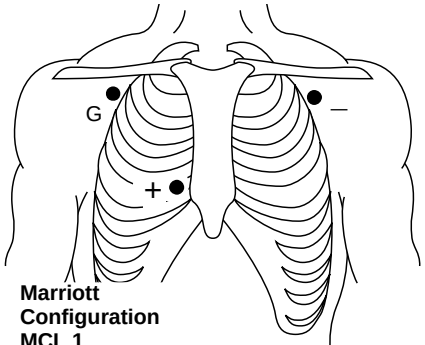
   For best product performance and measurement accuracy, do not use stainless steel needle electrodes, squeeze bulb electrodes, or electrodes with dissimilar metals. Do not use electrodes from more than one manufacturer on the same patient.

6. Attach lead wires to the electrodes before applying them to the patient. Apply the electrodes to the patient as shown.



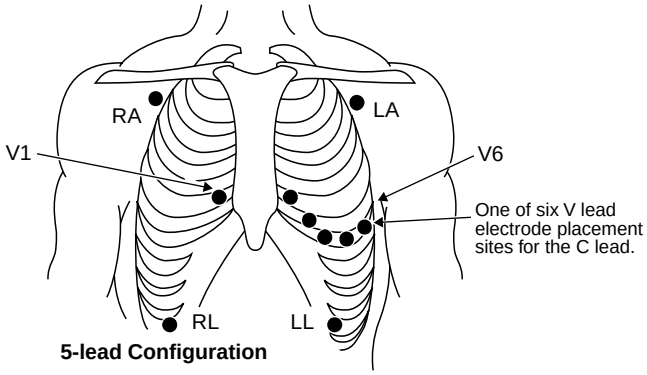
Standard 3-lead Configuration

If using MCL1, select LEAD II on the monitor, and use all three electrodes.

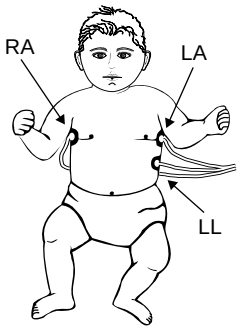


Marriott Configuration MCL 1

(G)=LA (-)=RA (+)=LL



5-lead Configuration



Neonate 3-lead Configuration

7. Plug the ECG cable into the ECG connector on the monitor's left side panel.

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

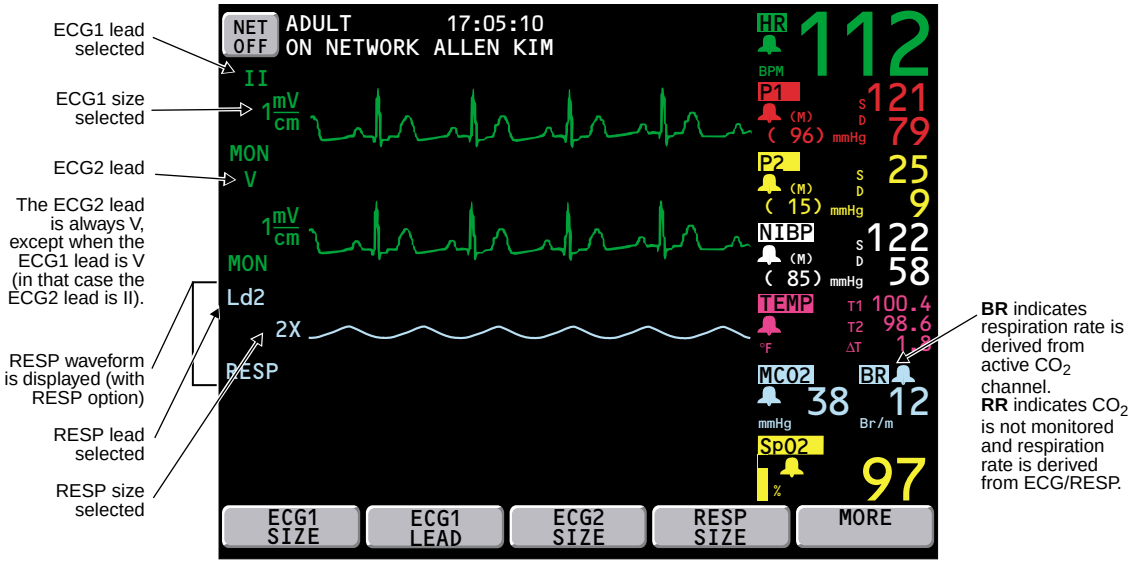
9. If an electrosurgical unit will be used, place the ECG cable and electrode wires as far as possible from the surgical site and from the electrosurgical return electrode and its cables. This minimizes interference.

   Although 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. Choose electrode placement to minimize interference.

10. Look for an ECG waveform and heart rate on the monitor. Depending on how your monitor is programmed, a beep tone may occur with each detected QRS.

    If there is no waveform, check the electrodes, wires, cable, and the monitor for a possible misconnection or lead fault.

11. To set up the ECG/RESP display, from the Main Menu press **ECG/RESP** to display the first ECG/RESP menu:



12. Press buttons as desired to adjust the display:

ECG1 SIZE Selects the ECG1 waveform size: 4, 2, 1, 0.5, or 0.2 mV/cm.

ECG1 LEAD Selects the ECG1 lead: I, II, III, aVR, aVL, aVF, or V.

Selections aVR, aVL, aVF, and V are only available with a 5-lead ECG cable.

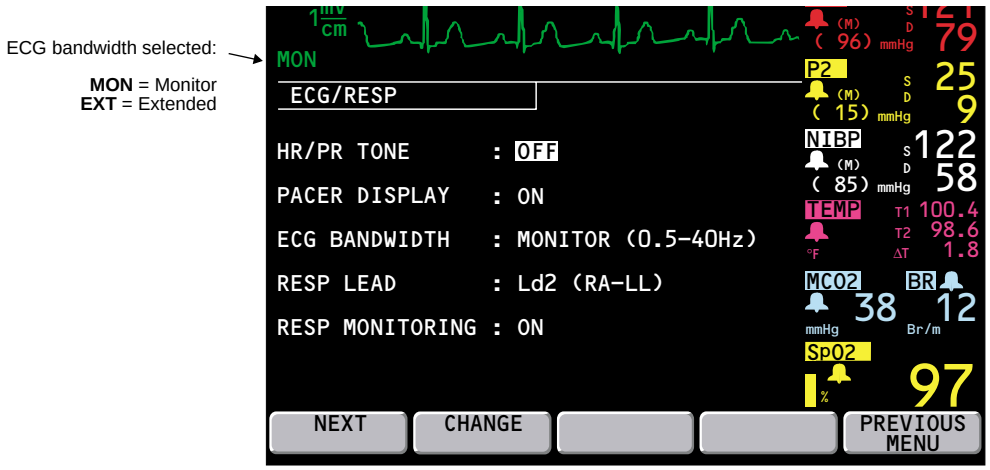
The ECG2 lead is always V, except when the ECG1 lead is V (in that case the ECG2 lead is II).

ECG2 SIZE Selects the ECG2 waveform size: 4, 2, 1, 0.5, or 0.2 mV/cm.

RESP SIZE Selects the RESP waveform size: 1x, 2x, 4x, 8x, or 16x.

The QRS detector sensitivity threshold is not affected by changing the ECG display size. Likewise, the RESP breath detector threshold is not affected by changing the RESP display size.

13. Press **MORE** to display the second ECG/RESP menu and status window:



14. Press **NEXT** and **CHANGE** as desired to adjust the display.

HR/PR TONE	Sets heart tone loudness to LOW, MEDIUM, HIGH, or OFF. If SpO_2 is monitored, tone pitch varies with the SpO_2 value.
PACER DISPLAY	Turns on and off the pacer indicator in the ECG waveform.
	If the patient has a pacemaker, you may want to turn on the pacer indicator (see page 32).
ECG BANDWIDTH	Selects the bandwidth for displayed and printed data.
	MONITOR is 0.5-40 Hz (Adult mode) or 0.5-120 Hz (Pediatric and Neonatal mode).
	Monitor Mode filters out extraneous noise and artifact to provide a more stable display.
	EXTENDED is 0.05-40 Hz (Adult mode) or 0.05-120 Hz (Pediatric and Neonatal mode).
	Extended Mode is a higher-resolution setting that allow more detailed analysis.
	Always use Extended Mode when observing ST segment morphology on the display or printer. Although Monitor Mode is useful to minimize baseline wander due to artifact, ST segments can be distorted in Monitor Mode. This can potentially cause underestimation of ST elevation and overestimation of ST depression. Although the monitor does not have automated ST segment monitoring, ST segments may be accurately displayed and printed in Extended Mode.
RESP LEAD	Selects the RESP lead: Ld1 (RA-LA) or Ld2 (RA-LL). RESP lead selection is independent of ECG lead selection.
	Choose the RESP lead that gives you the best signal. If neither signal is adequate, experiment with nonstandard electrode placement such as placing the RA and LA electrodes on the respective mid-axillary lines just above the level of the nipples.
RESP MONITORING	Turns RESP on or off.

15. Set alarms according to your facility's standards.

Use the ECG Filter to Display a Better Waveform

If the ECG waveform appears unclear or distorted, make sure the monitor ECG filter is properly set to reduce interference from your facility's ac power frequency. To check the filter:

1. Press **SETUP, MORE, MORE, SERVICE, YES** to access the Service Menu.
2. Press **MORE, MORE, SETTINGS** to display the Settings Menu.
3. If the FILTER setting does not match your ac power frequency (60 or 50 Hz), press **NEXT** to highlight FILTER, then press **CHANGE** to change settings.

Contact a qualified service person if you have questions.

Use the Propaq CS Monitor With Pacemaker Patients

Warning

Pacemaker signals can differ from one pacemaker to the next. The Association for Advancement of Medical Instrumentation (AAMI) 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."

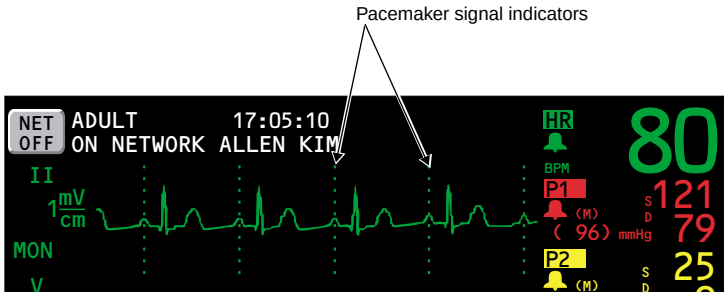
The presence of much pacer-like noise can cause the displayed heart rate to be erratic even though the ECG trace may look undistorted with the pacer indicator off. To help avoid this noise problem, use fresh ECG electrodes and make sure the ECG cable lead wires make good connections.

If the patient being monitored has a pacemaker, the Propaq CS monitor detects and can indicate the occurrence of pacemaker signals.

1. To access the monitor pacer indicator, from the Main Menu press **ECG/RESP, MORE,** and then **NEXT** to select the PACER DISPLAY.

2. Press **CHANGE** to set the PACER DISPLAY either ON or OFF.

   When ON, the monitor displays (and prints on printouts) vertical dashed lines to indicate each time a pacemaker signal is detected. (If the pacemaker signal is strong enough, the monitor also displays it as a waveform "spike.")



When OFF, the vertical lines are not displayed (or printed), but the pacemaker signal waveform spike is still displayed if strong enough.

Note

Pacemaker pulses are not counted as heartbeats as defined by the Pacer Pulse Rejection specifications (see page 100).

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, turn off the pacemaker indicator for a better ECG waveform display.

Perform Invasive Blood Pressure (IBP) Monitoring

Warning

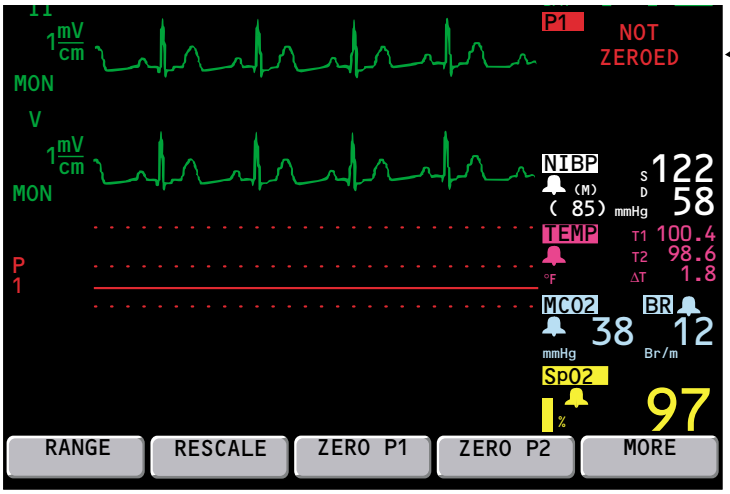
If electrocautery is used, always avoid using any transducer with a conductive (metal) case that is electrically connected to its cable shield. Using a conductive transducer case with such a shield connection risks high-frequency burns at the ECG electrodes if the transducer case becomes earth grounded.

Although complete disconnections of invasive pressure transducers will be detected by the normal alarm functions, partial disconnection will not be detected, nor will the use of some incompatible transducers. The user must exercise reasonable measures to ensure that approved transducers are used and that pressure transducers are connected properly.

Before you use a Propaq CS monitor on a new patient, always turn it off for a few seconds, then turn it on again. This clears the prior patient's trend values and alarm limit settings.

For best product performance and measurement accuracy, use only accessories supplied by Protocol Systems or recommended in the Protocol Systems *Products and Accessories* booklet. Use accessories according to your facility's standards and the manufacturer's recommendations. Always refer to the manufacturer's Directions for Use. Do not use light-sensitive disposable transducers.

1. Inspect the transducer cable and transducer dome for wear, breakage, or fraying. Replace any worn or broken accessory.
2. Set up the transducer according to your hospital's procedures. Always refer to the transducer manufacturer's Directions for Use. If the transducer is a disposable unit with separate cable, connect the transducer to the transducer cable.
3. Plug the transducer (or transducer cable) into an invasive pressure connector on the monitor left side panel.



The message NOT ZEROED immediately appears in the IBP numerics window for the invasive pressure channel being used.

4. To zero the transducer, open the transducer's stopcock to atmospheric air. Wait a few seconds for the transducer to settle.

   Before zeroing, make sure the transducer cable is properly connected to the monitor and the transducer is open to atmospheric air and positioned at the same level as the patient's heart. The monitor will not zero the transducer if the pressure waveform is pulsatile, there is too much signal noise, or the transducer's offset is too great.

5. If the ZERO menu is not displayed, from the Main Menu press **INVASIVE PRESSURE**, then **ZERO P1** (or **ZERO P2**). The word ZEROING appears in the numerics window during zeroing.

   If you want to cancel the zeroing process, press **CANCEL**.

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

7. Close the transducer's stopcock. The monitor displays the pressure scale and numerics.

8. If the transducer will not zero, the monitor displays the words ZERO REJECTED in the numerics window. Press **CANCEL** and try zeroing again beginning at step 4. The monitor does not display numerics or scales until an acceptable zero reference is established.

   You can rezero an IBP transducer at any time after you again open the transducer stopcock to atmospheric air. If the transducer has already produced pressure readings, rezeroing provides a new zero reference for the monitor.

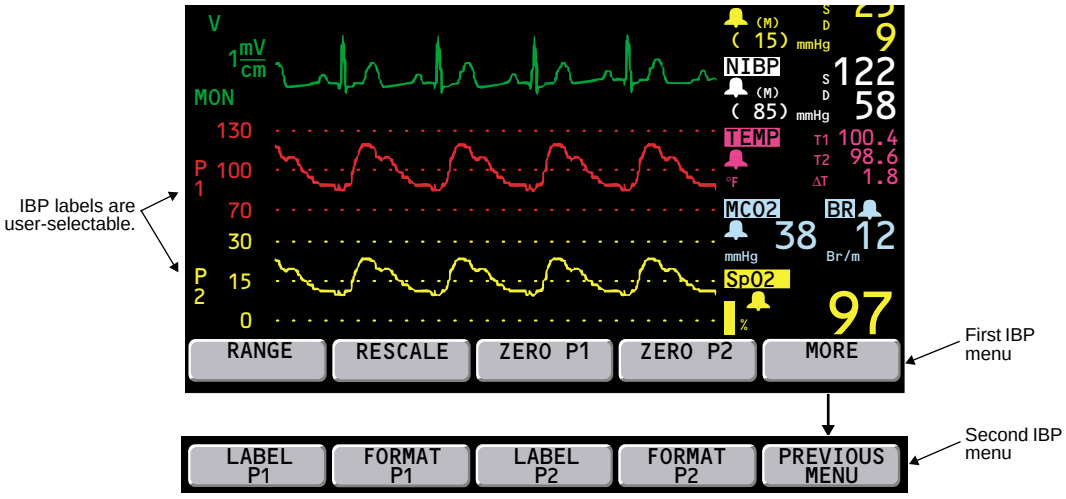
   If the zero value is not accepted, the monitor continues to use the previous zero reference and displays numerics and waveforms based on that value.

   If the transducer still does not zero, try another transducer or another cable.

Warning

If you press ZERO after an invasive pressure channel has been successfully zeroed and the channel is currently monitoring a pressure waveform, the message ZERO REJECTED will display in the IBP numerics window. This message continues to display in place of the valid invasive pressure numerics until you press Home, INVASIVE PRESSURE, and then CANCEL in the IBP menu. If an IBP alarm occurs while ZERO REJECTED is displayed in place of IBP numerics, the IBP numerics will not flash to indicate invasive pressure is in alarm.

9. To set up the IBP display, from the Main Menu press **INVASIVE PRESSSURE** to display the first IBP menu:



10. To display all invasive pressure waveforms on one scale (when two IBP channels are active), press **RANGE** to select the Range Mode.

Press **RANGE** again to select another scale. Five scales are available:
300 / 150 / 0
180 / 90 / 0
120 / 60 / 0
60 / 30 / 0
30 / 15 / 0

Choose the scale carefully to make sure both waveforms are displayed (if monitored).

Range Mode displays both waveforms on one scale.

11. To display each invasive waveform on its own scale, press **RESCALE** to select the Rescale Mode.

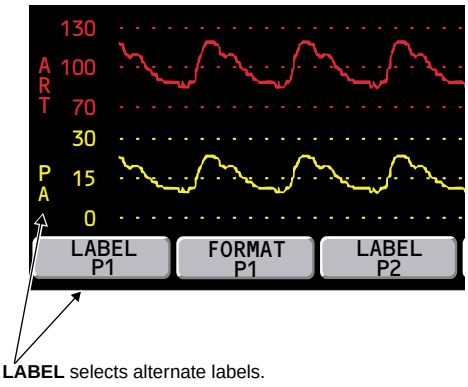
Whenever you press **RESCALE**, the monitor automatically adjusts the scale for the best appearance based on the highest and lowest pressure levels.

Rescale Mode displays each waveform on its own scale.

12. To change the displayed waveform label, press **MORE** to access the second IBP menu, then press **LABEL P1** (or **LABEL P2**).

Selectable labels (and display colors) are:

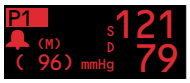
P1	(red)	default label
P2	(yellow)	default label
ART	(red)	arterial
PA	(yellow)	pulmonary artery
CVP	(blue)	central venous pressure
ICP	(white)	intracranial pressure
UA	(red)	umbilical artery (NEO mode only)
UV	(blue)	umbilical vein (NEO mode only)



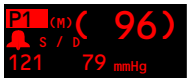
LABEL selects alternate labels.

13. To change the format of the IBP numerics, from the second IBP menu press **FORMAT**.

To restore the first format, press **FORMAT** again.



First format



Second format

14. Set alarms according to your facility's standards.

Take a Non-Invasive Blood Pressure (NIBP) Reading

Warning

Periodically observe the patient's limb to make sure that the circulation is not impaired for a prolonged period of time. Also make sure the cuff is properly placed according to the following instructions. Prolonged impairment of circulation or improper cuff placement can cause bruising.

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

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

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

When monitoring NIBP, match the monitor patient mode to the NIBP cuff. For neonates, set the monitor to Neonatal Mode unless the circumference of the limb is too large for the cuff. In that case, use the Pediatric Mode. Be aware, however, that the maximum cuff inflation limits are based on the patient mode, not the cuff; the maximum cuff inflation limits for Pediatric Mode are greater than for Neonate Mode (see page 104 for values).

Warning

Before you use a Propaq CS monitor on a new patient, always turn it off for a few seconds, then turn it on again. This clears the prior patient's NIBP cuff inflation target, trend values, and alarm limit settings.

At powerup, the Propaq CS monitor has an NIBP default inflation pressure (cuff inflation target) based on the patient mode (see page 104 for the values). After each NIBP measurement, the monitor adjusts the target inflation pressure to optimize the next NIBP measurement. To avoid possible patient discomfort, turn the monitor off and then on between different patients to reset the cuff inflation target to the default value.

NIBP measurements can be adversely affected by poorly fitting cuffs or improper cuff placement. Be sure to select the appropriate cuff and apply the cuff properly according to the directions in this manual.

Note

NIBP measurements are affected by normal physiological pressure variations from reading to reading.

Improve NIBP Accuracy with Smartcuf™

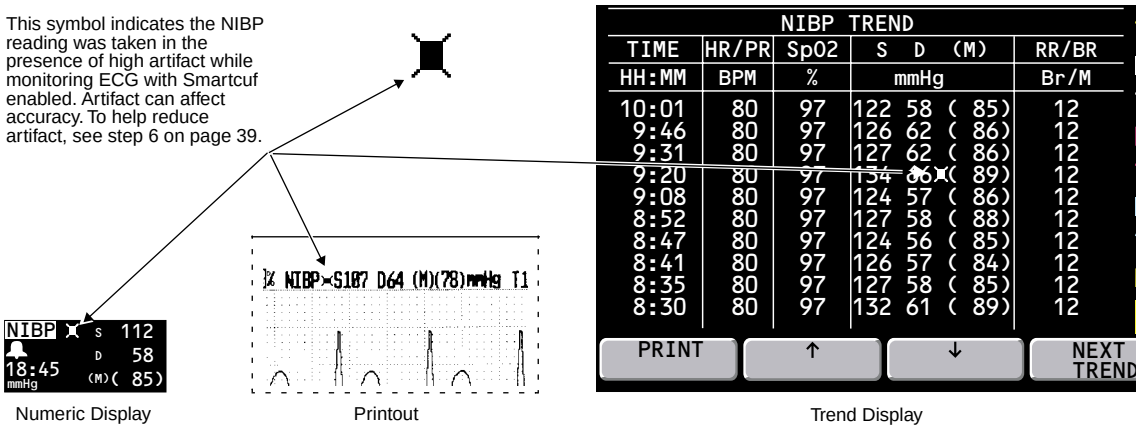
NIBP measurements can be adversely affected by many factors such as cardiac arrhythmias, sudden changes in blood pressure, body motions such as convulsions or shivering, bumping the cuff, vibration, vehicle motion, or weak pulses.

The patented Smartcuf software filtering technology greatly increases NIBP measurement accuracy in the presence of motion artifact or diminished pulses. Smartcuf synchronizes the NIBP reading with the R-wave of the patient's ECG to eliminate noise created by external stimuli such as patient motion or vibration. The monitor must perform ECG monitoring while using Smartcuf.

To enable the Smartcuf filter:

- Connect the ECG leads to the patient and perform ECG monitoring during NIBP.
- From the Main Menu, press **NIBP** to display the NIBP Menu (shown on page 38) and set Smartcuf to ON.

If artifact is so severe while Smartcuf is enabled that it affects the accuracy of an NIBP measurement, that measurement is marked with a special symbol on the display and on printouts:



Numeric Display Printout Trend Display

There may be some situations where it is desirable to disable Smartcuf. This may include situations with very extreme motion artifact, certain types of arrhythmias, or other situations where it is not possible to obtain a good ECG signal. NIBP measurements can still be performed when Smartcuf is disabled.

To disable Smartcuf, from the Main Menu press **NIBP** to display the NIBP Menu and set Smartcuf to OFF.

Take the NIPB Reading

1. Select a cuff and hose appropriate for the patient. Select cuff size based on limb circumference. Use only hoses and cuffs listed in the Protocol Systems *Products and Accessories* booklet.

	Neonate Mode	Pediatric Mode	Adult Mode
Typical Hoses	Neonate/Infant	Neonate/Infant, Adult	Adult
Typical Cuffs	Neonate #1 to #5 (disposable); newborn, infant (reusable)	Neonate #4, neonate #5, infant, child, small adult	Child, small adult, adult, large adult, thigh
Recommended Limb Circumference	up to 15 cm	10 to 25 cm	greater than 15 cm

Note

Be sure the patient mode selected is appropriate for the cuff you are using. For instructions about changing the patient mode, see page 22. Be aware that changing patient modes will cancel an NIBP reading in progress.

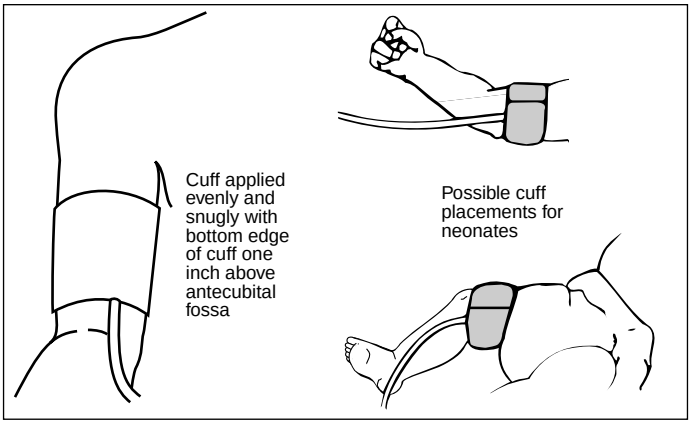
2. Squeeze as much air from the cuff as you can before placing it on the patient.

3. Place the cuff on the limb.

If possible, place it at the same level as the heart. If above the heart, add 1.9 mmHg to the NIBP measurement for every inch above the heart. If below the heart, subtract 1.9 mmHg for every inch.

The cuff should be snug, but not uncomfortable. The hose must not be kinked or pinched.

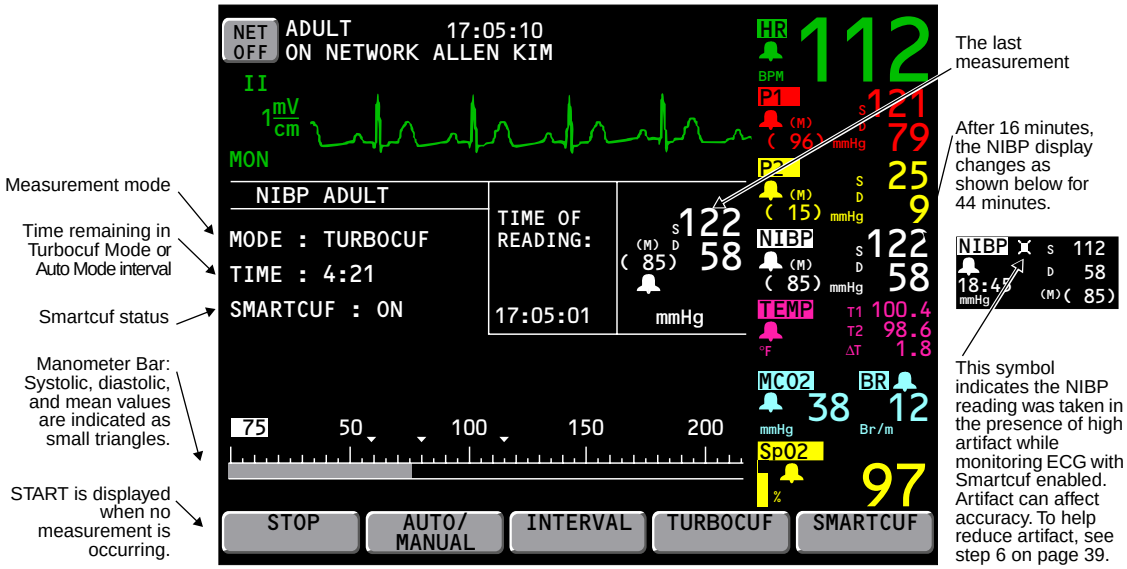
Make sure the cuff tubing is centered over the brachial artery.



If SpO_2 will also be monitored, place the NIBP cuff on a different limb than the SpO_2 sensor to help reduce unnecessary SpO_2 alarms.

4. Screw the hose connector onto the NIBP connector on the monitor's left side.

5. From the Main Menu, press **NIBP** to display the NIBP Menu:



START/STOP Starts and stops NIBP measurements. During the measurement, you can press **STOP** (or the **Start/Stop NIBP** key at the right side of the screen) to stop the measurement and vent the cuff.

If the Propaq CS monitor does not recognize a valid NIBP reading, it automatically attempts another measurement while displaying a retry message. The monitor attempts up to two retries (depending on patient mode and settings).

AUTO/MANUAL Switches between Automatic and Manual Mode. In Automatic Mode, the monitor automatically takes measurements at the selected interval.

INTERVAL Selects the measurement interval for Automatic Mode NIBP measurements: 1, 2, 3, 5, 10, 15, 30, or 60 minutes.

For intervals 5, 10, 15, 30, or 60, measurements occur at corresponding intervals past the hour. For example, if 5 is selected at 10:47:20, the measurements occur at 10:50, 10:55, 11:00, etc.

For intervals 1, 2, or 3 minutes, measurements begin 1, 2, or 3 minutes after the interval is set. For example, if 1 is selected at 10:47:20, the next measurement starts at 10:48:20.

TURBOCUF Automatically starts NIBP measurements and takes as many as possible within five minutes. To stop the Turbocuf Mode, press **STOP** or the **Start/Stop NIBP** key.

After you stop the Turbocuf Mode or the monitor completes the five-minute Turbocuf cycle, the monitor returns to the previous NIBP mode (Automatic or Manual).

SMARTCUF Enables or disables the Smartcuf motion artifact filter. NIBP measurements can still be taken when Smartcuf is off. Artifact may interfere with the accuracy of NIBP measurements with Smartcuf off.

6. If motion artifact such as shivering, coughing, or other motion interferes with NIBP readings, do the following:

   Position the patient's limb away from the body so the applied cuff is not in contact with the patient's body or any other object such as a bed rail. Try to keep the cuff at the same level as the heart.

   Make sure the Smartcuf filter is ON. Make sure ECG leads are properly connected to the patient and perform ECG monitoring during NIBP. (ECG monitoring is required for Smartcuf.)

7. Set alarm limits according to your facility's standards.

Perform Temperature Monitoring

1. Place the temperature probe on the patient.

Warning

Application and use of metal-jacketed temperature probes that come in contact with conductive objects or clinical personnel during electrocautery may cause burns at the patient-probe/electrode contact points. Do not touch conductive temperature sensors during defibrillation or cautery.

Use only temperature probes listed in the Protocol Systems *Products and Accessories* booklet. Other probes may produce incorrect temperature readings.

2. Plug the probe cable into one of the temperature connectors on the monitor side panel. Within a few seconds, the monitor displays the temperature:

If you connect a second temperature probe, the monitor displays the temperature for T1, T2, and ΔT.

3. To set alarm limits, from the Main Menu press **SETUP, ALARMS, LIMITS** to access the Alarms Limits Menu. Press **NEXT PARAMETER** as needed to highlight the desired temperature parameter. Use **NEXT SETTING, UP, DOWN,** and **ON/OFF** to set the alarm limits according to your facility's standards.

4. To change the temperature units (°C or °F), from the Main Menu press **SETUP, MORE, MORE, SERVICE, YES** (to access the Service Menu), **MORE, MORE, SETTINGS.** Use **NEXT** and **CHANGE** to change the temperature units.

Changing units does not clear temperature trends.

Perform SpO_2 Monitoring

Warning

Oxygen saturation measurements using pulse oximetry are highly dependent on proper placement of the sensor and patient conditions. Patient conditions such as shivering and smoke inhalation may result in erroneous oxygen saturation readings. If pulse oximetry measurements are suspect, verify the reading using another clinically accepted measurement method, such as arterial blood gas measurements.

Tissue damage can be caused by incorrect application or use of a sensor (e.g., wrapping the sensor too tightly, applying supplemental tape, failing to periodically inspect the sensor site, leaving a sensor on too long in one place). Refer to the Directions for Use provided with each sensor for specific instructions on application and use, and for description, warnings, cautions, and specifications.

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.

Before you use a Propaq CS monitor on a new patient, always turn off the monitor for a few seconds, then turn it on again. This clears the prior patient's trend values, alarm limit settings, and NIBP cuff inflation target.

Note

During SpO_2 monitoring, the monitor performs an SpO_2 self-calibration procedure every 15 minutes to help make sure the SpO_2 channel is functioning properly. During the self-calibration, the SpO_2 waveform is displayed as a flat line for a few seconds. After calibration, the SpO_2 monitoring resumes.

1. Attach the sensor to the patient according to the sensor manufacturer's instructions, observing all warnings and cautions.

   Use only NELLCOR accessories and sensors with the Propaq CS monitor SpO_2 option as listed in the Protocol Systems *Products and Accessories* booklet. Each sensor is designed for application to a specific site on a patient within a certain size range. To ensure optimal performance, use an appropriate sensor and apply it as described in the sensor's Directions for Use. Always observe all warnings and cautions. Consider using other types of listed sensors for different applications if you have problems obtaining good measurements.

   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.

   If NIBP will be monitored while using SpO_2, place the NIBP cuff on a different limb than the SpO_2 sensor to help reduce unnecessary SpO_2 alarms.

2. Plug the sensor into the SpO_2 sensor extension cable and plug the cable into the monitor, or plug the sensor directly into the monitor.

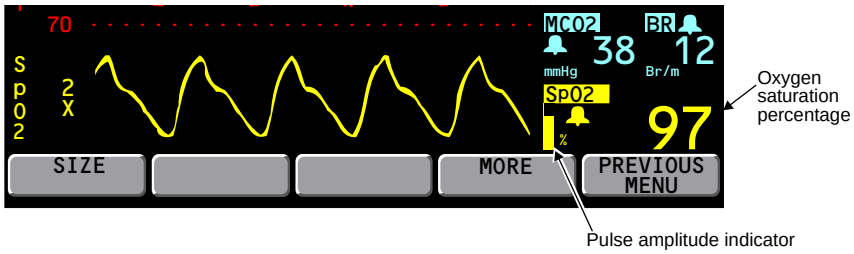
3. Lock the connector in place by turning the locking ring clockwise until it stops.

   The monitor displays STANDBY in the SpO_2 numeric window until it measures and displays the SpO_2 value.

   The monitor self-calibrates the SpO_2 channel whenever the monitor is first turned on, at least every 15 minutes thereafter, and whenever a sensor is connected to the SpO_2 channel. During calibration, the SpO_2 waveform is momentarily flat.

   As oxygen saturation increases and decreases, the pitch of the heart tone rises and falls.

4. From the Main Menu, press **SpO2** (or **SpO2/CO2**, then **SpO2**) to display the first SpO_2 menu:



5. Press **SIZE** to adjust the waveform size for best viewing (1x, 2x, 4x, or 8x).

6. Adjust the placement of the sensor until a good SpO_2 waveform is displayed. A waveform with artifact may cause erroneous oxygen saturation readings.

7. Press **MORE** to display the second SpO_2 menu:

8. Press **RESPONSE** to select the appropriate time required to measure SpO_2:

Response	Time	Indications for Use
NORMAL	5-7 seconds	Use for relatively stable patients.
FAST	2-3 seconds	Use when patient movement or other artifact is not present.
SLOW	10-15 seconds	Use when patients exhibiting movement are preventing accurate measurement at NORMAL setting.

9. If the C-LOCK function is desired, press **C-LOCK** to set it to ON.

   C-LOCK synchronizes the pulse oximeter's systole determination to the R-wave to reduce the effects artifact may have on SpO_2 measurements. Under some conditions you may find more stable SpO_2 readings with C-LOCK set to ON. SYNC appears next to the waveform when synchronization to the ECG has been obtained. Synchronization takes a few seconds to establish the first time. If C-LOCK is on and the HR source is SpO_2, the heart rate source is automatically changed to ECG. An ECG signal must be present or C-LOCK does not activate.

   If you get false SpO_2 alarms with patients with low perfusion states or multiple arrhythmias, try turning off C-LOCK.

10. Set alarm limits according to your hospital's standards.

11. If patient movement interferes with measurements, consider the following possible solutions:

    - be sure the sensor is secure and properly applied
    - use a new sensor with fresh adhesive backing
    - select a different type of sensor
    - move the sensor to a less active site
    - set the RESPONSE mode to SLOW
    - consider using C-LOCK; see step 9.

Perform SpO_2 "Spot-Check" Monitoring

The SpO_2 Standby Mode allows you to remove the SpO_2 sensor from a patient without having to disable all alarms or disconnect the SpO_2 sensor cable from the Propaq CS monitor. You can therefore perform intermittent or "spot-check" SpO_2 monitoring.

1. While monitoring SpO_2, remove the SpO_2 sensor from the patient, but leave it connected to the monitor. When the monitor detects the lack of a pulsatile waveform, it sounds a patient alarm and displays this menu:

2. Press **STANDBY** to place SpO_2 into the Standby Mode.

   The monitor suspends the SpO_2 alarm tone indefinitely and displays **STANDBY** in place of SpO_2 numerics. SpO_2 remains in the Standby Mode until the SpO_2 sensor is reapplied to a patient. Other vital sign monitoring is not restricted. By contrast, if you press **SUSPEND** instead of **STANDBY**, the monitor temporarily suspends all alarm tones; however, the alarm tone resumes after 90 seconds if the SpO_2 sensor is still disconnected from the patient—see page 53.

3. To resume SpO_2 monitoring, reapply the SpO_2 sensor to a patient.

   The monitor exits the Standby Mode and resumes SpO_2 monitoring

Note

The message STBY on the SpO_2 trend display and trend printouts indicates the monitor was in the SpO_2 Standby Mode.

Perform Mainstream CO_2 Monitoring

The capnography (CO_2) option measures End-tidal CO_2 ($ETCO_2$), Inspired CO_2 ($INCO_2$), Breath Rate, and Apnea. Patients using Mainstream CO_2 must either be intubated or breathing through a tight-fitting face mask connected to a breathing system such as an anesthesia circle system. The Mainstream CO_2 option requires the SpO_2 option.

Warning

Avoid exposing older Mainstream CO_2 sensors to non-patient sources of CO_2 such as vehicle engine exhaust or smoke. Exposure to these CO_2 sources can temporarily trap CO_2 within the monitor or Mainstream CO_2 sensor housing, even when monitor power is off. This can temporarily cause an erroneous elevated CO_2 measurement baseline until the trapped CO_2 leaks out and the baseline returns to zero (which can require as long as 3-24 hours).

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.

Do not clean and/or reuse a single-patient-use airway adapter. When a single-patient-use airway adapter becomes occluded, replace it.

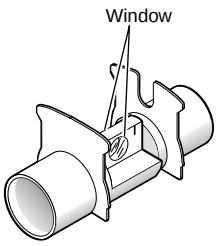
For best product performance and measurement accuracy, use only accessories supplied by Protocol Systems or recommended in the Protocol Systems *Products and Accessories* booklet. Use accessories according to your facility's standards and the manufacturer's recommendations. Always refer to the manufacturer's Directions for Use for instructions about operation, cleaning, and replacement. Only sensors recommended by Protocol Systems provide calibrated waveforms and numerics.

Note

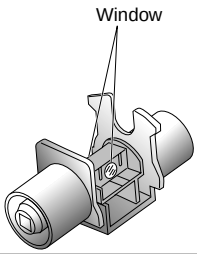
The Mainstream CO_2 operating temperature range is 10° to 40°C. This is different than the range of 0° to 40°C for other Propaq CS monitor functions. CO_2 monitoring outside the specified range can cause inaccurate CO_2 measurements.

1. Select the appropriate airway adapter.
2. Connect the adapter, ventilator circuit, and CO_2 sensor according to the manufacturer's instructions.

Adult airway adapter



Low dead space airway adapter



Warning

Before using an airway adapter, always look through the window lumen and inspect the adapter for inadvertently lodged obstructions and for window integrity.

If the sensor does not easily slide onto the adapter, do not attempt to force these components together. They fit together in only one way. Take care not to damage the glass window.

After attaching the sensor to the adapter, check for proper placement. Check the sensor and adapter periodically during monitoring to make sure they are properly connected and the adapter is not clogged by obstructions or debris.

When attaching the airway adapter, position the adapter so the sensor is on top to avoid fluid collection in the sensor airway slot. Any concentration of fluids here can cause inaccurate CO_2 readings.

When connecting the adapter and sensor to the ventilator circuit, do not use the adapter and sensor as a wrench to twist the adapter into the ventilator circuit. Such action could damage the adapter and sensor.

Always check to make sure there are no leaks in the breathing circuit. Check all of the connections.

3. Plug in the CO_2 sensor cable to the Mainstream CO_2 connector on the monitor left side panel.

Warning

When disconnecting the CO_2 sensor from the tracheal or endotracheal tube, check the sensor to determine how hot it is. If it is too hot for patient comfort, do not allow it to come into contact with the patient.

4. See page 48 and set up the CO_2 display and alarm limits.

Note

When disconnecting the airway adapter from the ventilator circuit, always detach the CO_2 sensor from the airway adapter before removing the airway adapter from the ventilator circuit.

Perform Sidestream CO_2 Monitoring

The capnography (CO_2) option measures End-tidal CO_2 ($ETCO_2$), Inspired CO_2 ($INCO_2$), Breath Rate, and Apnea. Patients using Sidestream CO_2 can either be intubated or non-intubated using a CO_2 Sampling cannula or a combination CO_2 Sampling / Oxygen Delivery nasal cannula. The Sidestream CO_2 option requires the SpO_2 option.

Warning

Do not use Sidestream CO_2 if flammable anesthetic gases are in use.

If the Sidestream CO_2 option is connected to a ventilatory circuit, be sure to adjust appropriate ventilator or anesthesia system settings to compensate for the sampling flow volume (90 or 175 ml/min) that is aspirated from the ventilatory circuit by the Sidestream CO_2 option.

Avoid exposing a Propaq CS monitor with the Sidestream CO_2 option to non-patient sources of CO_2 such as vehicle engine exhaust or smoke. When such exposure is possible, avoid opening the printer door. Exposure to these CO_2 sources can temporarily trap CO_2 within the monitor, even when monitor power is off. This can temporarily cause an erroneous elevated CO_2 measurement baseline until the trapped CO_2 leaks out and the baseline returns to zero (which can require as long as 3-24 hours).

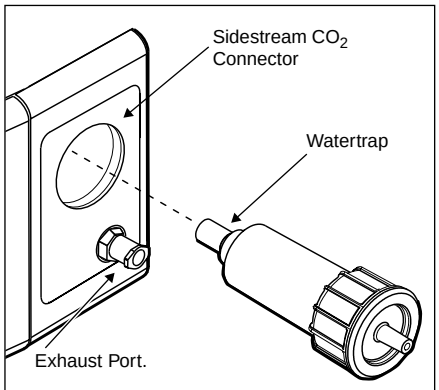
For best product performance and measurement accuracy, use only accessories supplied by Protocol Systems or recommended in the Protocol Systems *Products and Accessories* booklet. Use accessories according to your facility's standards and the manufacturer's recommendations. Always refer to the manufacturer's Directions for Use for instructions about operation, cleaning, and replacement.

Note

The Sidestream CO_2 operating temperature range is 5° to 40°C. This is different than the range of 0° to 40°C for other Propaq CS monitor functions. CO_2 monitoring outside the specified range can cause inaccurate CO_2 measurements.

- When monitoring a small child with a rapid respiratory rate, Mainstream CO_2 can provide a more accurate representation of the expired CO_2 waveform than Sidestream CO_2.
- Breath rates greater than 50 breaths / minute may reduce the reported ETCO2 values. Select the 175 ml / min flow rate to minimize errors at higher breath rates.
- The 175 ml / min flow rate is recommended for intubated adult patients.

1. Firmly insert the Sidestream CO_2 watertrap into the Sidestream CO_2 connector on the monitor left side panel.



WARNING - Do not connect sample line or patient input to exhaust port.

Warning

The watertrap is disposable and should only be used for a single patient. Do not reuse the watertrap for another patient.

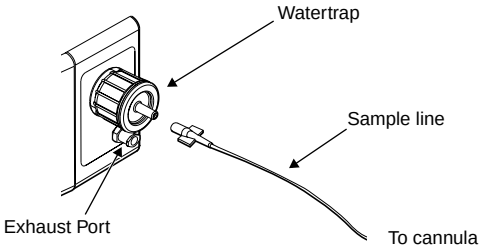
2. See page 48 and set up the CO_2 display and alarm limits, then continue this procedure with step 3.

3. **For a non-intubated patient,** position the cannula on the patient according to the manufacturer's instructions.

Warning

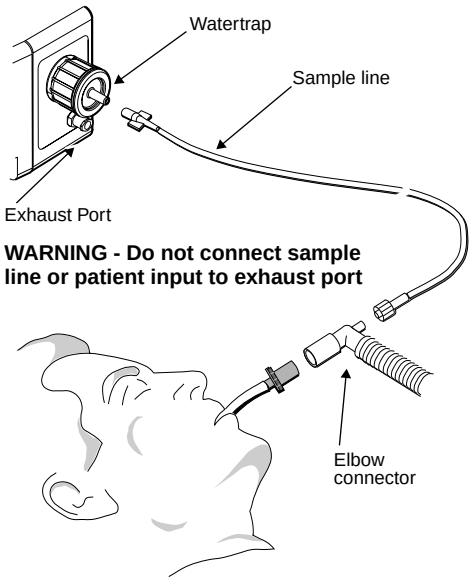
The cannula is disposable and should only be used for a single patient. Do not reuse the cannula for another patient.

If oxygen is being delivered while using Sidestream CO_2, be sure to use a CO_2 Sampling and O_2 Delivery Cannula. Using a different type of cannula could obstruct oxygen delivery.



WARNING - Do not connect sample line or patient input to exhaust port

3. **For an intubated patient,** connect the gas sampling elbow and elbow connector into the patient's breathing circuit according to the manufacturer's instructions.



WARNING - Do not connect sample line or patient input to exhaust port

4. Connect the sample line to the cannula (for a non-intubated patient) or the elbow connector (for an intubated patient) and the watertrap. Make sure that the sample line is firmly connected.

Warning

The exhaust port for Sidestream CO_2 is an output for the expired gases from the patient and any connected breathing apparatus. The exhaust port is intended only for connection to gas collection equipment such as gas scavenger devices (the device should comply with ISO 8835-3:1997 E). Do not allow any other connection to the exhaust port.

If the Sidestream CO_2 option is connected to a ventilatory circuit, be sure to adjust appropriate ventilator or anesthesia system settings to compensate for the sampling flow volume (90 or 175 ml/min) that is aspirated from the ventilatory circuit by the Sidestream CO_2 option.

If you use a gas scavenging system with Sidestream CO_2, be sure to install it according to the manufacturer's instructions. The scavenging system should comply with ISO 8835-3:1997 (E).

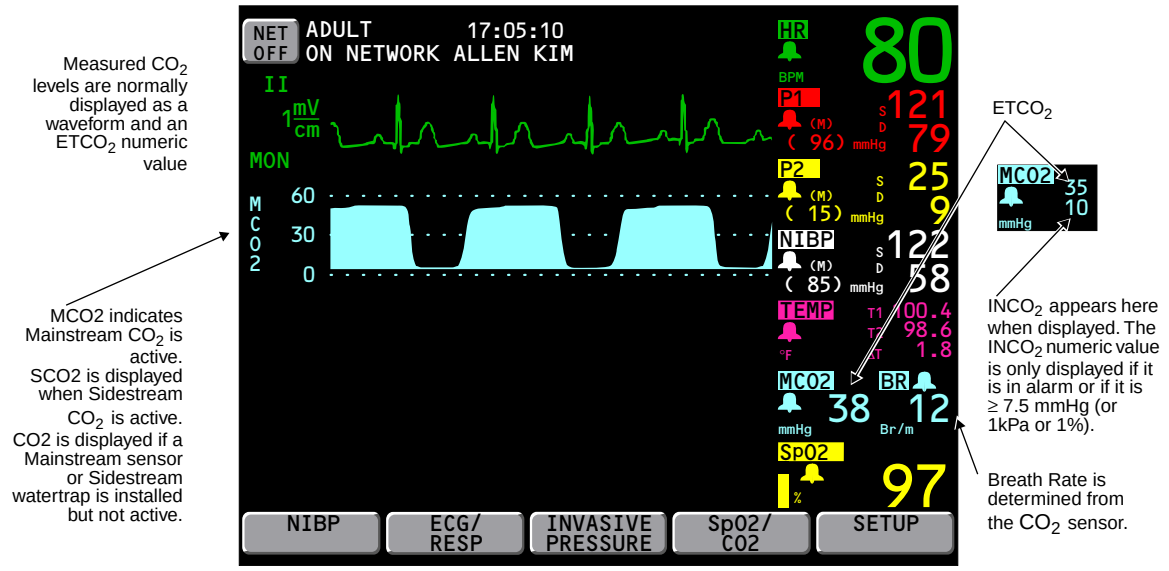
Sidestream CO_2 accuracy decreases if additional tubing is connected to the sample line. Avoid connecting additional tubing to the standard sample line.

Set Up the CO_2 Display and Alarm Limits

Note

After you connect a Mainstream CO_2 sensor or Sidestream CO_2 watertrap, the Propaq CS monitor displays the waveform briefly without a scale. It displays WARM UP (for Mainstream) or START UP (for Sidestream) in the CO_2 numerics window. After about 30 seconds, the monitor displays the CO_2 measurement and waveform range.

CO_2 monitoring is typically displayed as shown:



1. To adjust the display, from the Main Menu press **SpO2/CO2, CO2** to access the first CO_2 menu:

2. Press **RANGE** to select the CO_2 waveform scale or range.

mmHg:	0-100	0-60 (default)	0-30
kPa:	0-14	0-8	0-4
%:	0-14	0-8	0-4

To change CO_2 units (mmHg, kPa, or %) see page 96.

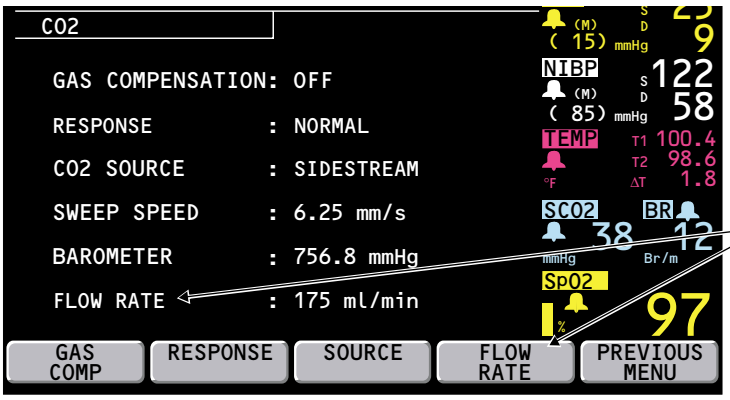
Note

If an inspired value is displayed indicating patient rebreathing (non-zero $INCO_2$), check the patient breathing circuit for proper function. For Mainstream CO_2, also remove the sensor from the patient's airway, hold it away from any source of breath, and confirm $INCO_2$ begins to go down to the baseline value. If the Propaq CS monitor continues to display inspired values, return the Mainstream CO_2 sensor to Protocol Systems for service.

3. Press **mm/s** to set the display sweep speed for CO_2 and RESP (3.13, 6.25, or 12.5 mm/sec). The default is 6.25.

To view the sweep speed setting, press **MORE** to access the CO_2 status window.

4. Press **MORE** to access the second CO_2 menu and status window:



FLOW RATE is only displayed for Sidestream CO_2 (not Mainstream CO_2).

5. If O_2 or N_2O is being administered to the patient, press **GAS COMP** to set the proper gas compensation (for specifications, see page 106). If no gas is being administered, choose OFF (the default).

Note

If $ETCO_2$ is displayed as + + +, have a biomedical technician check the CO_2 calibration against a known reference gas. If the sensor calibration is not accurate, return it to Protocol Systems for service.

6. Press **RESPONSE** to set CO_2 measurement response time (NORMAL, FAST, or SLOW).

   FAST 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. SLOW is recommended to help reduce $ETCO_2$ false alarms when breath morphology varies considerably from one breath to the next. The default is NORMAL.

7. Press **SOURCE** to change between Mainstream CO_2 and Sidestream CO_2 monitoring (if both options are installed), or to disable CO_2 monitoring.

   Choosing OFF allows you to disable CO_2 monitoring without removing the watertrap or sensor. When CO_2 is off, OFF is displayed for CO_2 numerics.

8. For Sidestream CO_2, press **FLOW RATE** to set the sampling flow rate (90 or 175 ml/min).

   You can change the flow rate while Sidestream CO_2 is active.

9. To set alarm limits, from the Main Menu press **SETUP, ALARMS, LIMITS.** Then set alarm limits for RR/BR, $ETCO_2$ and $INCO_2$.

   $INCO_2$ has an upper alarm limit setting but no lower alarm limit setting.

Warning

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

10. Set the Apnea Delay limit (the maximum time allowed between two consecutive breaths before an Apnea alarm occurs) in the Alarm Limits window.

    After the first breath has been detected, the Apnea Delay limit setting is automatically turned on for as long as the CO_2 channel is active.

4 – Alarms & Alerts

Respond to Patient Alarms

When an apnea alarm or patient alarm occurs, the monitor produces an audible tone and visual indicators and displays the following:

1. Press the **Suspend/Resume Alarms** key in the upper right corner of the screen or **SUSPEND** in the Patient Alarm Menu. The tone is suspended for 90 seconds. During that period, visual alarm indications continue.


Suspend/ Resume Alarms

To "unsuspend" the alarm before 90 seconds has elapsed, press the **Suspend/Resume** key or **RESUME**. If an alarm condition still exists, the tone will again sound. For NIBP, pressing **Suspend/Resume** or **RESUME** will not resume the NIBP alarm because NIBP is not continuously measured.

Warning

Suspending an alarm suspends ALL alarm tones for 90 seconds or until RESUME is pressed.

2. Check the patient and provide appropriate care.

3. To adjust alarm limits, press **Home, SETUP, ALARMS, LIMITS** to display the Alarm Limits Window. Use **NEXT PARAMETER** and **NEXT SETTING** as needed to highlight the limit you want to change.


Home

- Press **UP** or **DOWN** to change the limits.
- Press **ON/OFF** to turn an alarm off or on. (The **ON/OFF** button is not available for HR/PR alarm limits if HR/PR ALARM LIMITS in the Settings window is set to CANNOT TURN OFF.)

4. If you want to quickly turn off all alarm limits, from the Main Menu press **SETUP**, **ALARMS**, **ALL ALARMS.** You cannot turn off the Apnea alarm.

5. After caring for the patient, turn on the appropriate alarm limits.

Customize Alarm Limits Based on Patient's Current Vital Signs

1. To quickly set all alarm limits, from the Main Menu press **SETUP**, **ALARMS, STAT SET**. The monitor turns on all alarms and calculates new alarm limits based on the patient's current vital sign values. Make sure that the new limits are appropriate for the patient.

STAT SET Limit Calculations[1]

Vital Sign	If the Patient's Vital Sign Value is	Then Calculated New Lower Limit is	Then Calculated New Upper Limit is
Heart Rate	HR ≤ 99 100 - 250 HR ≥ 251	HR x 0.8 HR - 20 Unchanged	HR x 1.2 HR + 20 250
Pulse Rate	PR ≤ 99 PR ≥ 100	PR x 0.8 PR - 20	PR x 1.2 PR + 20
Invasive Pressure	Inv Prs ≤ 25 26 - 99 Inv Prs ≥ 100	Inv. Pressure - 5 Inv. Pressure x 0.8 Inv. Pressure - 20	Inv. Pressure + 5 Inv. Pressure x 1.2 Inv. Pressure + 20
NIBP	NIBP ≤ 25 26 - 99 NIBP ≥ 100	NIBP - 5 NIBP x 0.8 NIBP - 20	NIBP + 5 NIBP x 1.2 NIBP + 20
Respiration Rate/Breath Rate	RR/BR ≤ 25 26 - 99 RR/BR ≥ 100	RR/BR - 5 RR/BR x 0.8 RR/BR - 20	RR/BR + 5 RR/BR x 1.2 RR/BR + 20
Temperature	Temp ≥ 0˚C	Temp - 0.5	Temp + 0.5
SpO_2	SpO_2 ≥ 0%	SpO_2 - 5 (min. limit 50%)	100% (adult and pediatric mode) SpO_2 + 5 (neonate mode)
$ETCO_2$	$ETCO_2$ ≥ 0 mmHg $ETCO_2$ ≥ 2.0 (% or kPa)	$ETCO_2$ - 5 mmHg (min. 15 mmHg) $ETCO_2$ - 0.7 (% or kPa) (min 2.0% or 2.0 kPa)	$ETCO_2$ + 10 mmHg $ETCO_2$ + 1.4 (% or kPa)
$INCO_2$	$INCO_2$ ≥ 0 mmHg $INCO_2$ ≥ 0 (% or kPa)	Not affected by STAT SET	$INCO_2$ + 5 mmHg $INCO_2$ + 0.7 (% or kPa)
Apnea Delay	Not affected by STAT SET		

1. New alarm limits calculated by STAT SET cannot be outside the allowable alarm limit range. If a new limit is calculated to be above or below the allowable alarm limit range, it defaults to the maximum or minimum alarm limit allowed for that vital sign.

Warning

If a patient's vital sign value falls outside of the upper or lower alarm range limit, STAT SET turns off the alarm and the alarm limit except for the following:
1. The lower alarm limits for SpO_2 and $ETCO_2$ are not turned off by STAT SET.
2. If HR/PR ALARM LIMITS in the Settings window is set to CANNOT TURN OFF, STAT SET affects HR/PR alarm limits as follows:

HR/PR PATIENT VALUE	DISPLAY	UPPER LIMIT	LOWER LIMIT
Overrange	+++	Maximum	Unchanged
Underrange	- - -	Unchanged	Minimum
Indeterminate	???	Unchanged	Unchanged

Alarm Holdoffs

To help minimize false alarms, the monitor briefly delays or "holds off" triggering alarms for limit violations for HR/PR, SpO_2, and RR/BR. After the alarm holdoff period begins, if the monitor detects that the patient's vital sign has returned to acceptable limits, the monitor cancels the alarm holdoff. The next time a vital sign limit is violated, the monitor starts a new holdoff period.

Vital Sign	Alarm Holdoff Time Period
HR/PR	3 seconds (except NIBP PR)
SpO_2	10 seconds
RR/BR	5 seconds

Connect Nurse Call Option

The Propaq CS monitor can be connected to a Nurse Call system through a customized cable that connects to the left-side Nurse Call connector. When connected, the monitor immediately notifies the Nurse Call system whenever a patient alarm occurs.

To connect the monitor to the Nurse Call system, you need a cable (Protocol Part Number 008-0634-XX) that has been customized for your Nurse Call system. If you do not have this cable, contact your biomedical engineering department for assistance. For specifications, see page 110.

Note

When an apnea alarm or patient alarm occurs, pressing the **Suspend/Resume Alarm** key or **SUSPEND** suspends the alarm tone and Nurse Call alarm for 90 seconds. However, the visual indicators on the monitor are *not* suspended during this time.

Even though the Nurse Call option allows remote alarm indication, it does not replace appropriate bedside surveillance by trained clinicians.

Respond to An Equipment Alert

When the monitor detects an equipment problem, it produces an audible alert tone every five seconds. It also displays an equipment alert message similar to the following:

1. Press any key at the bottom of the screen to silence the alert tone (or press the **Suspend/Resume Alarms** key in the upper right corner to silence the alert tone for 90 seconds).

2. Determine what caused the problem and correct it. For descriptions of equipment alert messages and suggested responses, see page 57.

   Sometimes an equipment alert also causes one or more patient alarms. Patient alarms have a higher priority than equipment alerts and are displayed first. Respond to the patient alarm or alarms (see page 53), then respond to the equipment alert.

   If you turn off any alarm limits while responding to a patient alarm, be sure to restore the appropriate alarm limits before resuming patient monitoring.

Troubleshooting Equipment Alert Messages

ECG Messages

If a lead fault occurs, the ECG equipment alert typically shows which lead failed. If multiple leads fail, the monitor displays MULTIPLE.

ECG LEAD CHANGED. The Propaq CS monitor has automatically changed an ECG lead due to a lead wire or electrode problem.

LEAD FAIL: REPLACE ELECTRODES. The cable may not be properly connected to the electrodes or the electrodes may have failed. Check for proper connection; replace electrodes if needed.

RESP Messages

LEAD FAIL. One or more electrodes are making very poor or no contact. Check for proper connection; replace electrodes if needed.

INAPPROPRIATE ECG CABLE. ECG cable appears not to contain 1 kΩ current limiting resistors. These resistors are required for RESP operation and to protect the monitor from damage during defibrillation. Replace cable with proper type.

NOISY SIGNAL, CHECK ELECTRODES. Electrodes are making poor contact and may be dried out. Replace electrodes.

IBP Messages

TRANSDUCER NOT DETECTED. The transducer connection is broken.

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

INCOMPATIBLE TRANSDUCER. Check the compatible transducers listed in the Protocol Systems *Products and Accessories* booklet to confirm you are using a compatible transducer.

NIBP Messages

If an error number (ERR# *x*) is listed in an NIBP trend printout or display, it indicates that the corresponding NIBP equipment alert occurred.

AIR LEAK, CHECK HOSE (ERR# 1). The Propaq CS monitor could not properly inflate cuff. Check the hose and cuff for obvious leaks, such as the O-rings in the hose connections.

CUFF NOT DETECTED (ERR# 2). During cuff inflation the detected pressure did not sufficiently rise. Check that the cuff connection is tight and take the measurement again.

KINKED HOSE, CHECK HOSE (ERR# 3). The Propaq CS monitor could not properly inflate cuff. Check for a kinked hose between the monitor and the patient.

OVERPRESSURE CONDITION (ERR# 4). The pressure in the cuff exceeded the acceptable limits for patient mode. Check the hose and try taking another measurement.

WEAK PULSES, CAN'T FIND SYS/DIA (ERR# 5). 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.

ARTIFACT, CAN'T FIND SYS/DIA (ERR# 6). The systolic or diastolic pressures are unreliable due to artifact, but a mean pressure is available. May be caused by patient motion.

NO PULSES DETECTED (ERR# 7). The cuff may not be properly applied to the patient, or the patient may not have detectable pulses due to shock or arrhythmias.

Warning

The Propaq CS monitor cannot differentiate between physiologic and cuff application causes of the NO PULSES DETECTED message. Always evaluate the patient for presence of life threatening conditions whenever this message occurs.

CONNECT ECG TO REDUCE NIBP ARTIFACT (ERR# 8). NIBP artifact prevents a valid reading. Connect ECG electrodes to improve NIBP measurements.

NO VALID BLOOD PRESSURE FOUND (ERR# 9). This message can occur due to motion artifact, the Propaq CS monitor being set in the wrong patient mode, or the wrong hose or cuff being used in relation to the patient mode.

CALIBRATING, PLEASE WAIT (ERR# 10). The Propaq CS monitor periodically recalibrates the NIBP channel to ensure it can properly make NIBP determinations. Normal monitor operation continues while the NIBP channel is calibrating. If the NIBP channel has not updated its calibration in 15 minutes, the channel will briefly deactivate until a new calibration has occurred.

LOW BATTERY, NIBP DISABLED (ERR# 11). The battery lacks sufficient voltage to be able to operate the NIBP channel. Connect the Propaq CS monitor to the ac power adapter.

SERVICE REQUIRED, NIBP DISABLED (ERR# 12). Have the monitor serviced.

CUFF TOO LARGE FOR PATIENT MODE (ERR# 13). The monitor detects a cuff too large for the current patient mode. First, verify the patient mode. If the patient mode is correct, confirm the cuff size is correct and make sure the cuff fits snugly. If this alert occurs in Neonatal Mode, change the patient mode to Pediatric Mode and check the alarm limits. If the alert occurs in Pediatric Mode, change to Adult Mode and check the alarm limits. Note that different pressures and retries are used for each mode as stated in “NIBP Specifications” on page 104.

KINKED OR NEONATE HOSE (ERR# 14). This message occurs when a hose is kinked or when a neonate hose is detected in the adult patient mode. Check the hose or the patient mode selection.

ARTIFACT PRESENT, MINIMIZE ARTIFACT (ERR# 15). The monitor has detected too much artifact to allow accurate readings. Take steps to reduce artifact. Position the patient’s limb away from the body so the applied cuff is not in contact with the patient’s body or any other object such as a bed rail. If the Smartcuf motion artifact filter is on, make sure that the ECG leads are properly connected to perform ECG monitoring during NIBP. If the Smartcuf motion artifact filter is off, consider turning it on (and connect ECG if not already connected).

The following messages can appear in the NIBP status window.

CALIBRATING. The NIBP channel is running an internal calibration.

DISABLED, LOW BATT. See LOW BATTERY, NIBP DISABLED above.

NIBP DISABLED, SERVICE REQUIRED. See SERVICE REQUIRED, NIBP DISABLED above.

RETRY. Since the Propaq CS monitor did not receive a valid NIBP reading, it will automatically attempt to take another reading.

The following NIBP status message looks similar to an equipment alert, although it does not indicate a malfunction and does not cause an alert tone.

NIBP IN PROGRESS, PLEASE WAIT, FILTERING ARTIFACT. Noise or artifact such as vehicle motion is causing a delay while measuring NIBP. To remove the message, press any key below the screen. To cancel the NIBP measurement, press the **Start/Stop NIBP** key at the right of the screen.

Temperature Messages

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

PROBE SHORT. Verify that the probe is properly inserted in the left side panel. If so, replace probe.

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

Malfunction of the temperature probes may result in inaccurate readings. Confirm suspect readings.

SpO_2 Messages

SpO_2 messages can appear in the equipment alert window or in the SpO_2 numeric window.

NO SENSOR DETECTED. Indicates an SpO_2 sensor has been disconnected from the monitor after being plugged in for more than a few seconds.

SEARCH: During this search time, the SpO_2 channel tries to detect blood pulsing through the measurement site. After the measurement has been established, the oxygen saturation value is displayed in the numeric window.

STANDBY is displayed in the numeric window when the SpO_2 sensor is disconnected from the patient, an alarm occurs, and you press the **STANDBY** key. STANDBY is also displayed if you first plug the SpO_2 sensor cable into the monitor connector before attaching the SpO_2 sensor to the patient.

Mainstream CO_2 Messages

Messages for the Mainstream CO_2 option can appear in the equipment alert window and in numeric zones. If a sensor is damaged, contact Protocol Systems' Technical Services Department for information on sensor service options.

ALTIMETER FAILURE - RANGE. The Propaq CS monitor is operating at an altitude outside the Mainstream CO_2 option's operating altitude range of -2,000 to 15,000 feet. Returning the monitor to within this range automatically cancels this message and restores operation.

ALTIMETER FAILURE - RATE. The altimeter has detected that the ambient pressure is changing at a rate greater than 100 mmHg / minute. When the rate of change is back within the 100 mmHg / minute range, disconnect and reconnect the CO_2 sensor to the Propaq CS monitor.

DEGRADED WAVEFORM - CHECK ADAPTER (UNCAL appears in the numerics area). The Mainstream CO_2 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 WAVE - CHECK ADAPTER, SENSOR. Either the airway adapter is obstructed or the CO_2 sensor has failed. Replace the airway adapter if it is obstructed. The sensor must be unplugged and plugged in again.

LOW BATTERY - HEATER DISABLED (UNCAL appears in the numerics area). The monitor's battery voltage is too low. The CO_2 waveform is displayed without range values. To continue operation, supply ac power to the monitor.

NO MAINSTREAM SENSOR DETECTED (SRCH appears in the numerics area). The Mainstream CO_2 sensor has been disconnected from the Propaq CS monitor after providing CO_2 values. Disconnect and reconnect the sensor to the monitor if necessary.

NON-PROTOCOL SENSOR (UNCAL appears in the numerics area). 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 - CALIBRATION ERROR. A sensor is defective or out of calibration and disabled. Replace the sensor.

SENSOR FAILURE - EEPROM. The sensor has failed. Replace the sensor.

SENSOR FAILURE - HEATER. The sensor's temperature control circuit or the monitor's CO_2 circuitry has failed. Try replacing the sensor. If the message reappears, have the monitor serviced.

SENSOR FAILURE - MOTOR DRIVE. The sensor's motor drive (in the sensor head) has failed. Replace the sensor.

SENSOR TEMPERATURE TOO HIGH. The sensor's temperature is too high. The sensor's ambient operating range is 10° to 46° C. When the ambient temperature returns to this range, this message is automatically removed and operation is restored.

The following messages can appear in the numerics display area.

OFF. No CO_2 source is selected.

SRCH. The sensor is preparing for a measurement.

UNCAL. The monitor has detected a problem such as a lack of calibration, an obstruction, or a low battery.

WARM UP. The sensor heater is warming up. Wait 20 to 30 seconds for the sensor to heat. Values should appear in the numerics area when the sensor is sufficiently warm.

Sidestream CO_2 Messages

ALTIMETER FAILURE - RANGE. The Propaq CS monitor is operating at an altitude outside the Sidestream CO_2 option's operating altitude range of -2,000 to 15,000 feet. Returning the monitor to within this range automatically cancels this message and restores operation.

ALTIMETER FAILURE - RATE. The altimeter has detected that the ambient pressure is changing at a rate greater than 100 mmHg / minute. When the rate of change is back within the 100 mmHg / minute range, disconnect and reconnect the CO_2 sensor to the monitor.

ALTIMETER NOT CALIBRATED - EEPROM - The Sidestream CO_2 option has not been calibrated. Refer the Propaq CS monitor to a biomedical engineer for calibration.

AMBIENT TEMPERATURE TOO HIGH. The sensor temperature is too high. The Sidestream CO_2 option is disabed until the ambient temperature is within the operating range specifications.

AMBIENT TEMPERATURE TOO LOW. The sensor temperature is too low. The Sidestream CO_2 option is disabed until the ambient temperature is within the operating range specifications.

CALIBRATION ERROR - SERVICE REQUIRED. Send the Propaq CS monitor to a biomedical engineer for service.

DEGRADED WAVEFORM - SERVICE REQUIRED. Send the Propaq CS monitor to a biomedical engineer for service.

LACK OF WAVEFORM - SERVICE REQUIRED. Send the Propaq CS monitor to a biomedical engineer for service.

MOTOR FAILURE - SERVICE REQUIRED. The sensor hardware has failed. Send the Propaq CS monitor to a biomedical engineer for service.

NO WATERTRAP DETECTED. There is no Sidestream CO_2 watertrap installed. Install a watertrap.

OCCLUSION - CHECK EXHAUST PORT/TUBING. Blockage has been detected on the pneumatic exhaust port. Check the exhaust port and related tubing for occlusions. Make sure that the sampling line and any inputs to the patient breathing apparatus are not connected to the exhaust port.

OCCLUSION - CHECK WATERTRAP/TUBING. Blockage has been detected on the Sidestream CO_2 input. Check the watertrap, sample line, and any connected tubing for occlusion.

PUMP FAILURE, SERVICE REQUIRED. The pump is not able to maintain the target flow rate. Send the Propaq CS monitor to a biomedical engineer for service.

SIDESTREAM STICK EEPROM FAILURE. Send the Propaq CS monitor to a biomedical engineer for service.

SSP BOARD EEPROM FAILURE. Send the Propaq CS monitor to a biomedical engineer for service.

The following messages can appear in the numerics display area.

OFF. No CO_2 source is selected.

SRCH. The sensor is preparing for a measurement.

START UP. Sidestream CO_2 has been activated and is preparing for operation. This typically requires 30 seconds at room temperature.

UNCAL. The monitor has detected a problem such as a lack of calibration, an obstruction, or a low battery.

Network Alert Message with Acuity

NETWORK FAULT, CHECK ACUITY/DATA COMM CONNECTION. The Propaq CS monitor detects a problem in communication with Acuity. Check the Acuity network cable to be sure it is plugged in to the side panel and to the bedside jack. If the cable is damaged, replace the cable. If the cable appears undamaged and the Acuity system is operating normally, ask your service personnel to check the network and the Propaq CS monitor Acuity connector.

Program Alert Message

PROGRAM FAULT, SETTINGS LOST, TIME/DAY RESET. At powerup, the monitor cannot recall the programmed Custom patient mode settings and current time and date. This can occur if the battery is drained or after new software has been installed.

If this occurs, the monitor provides a special sequence of display windows to help you regain use of your monitor as quickly as possible. Do the following:

1. Connect an ac power adapter to recharge the battery (if the battery is drained).
2. Press any key below the equipment alert screen to acknowledge the alert. The monitor displays the Mode Setup window (shown on page 23).
3. Press these keys to select one of the Factory patient modes for use:
   - Factory Adult mode: **POWERUP*, YES.**
   - Factory Pediatric mode: **NEXT, POWERUP*, YES.**
   - Factory Neonatal mode: **NEXT, NEXT, POWERUP*, YES.**

   After you press **YES**, the monitor displays the Time / Day window.
4. Press **NEXT**, **UP**, and **DOWN** as needed to set the time and date. Then press **ENTER** to store the new time and date.
5. Turn off the monitor, then turn it on again so the settings will take effect.

   The monitor is ready for use. To store customized patient mode settings, refer to page 24.

   If you follow these steps and the equipment alert reappears at powerup, the monitor may need to be serviced and the battery replaced. Contact a qualified service person.

Note

These display screens are only displayed in this order if the PROGRAM FAULT equipment alert occurs.

Printer Alert Messages

CHECK DOOR. The door on the bottom of the printer is open. Close the door to remove this message.

LOW BATTERY, PRINTER DISABLED. The monitor's battery voltage is too low to support printing. Connect the ac power adapter to recharge the battery (see page 87).

OVERHEATING. The printer is overheating. Service may be required.

PAPER OUT. To add printer paper, see page 90.

Defibrillator Alert Message

DEFIB FAULT, CHECK INTERFACE CABLE. The monitor detects a problem with the interface cable. Check the cable and defibrillator.

Very Low Battery Alert Message

VERY LOW BATTERY, PLUG IN EXTERNAL POWER ADAPTER. The monitor battery needs to be recharged. Connect the ac power adapter to recharge the battery (see page 87).

If the battery is not recharged, the monitor will begin to disable monitor functions and eventually turn off completely.

5 – Printing & Trends

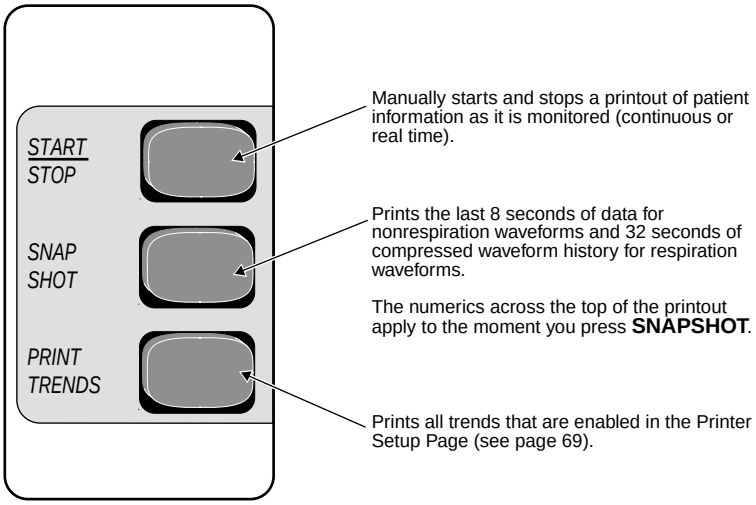
Print Patient Data

Print the Displayed Waveforms

1. Press **SNAPSHOT** or **START/STOP**. The Propaq CS monitor prints up to three of the displayed waveforms.

   When four waveforms are displayed, the monitor prints the top three displayed waveforms (except for the ECG2 waveform which is never printed).

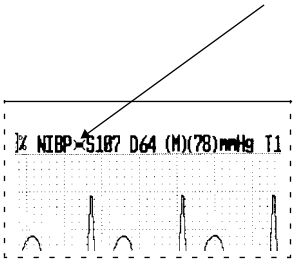
   If you pressed **START/STOP**, the monitor continues to print until you press **START/STOP** again.



Printer Buttons

Note

This symbol indicates the NIBP reading was taken in the presence of high artifact while monitoring ECG with the Smartcuf motion artifact filter on. Artifact can affect accuracy. To help reduce artifact, see page 39, step 6.



Display or Print Trends

Display or Print a Single Trend

1. To display a patient data trend, press **SETUP, TRENDS** from the Main Menu. The monitor displays the Trend Menu:

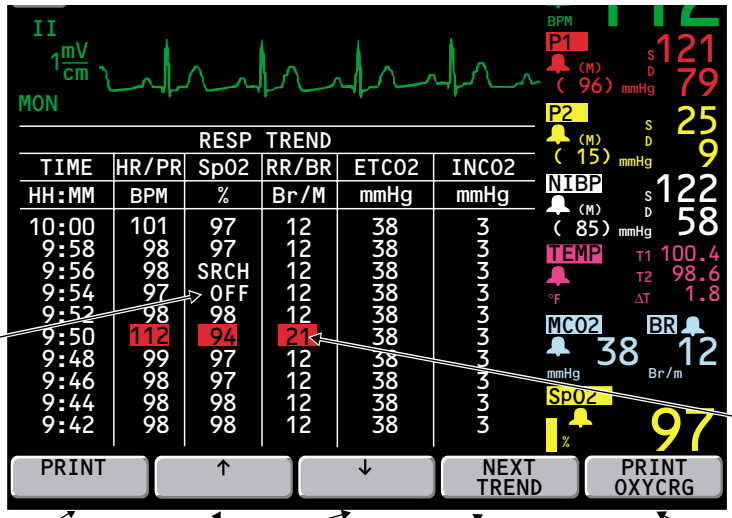
The monitor stores trends every 2 minutes (except for NIBP) for up to 5 hours. After 5 hours, newly recorded trends replace the oldest trends.

NIBP trends are stored when measured. Up to 128 NIBP trends can be stored (up to 8 hours).

The TIME, HR/PR, and SpO2 are stored for all trends.

OFF indicates the vital sign was not being monitored.

ERR#x in an NIBP TREND display or printout indicates an NIBP equipment alert occurred. See page 57 for NIBP alert error numbers and definitions.



Numerics that have alarmed are highlighted.

Press to print the displayed trend.

Press to scroll through the recorded trends.

Press to scroll to the next vital sign trend (IBP, TEMP, and NIBP).

Press to print OxyCRG (see page 71).

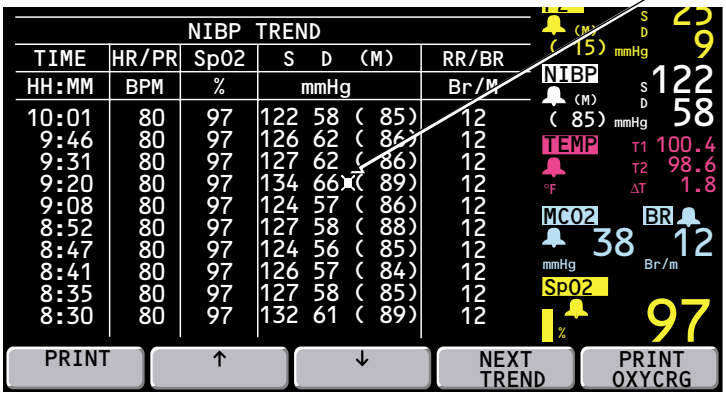
Trends are also displayed on the Main Menu if all waveforms except ECG1 are turned off in the Wave Select Window.

2. Press **NEXT TREND** as needed to display the desired trend.

3. Press **PRINT** to print the displayed trend.

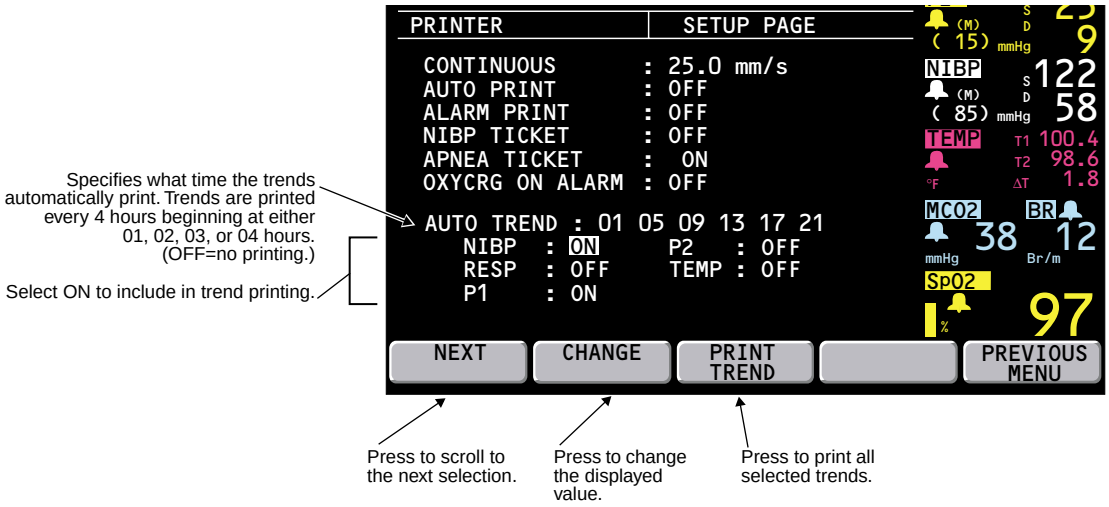
Note

This symbol indicates the NIBP reading was taken in the presence of high artifact while monitoring ECG with the Smartcuf motion artifact filter on. Artifact can affect accuracy. To help reduce artifact, see page 39, step 6.



Print Multiple Trends Manually or Automatically

1. Press **SETUP, MORE, PRINTER** from the Main Menu to display the Printer Setup Page:



2. Press **NEXT** as needed to scroll down to the parameters listed below AUTO TREND (NIBP, RESP, etc.).

3. Press **NEXT** and **CHANGE** to set desired trends to ON.

4. To manually print all selected trends, press **PRINT TREND** on this page or press **PRINT TRENDS** on the bottom front panel of the monitor.

   You can print all selected trends at any time by pressing this **PRINT TRENDS** button.

5. To program the monitor to automatically print selected trends every four hours, press **NEXT** as needed to highlight AUTO TREND, then press **CHANGE** to select the hours for printing.

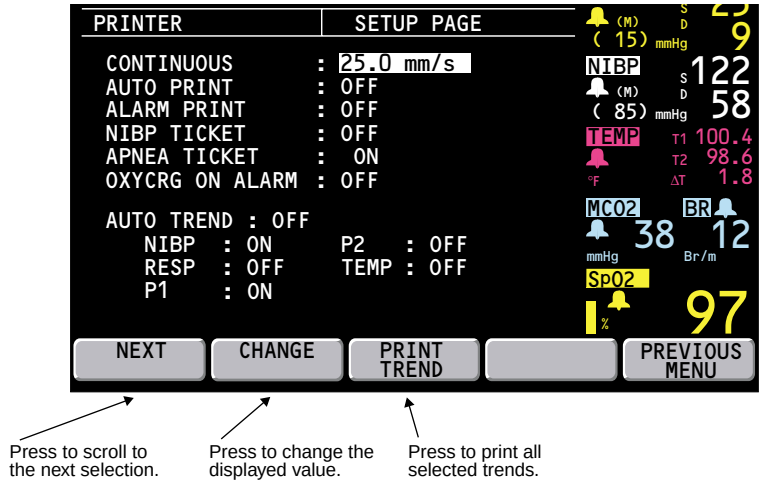
   For example, if you select 01 05 09 13 17 21 at 4:27, the printer will automatically print selected trends first at 5:00, then 9:00, etc.

Delete All Patient Trends

1. To delete all trends recorded for a patient, turn off the monitor.

Set Printer Options and Automatic Printing

1. Press **SETUP, MORE, PRINTER** from the Main Menu to display the Printer Setup Page:



2. Press **NEXT** and **CHANGE** as desired to set printer options.

CONTINUOUS — Set the speed for continuous printing: 6.25, 12.5, or 25.0 mm/s.

AUTO PRINT — Automatically print a waveform snapshot at the specified interval: 15 or 30 minutes, or 1, 2, or 4 hours (or OFF).

ALARM PRINT — If ON, automatically prints patient data whenever a patient alarm occurs, beginning with 12 seconds of patient data history stored before the alarm occurred.

> Printing continues for 20 seconds after you suspend the alarm. To immediately stop printing, press **START/STOP**.

Note

Because the Alarm Print begins with the 12 seconds of patient data stored before the alarm occurred, the monitor stores and prints all Alarm Print data 12 seconds after the patient data appears on the display. The time annotated on the Alarm Print indicates the time the data was recorded.

NIBP TICKET — If ON, automatically prints an NIBP TICKET with NIBP data whenever NIBP is measured.

APNEA TICKET — If ON, automatically prints an APNEA TICKET with apnea data after the patient resumes breathing and/or every minute the apnea alarm continues.

OXYCRG ON ALARM — If ON, automatically prints an OxyCRG whenever an SpO_2, HR/PR, RR/BR, or apnea patient alarm occurs (see page 71).

> If an SpO_2 or HR/PR alarm occurs, the OxyCRG prints 60 seconds later. If an Apnea or RR/BR alarm occurs, the OxyCRG prints 75 seconds later. Highlighted labels in the printout indicate which alarms occurred.

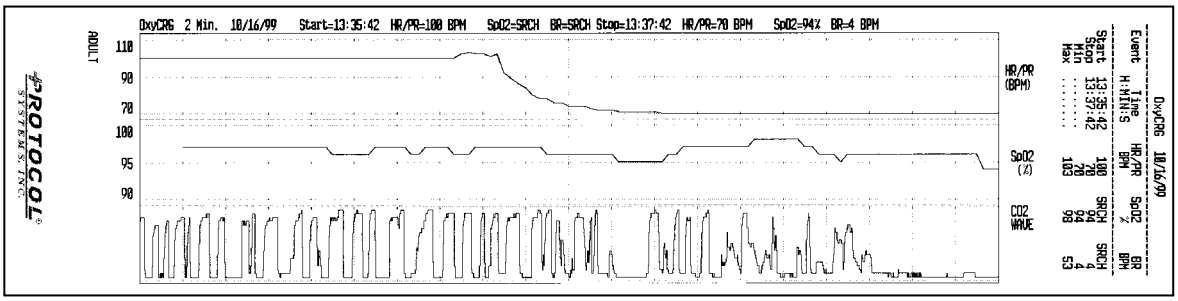
AUTO TREND — Automatically print trends at the selected hours. Only the parameters set to ON (for NIBP, RESP, P1, P2, or TEMP) are included in trend printouts.

Print OxyCRG

The OxyCRG is a printout of two minutes of continuous HR/PR and SpO_2 numerics, and a compressed respiratory waveform.

1. To print OxyCRG, from the Main Menu press **SETUP, TRENDS, PRINT OXYCRG**.

   If any of the parameters have been completely inactive for the two minutes prior to the printout, the associated band is empty.



6 – Acuity

Connect the Monitor to the Acuity System

Warning

Connect the Propaq CS monitor to an Acuity system only. Connecting to other networks could damage the monitor or injure the patient. If in doubt about the network jacks or devices, consult your facility's Biomedical Engineering Department.

Make sure the Acuity network cable is not damaged. The Acuity network cable is the sole link between the Propaq CS monitor and the Acuity Central Station.

If you don't set alarm limits, the Acuity system uses preset settings (for arrhythmia test limits), and the powerup default settings for the Propaq CS monitor.

Use the Acuity System in compliance with the instructions in this *Propaq CS Directions for Use*, the *Acuity System Reference Guide*, and accepted hospital and clinical protocols.

1. If the Propaq CS monitor has already been connected to the patient, save the patient's Trends and Alarm Limit settings by keeping the monitor turned on.

   The monitor transmits up to five hours of trend information when you connect it to the Acuity network.

   If the monitor has not been connected to the patient, clear any prior patient's trends and alarm limit settings by turning off the monitor, then turning it on after a few seconds.

2. If the monitor is not already connected to the patient, attach leads and sensors to the patient as described in this reference guide.

   For neonatal patients, use all Acuity features except the Protocol Cordless Acuity and the ST and arrhythmia detection options.

Caution

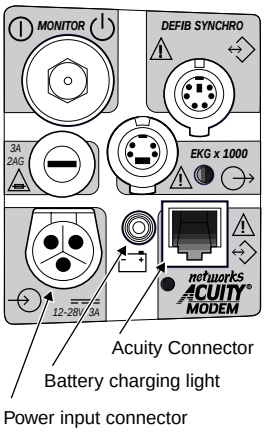
Accessory equipment connected to the analog and digital interfaces must be certified according to the respective IEC standards (e.g., EN 60950 for data processing equipment and EN 60601-1 for medical equipment). Furthermore, all configurations shall comply with the system standard IEC 601-1-1. Anyone connecting additional equipment to the signal input or output connectors is configuring a medical system, and is therefore responsible that the system complies with the requirements of the system standard IEC 601-1-1. If in doubt, consult your Biomedical Engineering Department.

3. Plug in the Acuity network cable to the Acuity network jack on the monitor side panel as shown. Plug in the other end of the cable to the bedside Acuity network jack.

4. Connect the ac power adapter to the monitor and the wall outlet to charge the battery (see page 87 for instructions). Check to see that the green battery charging light on the monitor's right side panel is on.

5. Confirm the patient identification at the bedside or enter the patient information at the Acuity Central Station using the Patient ID Setup Window.

6. If alarm limits have not been set, do so at the monitor or at the Acuity Central Station using the Alarms Setup Window.



Note

When a Propaq CS monitor in Adult or Pediatric Mode is connected to an Acuity System, the audible alarms at the bedside Propaq CS monitor can be delayed up to 4 minutes and 15 seconds. The delay time is selected in Acuity software at the time of Acuity installation. Visual alarm indications are not delayed.

Print at Acuity from the Propaq CS Monitor

1. To print a waveform displayed on the bedside Propaq CS monitor screen at the Acuity printer, press **SETUP**, **ACUITY**, **SNAPSHOT**.

Disconnect the Monitor from the Acuity System

1. To permanently disconnect the Propaq CS monitor from the Acuity network, press the **NET OFF** key on the upper left corner of the monitor display (or from the Main Menu press **SETUP**, **ACUITY**, **NET OFF**).

2. Within 15 seconds, disconnect the Acuity network cable from either the Propaq CS monitor side panel or the bedside jack. If the patient will no longer be monitored with this monitor, turn off the monitor to erase trend information.

   If you want to temporarily disconnect the Propaq CS monitor from the Acuity network and reconnect the same patient to the Acuity network later, see the *Acuity System Reference Guide.*

7 – Defibrillator Synchronization

Synchronous Cardioversion with LIFEPAK 5 Defibrillator

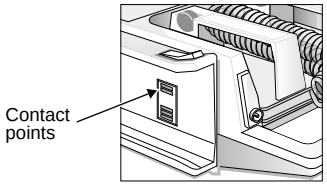
Warning

Use only the correct Protocol Systems cable with the LIFEPAK 5 Defibrillator as listed in the Protocol Systems *Products and Accessories* guide when performing synchronous cardioversion. (This cable contains circuitry in addition to wiring.) The use of any other cable will result in incorrect operation.

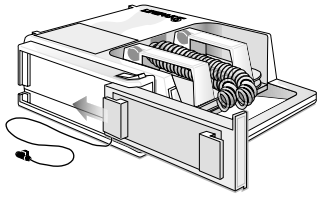
The Defibrillator Synchronization option is designed to operate only with the LIFEPAK 5 or LIFEPAK 6s defibrillator. These instructions are not intended to replace existing hospital procedures for cardiac electrical therapy and operation of the Physio-Control LIFEPAK 5 defibrillator. Follow all safety standards and clinical protocols as defined by your institution.

Install the Interface Cable

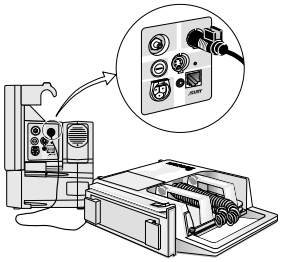
1. Before installing the LIFEPAK 5 Defibrillator Synchronization Interface Cable (P / N 008-0136-XX) on the defibrillator, examine the contacts on the left side of the LIFEPAK 5 defibrillator. Make sure the contacts are clean in order to allow good signal transmission to the Propaq CS monitor.



2. Slide the Interface Cable onto the left side of the defibrillator as shown until it snaps in place.



3. Connect the other end of the Interface Cable to the DEFIB SYNCHRO connector on the monitor right side panel.



Perform Synchronous Cardioversion

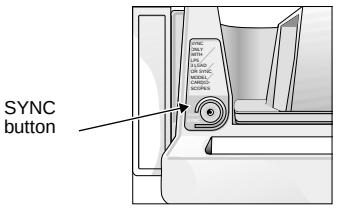
1. Set up the LIFEPAK 5 Defibrillator and any other instrumentation according to institutional procedures and manufacturer's operating instructions.

2. Confirm the monitor displays an ECG waveform with tall, distinct R-waves and minimal artifact.

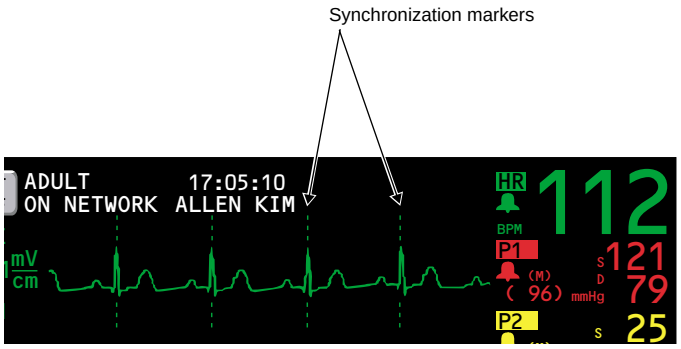
Warning

The R-wave amplitude must be at least 0.5 mV (5 mm tall when the Propaq CS monitor ECG SIZE is set to 1 mV/cm) to guarantee that the defibrillator sync pulse will occur no later than 35 milliseconds after the peak of an R-wave.[1] Reposition the patient electrodes or change the Propaq CS monitor lead selection as necessary to ensure sufficient ECG waveform amplitude. However, make sure the R-wave amplitude is not so high that it obscures the displayed sync markers.

3. With the defibrillator turned on, press the defibrillator SYNC button. Confirm the SYNC button light turns on.



4. Check the monitor display for synchronization markers as shown. The markers should be nearly simultaneous with the R-waves. Confirm the SYNC button also flashes with each R-wave.



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 CS monitor ECG sensitivity set to 1 mV/cm, compare the letter 'V' with the height of the R-wave, which should be at least 5 mm tall.

Warning

If the R-wave synchronization markers do not appear to be nearly simultaneous with the R-waves on the Propaq CS monitor display or are not present, do not proceed with synchronized cardioversion.

You must press the LIFEPAK 5 Defibrillator SYNC button and check for appropriate synchronization markers on the Propaq CS monitor before each attempt at cardioversion. Protocol Systems cannot guarantee the delay from the sync marker to the defibrillator discharge.

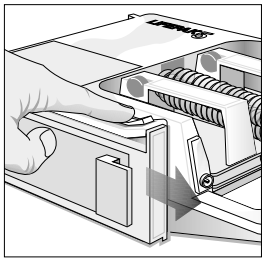
Note

A problem with the Interface Cable connecting the defibrillator and monitor, such as a cable fault or unplugging the cable, will prevent display of synchronization markers and may prevent the defibrillator from entering the synchronized mode.

5. Follow hospital procedures and LIFEPAK 5 Defibrillator instructions for cardioversion.
6. If subsequent cardioversion must be performed, repeat steps 3 through 5.

Remove the Interface Cable

1. Disconnect the Interface Cable from the monitor.
2. Press the lever on the side of the LIFEPAK 5 Defibrillator and slide the Interface forward until it is detached.
3. Store the Interface Cable in its static-protected plastic bag.



Synchronous Cardioversion with LIFEPAK 6s Defibrillator

Warning

Use only the correct Protocol Systems cable with the LIFEPAK 6s Defibrillator as listed in the Protocol Systems *Products and Accessories* guide when performing synchronous cardioversion. (This cable contains circuitry in addition to wiring.) The use of any other cable will result in incorrect operation.

Note

The Physio-Control LP6s Defibrillator Sync Connector/Cover (Physio-Control P/N 801297-00) must be installed before you can connect it to the Propaq CS monitor.

The Defibrillator Synchronization option is designed to operate only with the LIFEPAK 5 or LIFEPAK 6s defibrillator. These instructions are not intended to replace existing hospital procedures for cardiac electrical therapy and operation of the Physio-Control LIFEPAK 6s defibrillator. Follow all safety standards and clinical protocols as defined by your institution.

1. Set up the LIFEPAK 6s Defibrillator and any other instrumentation according to institutional procedures or manufacturer's operating instructions.
2. Confirm the monitor displays an ECG waveform with tall, distinct R-waves and minimal artifact.

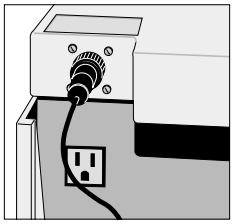
Warning

The R-wave amplitude must be at least 0.5 mV (5 mm tall when the Propaq CS monitor ECG SIZE is set to 1 mV/cm) to guarantee that the defibrillator sync pulse will occur no later than 35 milliseconds after the peak of an R-wave.[1] Reposition the patient electrodes or change the Propaq CS monitor lead selection as necessary to ensure sufficient ECG waveform amplitude. However, make sure the R-wave amplitude is not so high that it obscures the displayed sync markers.

3. Connect the monitor end of the LIFEPAK 6s Defibrillator Synchronization Cable (P / N 008-0154-XX) to the DEFIB SYNCHRO connector on the Propaq CS monitor right side 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 CS monitor ECG sensitivity set to 1 mV/cm, compare the letter 'V' with the height of the R-wave, which should be at least 5 mm tall.

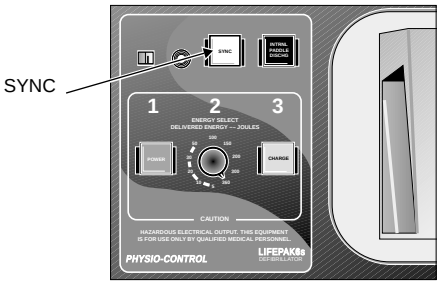
4. Connect the other end of the cable to the SYNC connector at the top rear of the LIFEPAK 6s Defibrillator.



5. With the LIFEPAK 6s turned on, press the SYNC button on the front control panel

   The SYNC button lights when activated.

6. Check the Propaq display for synchronization markers as shown on page 80. The markers should be nearly simultaneous with the R-waves. Confirm that the LIFEPAK 6s SYNC button flashes with each R-wave.



Warning

If the R-wave synchronization markers do not appear to be nearly simultaneous with the R-waves on the Propaq CS monitor display or are not present, do not proceed with synchronized cardioversion.

You must press the LIFEPAK 6s Defibrillator SYNC button and check for appropriate synchronization markers on the Propaq CS monitor before each attempt at cardioversion. Protocol Systems cannot guarantee the delay from the sync marker to the defibrillator discharge.

Note

A problem with the Interface Cable connecting the defibrillator and monitor, such as a cable fault or unplugging the cable, will prevent display of synchronization markers and may prevent the defibrillator from entering the synchronized mode.

7. Follow hospital procedures and LIFEPAK 6s Defibrillator instructions for cardioversion.
8. If subsequent cardioversion must be performed, repeat steps 5 through 7.

8 – Maintenance

Connect the AC Power Adapter to Recharge the Battery

Warning

Use only the Protocol Systems ac power adapter and power cord appropriate for your location and ac power source as listed in the Protocol Systems *Products and Accessories* booklet. Use of other power adapters or power cords could cause a current leakage hazard or damage the Propaq CS monitor.

Place the power adapter where it cannot fall and harm someone.

Caution

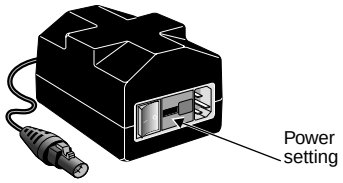
Leaving the monitor's lead-acid batteries in a completely discharged state may result in permanent battery damage. The batteries should be kept fully charged.

When the Propaq CS monitor battery voltage is low, the monitor displays the message LOW BATTERY at the top of the screen or the equipment alert message VERY LOW BATTERY, PLUG IN EXTERNAL POWER ADAPTER. You should connect an ac power adapter as soon as possible to recharge the battery.

If the battery is not recharged, the monitor will begin to disable monitor functions and eventually turn off completely.

1. Before connecting the ac power adapter, check the adapter power setting in the small window next to the power cord connector. Make sure the setting matches your ac power source (either 100V-120V or 200V-240V).

   If it does not match, send it to your service department.



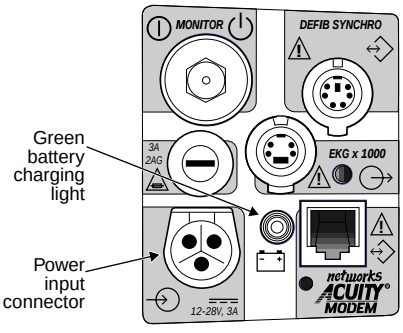
2. Plug the ac adapter power cord into the ac power adapter and the ac power source outlet.

3. Plug the ac adapter cord into the power input connector on the right side of the monitor.

4. Confirm that the green battery charging light is on. The ac power adapter charges the battery even when monitor power is off. If monitor power is off, the battery charges to full capacity within 8 hours.

   If the green light is not on, check all connections and make sure the ac power source is on.

   If the green light is still not on, fuses may need replacement in the ac power adapter or the monitor. Contact your service department.

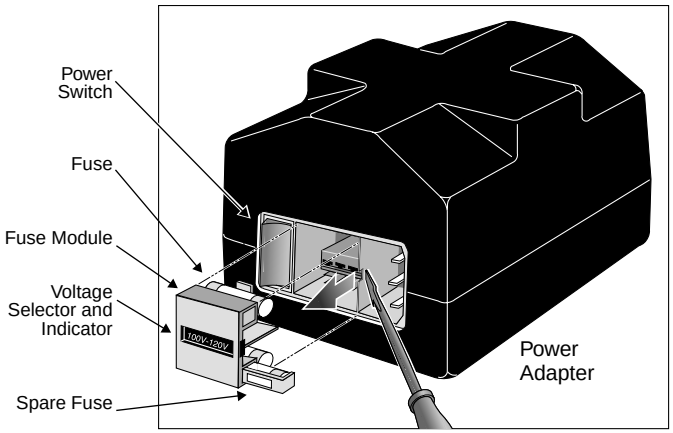


Right Side Panel

Replace Power Adapter Fuses

If the green battery charging light is off and the ac power adapter does not provide power to the monitor even when all connections are intact, the adapter fuses may need to be replaced. This procedure must be performed by a qualified service person. To change fuses:

1. Unplug the removable power cord from the ac power source and adapter.
2. Using a small, flat-blade screwdriver, carefully pry the fuse module away from the adapter.
3. Remove and replace both fuses with the correct type specified on the adapter. The fuse module can contain spare fuses.



Note

Replace both fuses at the same time, even if only one fuse has opened due to an overcurrent situation. The unopened fuse may be damaged and unreliable.

Caution

Spare fuses are contained in housings next to the fuses in the fuse module as shown in the illustration. Between the fuses is a small printed-circuit board (PCB) that sets the power adapter to the desired ac mains voltage. When handling the fuse module, the PCB may slide out.

Make sure the voltage selector indicates the proper ac input voltage. If you change the adapter voltage setting, you must replace all fuses to match the appropriate type specified on the bottom of the power adapter. The only fuses contained in the power adapter when shipped from the factory are fuses specified for the original adapter input voltage setting.

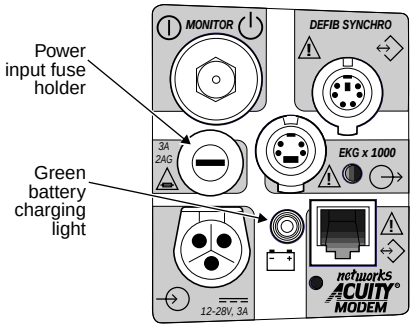
Replace each fuse only with the specified type (see page 114).

If the small PCB between the fuses has slipped out of place, slide it back into place in the fuse module, and verify that the voltage setting indicated in the window on the fuse module is correct. If the voltage setting is incorrect, simply slide the PCB out of the fuse module, rotate it 180° and slide it back into place.

Replace Monitor Input Power Fuse

If the green battery charging light is off and the ac power adapter does not provide power to the monitor even when all connections are intact, the monitor's input power fuse may need to be replaced. This procedure must be performed by a qualified service person. To change fuses:

1. Disconnect the monitor from the patient and turn off the monitor.
2. Disconnect the ac power adapter from the monitor.
3. Using a small, flat-blade screwdriver, turn the fuse carrier counterclockwise to release it.
4. Remove the fuse carrier and replace the fuse with the type 3A / 250V, 2AG.



Right Side Panel

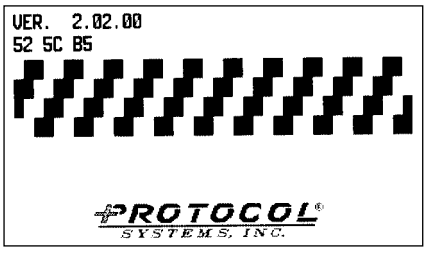
Install Printer Paper

Caution

Use only low-debris printer paper listed in the Protocol Systems *Products and Accessories* booklet. Use of other paper can cause unclear printing of patient data, printhead damage, and eventual printer failure. Store all paper (including a monitor loaded with paper) in compliance with paper storage specifications (see page 113).

1. Lay the monitor on its back to gain access to the bottom of the printer.
2. Squeeze the locks on the paper door and pull out to open it.
3. Lift the paper roll from the holder and pull out any paper remaining in the printer.
4. Place the new paper roll onto the spindle on the door as shown, and pull out several inches of paper.

5. Slide the end of the paper into the printer slot until it extends out the side.
6. Close the paper door and turn the monitor upright.
7. Simultaneously press the **START/STOP** and **PRINT TRENDS** button. Confirm the monitor prints a test print similar to the following:



Inspect and Clean the Monitor and Accessories

Before cleaning, thoroughly inspect the monitor and all accessories for any signs of damage, cracks, or improper mechanical function of keypads, switches, connectors, and printer paper door. While gently bending and flexing cables and tubing, inspect for damage, cracks, cuts, abrasions, extreme wear, exposed wires or bent connectors. Confirm connectors securely engage. Report damage or improper function to your service department.

Equipment	Cleaning Instructions	Approved Cleaning Solutions[1]
Propaq CS Monitor[2]	• Wipe with a nearly-dry cloth moistened with cleaning solution. • Thoroughly wipe off any excess cleaning solution. Do not let water or cleaning solution run into connector openings or crevices.[3]	Warm water Liquid soap Wex-cide®[4] T.B.Q.®[4] Cidex® Ovation® Coverage® Fantastik® Formula 409® Windex® Hydrogen peroxide solution
NIBP cuff	• Wipe gently with cloth dampened with cleaning solution. • Thoroughly wipe off excess cleaning solution. To avoid harming cuff function, do not let water or cleaning solution enter cuff tubing.	Common hospital disinfectants, including Cidex, Clorox® liquid bleach (1:10 solution of Clorox/water), isopropyl alcohol, Lysol® solution, Phisohex®, Quatricide®, Virex® and Vesphene®
Cables, tubing, CO_2 sensor[5]	• Wipe gently with cloth dampened with cleaning solution. Do not immerse the CO_2 sensor in liquid.	Mild detergent solution; also consult manufacturer's instructions.
Nellcor cables, Durasensor oxygen transducers	• Wipe gently with cloth dampened with isopropyl alcohol.	Isopropyl alcohol
Other accessories	• Consult manufacturer's instructions.	Consult manufacturer's instructions.

1. **Do not use these cleaning solutions (they may damage the monitor):** Butyl alcohol, Denatured ethanol, Freon™, Mild chlorine bleach solution, Isopropyl alcohol, Trichloroethane, Trichloroethylene, Acetone, Vesphene II, Enviroquat®, Staphene®, Misty®, Glutaraldehyde.

2. The monitor may be disinfected to comply with OSHA requirements for cleaning and decontaminating spills of blood and other body fluids. (Federal OSHA Standard on bloodborne pathogens: 29 CFR 1910.1030, 12/6/91.)

3. If liquid gets into the right side panel connectors, it will drain out. If moisture gets into a left side panel connector, dry the connector with warm air, then check the monitoring functions for proper operation.

4. **Wex-cide** (Wexford Labs, Inc., Kirkwood, MO) and **T.B.Q.** (Calgon Vestal Lab., Calgon Corp., St. Louis, MO) are disinfectants that meet OSHA requirements, are EPA approved, and will not harm the outside of the monitor. Wipe away disinfectants with a water-dampened cloth after the manufacturer's recommended period of time.

5. The Mainstream CO_2 sensor may also be disinfected with Wex-cide. Follow the disinfectant manufacturer's instructions. Do not leave Wex-cide on sensor longer than 30 minutes. Thoroughly clean off residue with water-dampened cloth. Prolonged exposure of the sensor to Wex-cide will damage the sensor.

Caution

Do not autoclave the Propaq CS monitor or its accessories. Do not immerse the monitor in liquid when cleaning. Do not immerse accessories in liquid when cleaning unless the accessory manufacturer's cleaning instructions explicitly instruct you to do so.

Service Interval Recommendations

At the intervals recommended below, qualified biomedical service personnel should service the Propaq CS monitor. Service information is described in the *Propaq CS Service Manual* (P / N 810-1101-XX).

Recommended Interval[1]	Service Action
Six months to two years	• Complete functional verification; see *Propaq CS Service Manual* • Inspect the monitor for mechanical and functional damage • Inspect safety labels for legibility • Inspect the side panel fuse for compliance to specified rating • Verify that visual and acoustic alarms are functioning properly • Test patient leakage current according to IEC 601-1/1988 • Test patient leakage current with mains voltage on patient-applied parts according to IEC 601-1/1988: limit 50µA[2]
Minimum every three years	• Check battery capacity

1. More frequent service may be needed in extreme environments (heat, cold, dust, etc.).
2. The leakage current should never exceed the 50µA limit. The data should be recorded in an equipment log. If the device is not functioning properly or fails any of the above tests, do not attempt to repair the device. Please return the device to the manufacturer or to your distributor for any required repairs.

Monitor Recycling

You can return a Propaq CS monitor to Protocol Systems for recycling when the monitor reaches the end of its life.

Battery Recycling

When the monitor's internal lead-acid battery reaches the end of its life, recycle the battery locally according to national, state, and local regulations. You can also return the battery to Protocol Systems for recycling.

Extended Storage Precautions

Caution

If a Propaq CS monitor has a battery installed or ac power connected and is stored for an extended period of time without use, the printer paper can cause damage to the printhead. Before storing a Propaq CS monitor for more than two months without use, remove the roll of printer paper.

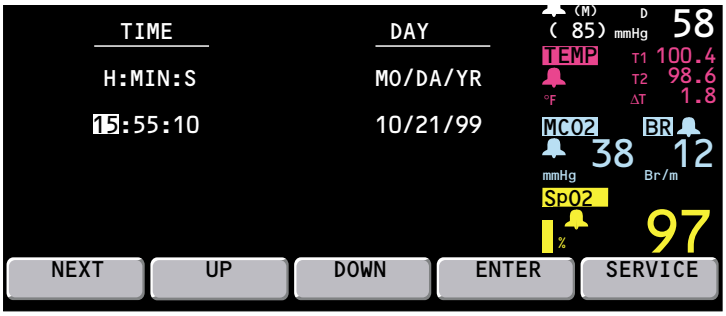
Storing the Propaq CS monitor for extended periods (more than three months) without being connected to the ac power adapter can cause damage to the battery. Even when the monitor is turned off, a very small amount of current is drawn from the battery. For long-term storage, remove the battery from the monitor. Battery removal is described in the *Propaq CS Service Manual.*

Removing the battery will erase all stored Custom patient mode settings. See page 24 to reprogram Custom patient mode settings.

9 – Reference

Set the Time and Date

1. From the Main Menu press **SETUP, MORE, MORE** to display the Time / Day window:



2. Press **NEXT, UP,** and **DOWN** as needed to set the time and date. Then press **ENTER** to store the new time and date.

Time/Day Settings and Trends

Warning

Changing the hour/minute/second setting for the monitor in the Time/Day window can cause the monitor to erase previously stored patient trend data.

When you change the hour / minute / second setting for the monitor in the Time / Day window, the monitor deletes any patient trend data that is older than five hours for non-NIBP trends or older than eight hours for NIBP trends according to the new clock setting.

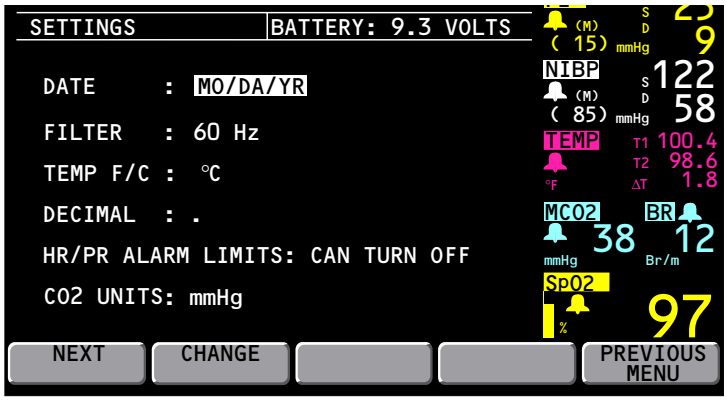
However, if the monitor has not yet stored the full capacity of trends and you change the hour / minute / second setting to a time that is within the stored trend period, previously stored trends are not erased.

Changing the day, month, or year setting does not affect the stored patient trends.

Change the Date Format, ECG Filter, and Units

1. Make sure you are in the Adult patient mode (from the Main Menu press **SETUP**, **MORE**, **CHANGE**, **ADULT**, **YES**).

2. From the Main Menu press **SETUP**, **MORE**, **MORE**, **SERVICE**, **YES** (to access the Service Menu), **MORE**, **MORE**, **SETTINGS**. The monitor displays the Settings window:



3. Press **NEXT** and **CHANGE** to select the desired settings.

DATE	Sets the date format: Month / Day / Year, Day.Month.Year, or Year / Month / Day.
FILTER	Sets the ECG filter frequency: 60 Hz, 50 Hz, or OFF. Make sure it is set to your ac mains frequency.
TEMP F/C	Sets the temperature display units: Fahrenheit or Celsius. Changing units does not erase the TEMP trends.
DECIMAL	Sets the decimal character as either a period (.) or a comma (,).
HR/PR ALARM LIMITS	Allows or prohibits turning off the HR / PR alarm limits. If CANNOT TURN OFF is selected, the **ON/OFF** key is not displayed for HR / PR in the Alarm Limits Menu.
CO2 UNITS	Sets the CO_2 display units as mmHg, kPa, or percent (%).

Changing units erases the CO_2 trends and changes CO_2 alarm limit settings to the factory default settings for the currently-used patient mode.

Note

Any time you change the Date, Filter, Temp F/C, Decimal, HR/PR Alarm Limits (CAN or CANNOT TURN OFF), or CO_2 Units setting, the new setting also becomes the powerup default setting.

Factory Default Settings

The monitor is shipped from the factory with these preset default settings. For information about how to customize your monitor settings, see page 23.

Factory Default Settings

Setting	Factory Default
Date[1]	MO/DA/YR. This setting is automatically updated whenever it is changed during use (continuously programmed).
Decimal[1]	. (Period) This setting is automatically updated whenever it is changed during use (continuously programmed).
HR/PR Sweep	25 mm/s
RR/BR Sweep	6.25 mm/s
Alarm Tone	MEDIUM
HR/PR TONE	LOW
HR/PR SOURCE	ECG
RR/BR Source	CO_2 if available or ECG (not programmable)
Patient Mode	Adult
Display Brightness	Normal
ECG Bandwidth	Monitor
ECG Size	1 mV/cm
ECG1 Lead	II
ECG2 Lead	V
ECG Filter[1]	60 Hz. This setting is automatically updated whenever it is changed during use.
ECG Pacer	ON
RESP size	2X
RESP lead	Ld2
RESP sweep	6.25 mm/s
RESP monitoring	ON
RESP window	ON
IBP Range	0 to 180 mmHg
IBP Rescale	0 to 140 mmHg (not programmable)
IBP Mode	RESCALE
Invasive Pressure Formats	Label dependent
NIBP Mode	MANUAL
NIBP Auto Time	15 min
NIBP Smartcuf	ON
SpO_2 SIZE	2x
SpO_2 C-LOCK	OFF
SpO_2 Response	NORMAL
TEMP F/C[1]	Celsius
CO_2 Range	0 to 60 mmHg
CO_2 Sweep	6.25 mm/s
CO_2 Response	NORMAL
CO_2 Units[1]	mmHg
CO_2 Gas Compensation	OFF
Sidestream CO_2 Flow Rate	Adult: 90 ml/minute Ped: 90 ml/minute Neonate: 90 ml/minute (The flow rate cannot be programmed to a different value in a Custom Patient Mode, see page 23.)
Display Wave Select	Adult and Pediatric Patient Mode: ECG1, ECG2, P1, P2, and CO_2 = ON, and large NIBP numerics are displayed (in order of priority); SpO_2 and RESP = OFF. Neonatal Mode: all waveforms are ON and large NIBP numerics are displayed (in order of priority).

Factory Default Settings (Continued)

Setting	Factory Default
Trend Group	NIBP
Alarm Limits	All are ON except P2
HR/PR Alarm Limits[1]	CAN TURN OFF
HR Limits	Adult: 50, 120 beats per minute Ped: 50, 150 beats per minute Neonate: 100, 200 beats per minute
NIBP Limits - Systolic	Adult: 75, 220 mmHg Ped: 75, 145 mmHg Neonate: 50, 100 mmHg
NIBP Limits - Diastolic	Adult: 35, 110 mmHg Ped: 35, 100 mmHg Neonate: 30, 70 mmHg
NIBP Limits - Mean	Adult: 50, 120 mmHg Ped: 50, 110 mmHg Neonate: 35, 80 mmHg
P1, P2 Limits - Systolic	Adult: 75, 220 mmHg Ped: 75, 145 mmHg Neonate: 50, 100 mmHg
P1, P2 Limits - Diastolic	Adult: 35, 110 mmHg Ped: 35, 100 mmHg Neonate: 30, 70 mmHg
P1, P2 Limits - Mean	Adult: 50, 120 mmHg Ped: 50, 110 mmHg Neonate: 35, 80 mmHg
SpO_2 Limits	Adult: 90%, 100% Ped: 90%, 100% Neonate: 85%, 98%
RR/BR	Adult: 5, 30 Br/M Ped: 10, 45 Br/M Neonate: 10, 75 Br/M
TEMP Limits	35.0°, 37.8° C
ΔT Limits	0.0°, 2.8° C
$ETCO_2$ Limits	25, 60 mmHg (3.0 and 8.0 for % and kPa)
$INCO_2$ Limits	N/A, 5 mmHg (0.7 for % and kPa)
Apnea Delay	Adult/Ped: 20 seconds Neonate: 15 seconds
Printer Settings	
Printer Alarm Print	OFF
Printer Auto Print	OFF
Printer NIBP Ticket	OFF
Printer Apnea Ticket	ON
Printer Print Speed	25 mm/s
Printer Auto Trend	OFF
Printer Trend Selections	NIBP and P1 = ON; all others = OFF
Printer OxyCRG on Alarm	OFF

1. Any time you change the Date, Filter, Temp F/C, Decimal, HR/PR Alarm Limits (Can or Cannot Turn Off) or CO_2 Units setting, the new setting also becomes the powerup default setting.

Specifications

ECG Specifications

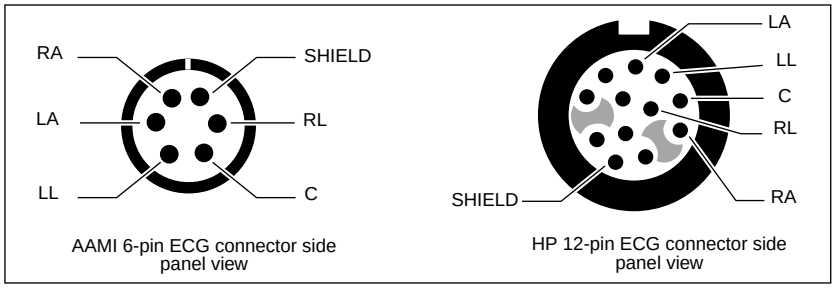
The ECG channel meets all the requirements for Cardiac Monitors Heart Rate Meters and Alarms specified ANSI / AAMI EC13-1992, except for Standardizing Voltage (section 3.2.9.9). The channel also meets the American National Standard, Safe Current Limits for Electromedical Apparatus (ANSI / AAMI ES1-1993).

ECG Specifications

Characteristic	Specification
Connector	AAMI 6 pin or Hewlett-Packard compatible 12-pin style connector (optional). See illustration on page 100.
Selectable Leads	I, II, III, aVR, aVL, aVF, V
Lead Fault Indicator	LA, LL, RA, RL, C, multiple
ECG Size (sensitivity) in mV/cm	4, 2, 1, 0.5, 0.2
Display Sweep Speeds	12.5, 25, and 50 mm/s
QRS Tone Volume	High, Low, Medium, Off
QRS Tone Frequency	900 Hz for Propaq CS monitor without Expansion Module, 665 Hertz when equipped with SpO2 but SpO2 not being monitored; variable pitch with SpO_2 option and SpO_2 being monitored
Bandwidth: MONITOR	Adult Mode: 0.5 to 40 Hz Pediatric Mode: 0.5 to 120 Hz Neonatal Mode: 0.5 to 120 Hz
EXTENDED	Adult Mode: 0.05 to 40 Hz Pediatric Mode: 0.05 to 120 Hz Neonatal Mode: 0.05 to 120 Hz (see Real-Time ECG Analog/Defib Sync specification)
Sample Rate	364 Hz
Input Protection	Electrosurgery and defibrillator protected when used with specified ECG cables. All models also include electrosurgery interference suppression.
Lead Fail Sense Current	50 nA dc for active leads 100-200 nA dc for driven lead, depending on number of electrodes attached
Tall T-wave Rejection	Meets AAMI (USA) EC13-1992, section 3.1.2.1.c, 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, 200 pF source impedance, input unbalanced, FILTER function OFF <0.1 mV p-p RTI for 10V rms, 50/60 Hz input, 200 pF source impedance, input unbalanced, FILTER function ON
Input Impedance	>2.5 MΩ differential @ 60 Hz
Input Range (ac)	10 mV peak to peak
Input Range (dc)	Up to ±300 mV
System Noise	≤30 µV peak-to-peak, RTI, with all inputs = 47K in parallel with 0.047 µF.
QRS Detector	Adult or Pediatric Amplitude Range: 0.22 to 5.0 mV (RTI) Neonatal Amplitude Range: 0.1 to 5.0 mV (RTI) Neonatal and Pediatric Width Range (Duration): 40 to 120 ms Adult Width Range (Duration): 70 to 120 ms
Heart Rate Range	25 to 350 beats per minute (measurement) 25 to 300 beats per minute (display)
Heart Rate Meter Response Time	Responds to change in heart rate within 5 to 9 seconds depending on physiological waveform. (As measured per AAMI standard EC 13-1992 clause 4.1.2.1 (f), including 3.1.2.1 parts f. and g. waveforms.) Includes 1 second readout update interval.

ECG Specifications (Continued)

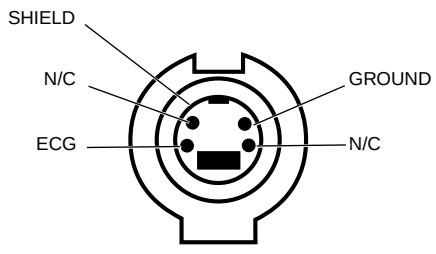
Characteristic	Specification
HR Accuracy	±3 beats per minute or 3%, whichever is greater NOTE: AAMI Test 4.1.4 part f: Accuracy is affected (i.e., rate drops) when QRS and pacer spikes are nearly simultaneous as occasionally is the case during this AAMI test.
Heart Rate Averaging Method	Heart rate = 60 / latest average interval in seconds. For higher heart rates, latest average interval = 7/8 of previous average interval + 1/8 of latest interval. For lower heart rates, latest average interval = 3/4 (previous average interval) + 1/4 latest interval. Transition rates for choice of formula include hysteresis and are 70 and 80 beats per minute.
Drift Tolerance (AAMI Specification EC13-1992, 3.2.6.3)	80 beats per minute indicated for 80 beats per minute ECG plus drift waveform
Pacer Display	Pacer indicator shown on screen if PACER function turned on; pacer spike always shown if of sufficient amplitude.
Pacer Pulse Rejection	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. Will not count as heartbeats approximately 95% of pacemaker pulses within pacer detection range, with or without AAMI (EC13 1992) tails of 4, 25, 50, 75, or 100 ms decay time constant, whose tail amplitudes are 2.5% or 25%, 2mV maximum, whether ventricular only, or A-V sequential pulses, all per AAMI tests 3.1.4.1 and 3.1.4.2
Response to Irregular Rhythm (AAMI specification EC13-1992, 3.1.2.1. Part e.)	
Ventricular Bigeminy (VB)	78 to 81 bpm (80 bpm expected)
Slow Alternating VB	57 to 65 bpm (60 bpm expected)
Rapid Alternating VB	118 to 123 bpm (120 bpm expected)
Bidirectional Systole	88 to 93 bpm (90 bpm expected)
1mV Ventricular Tachycardia	197 to 198 bpm (206 bpm expected)
2mV Ventricular Tachycardia	193 to 197 bpm (206 bpm expected)



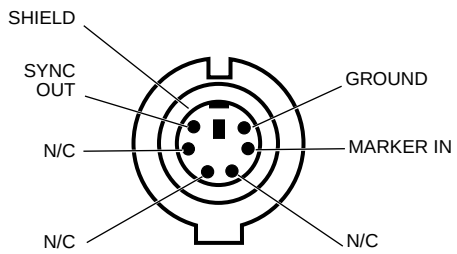
Real-Time ECG Analog/Defib Sync Specifications

Special cables are required to interface the defib sync connector to a Physio-Control LIFEPAK 5 or LIFEPAK 6s defibrillator. The sync and real-time ECG outputs do not operate during in-service mode.

Signal	Specification
Sync Output	0 to 5 V pulse, 100 ±5 ms wide, starts within 35 ms after peak of R-wave. 15 mA short circuit current.
Real-time ECG Output	Range = ±6 V minimum, centered about 0 V, Gain = 1000X, noninverting for lead II, inverting for all other leads, delay <3 ms, 0.05-100 Hz, going to -5.9 V ±5% during ECG lead fail. V lead has no Real-Time analog output.
Marker Input (Defib Sync only)	Normally 0 V in, a pulse either ±3 to ±15 V for 10-70 ms puts a marker in ECG trace. ~ 5 kΩ input resistance.
Shield	Common terminal for other signals



Real-time ECG Output connector side panel view



Defib Sync connector side panel view

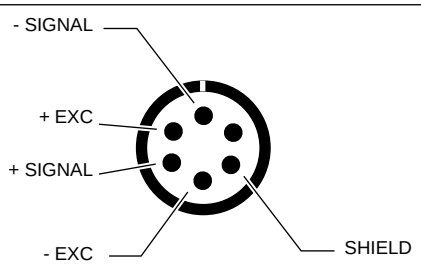
Impedance Pneumography (RESP) Specifications

Characteristic	Specification
Sweep speed	3.13, 6.25, 12.5 mm/s; user-selectable
Amplitude range	1x, 2x, 4x, 8x, 16x
Excitation signal characteristics	65 µA RMS ±5% at 63.0 kHz pseudo sine wave
Sensing electrodes	User selectable RA-LA or RA-LL
Base impedance (in addition to 1kΩ resistors in ECG cables)	100 to 1200 ohms is normal monitoring range, approx. 1200-1500 ohms range produces a “NOISY SIGNAL, CHECK ELECTRODES” equipment alert. Above approx. 1500 ohms produces a “RESP FAULT, LEAD FAIL” equipment alert. Thresholds are dependent on ECG cable type.
Impedance dynamic range	20 ohms
Signal bandwidth after detection	0.06 Hz (single pole) to 3.2 Hz (2 pole)
Breath detection threshold	140 milliohms or 2x CVA, whichever is greater
Respiration rate range	Adult/Ped: 0 (apnea), 2 to 150 breaths/min Neonate: 0 (apnea), 3 to 150 breaths/min
Respiration rate accuracy	±2 breaths/min or ±2%, whichever is greater
Respiration rate source (RR)	When CO_2 is active, CO_2 is the BR source. Otherwise, RESP from ECG is the RR source.
Apnea alarm delay accuracy	+1 second
Resolution	5 seconds
Apnea alarm delay settings	Central apnea only - alarm delay is set by the user Adult/Ped = 6, 10, 15, 20, 25, 30 seconds Neonate = 6, 10, 15, 20 seconds
Cardiovascular artifact rejection (CVA)	Presence of CVA is detected automatically. Breaths will be picked in the presence of CVA unless the Breath Rate is within 5% of the Heart Rate or a sub-multiple of the heart rate.
Motion artifact rejection	not rejected
Obstructive apnea	not detected

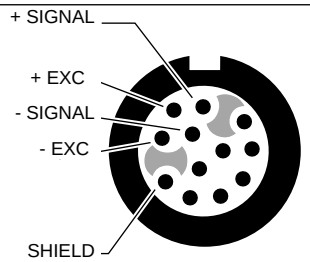
Invasive Pressure Specifications

Characteristic	Specification
Transducer Type	Strain-gauge resistive bridge, or HP quartz (with HP Option). [1]
Transducer Excitation Impedance Range	200 to 2000 Ω
Transducer sensitivity	5 µV/V/mmHg
Excitation Voltage	4.85 V Pulsed dc @ 181 Hz [2]
Connector	ITT-Cannon plug MS3106F-14S-6P Std. Hewlett-Packard compatible 12-pin connector (optional).
Bandwidth	Digital filtered, dc to 20 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 beats per minute
Leakage Current	Meets ANSI/AAMI risk (leakage) requirements
Electrosurgery interference suppression	Included in all models

1. Transducers with 40 µV/V/mmHg sensitivity are not compatible.
2. Duty factor depends on transducer impedance. For 200 to ~900 Ω, duty factor is ≈ 11%. Above ~900 Ω, the duty factor increases to ≈ 91%.



Standard 6-pin IBP connector side panel view



HP 12-pin IBP connector side panel view

NIBP 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
Systolic Range	Adult: 30 to 260 mmHg Ped: 30 to 160 mmHg Neonate: 25 to 120 mmHg
Diastolic Range	Adult: 20 to 235 mmHg Ped: 15 to 130 mmHg Neonate: 10 to 105 mmHg
Mean Range	Adult: 20 to 255 mmHg Ped: 15 to 140 mmHg Neonate: 10 to 110 mmHg
Static Manometer Accuracy	±3 mmHg
Minimum Inflation Pressure	Adult: 100 mmHg Ped: 80 mmHg Neonate: 50 mmHg
Maximum Allowable Pressure	Adult: 270 mmHg Ped: 170 mmHg Neonate: 132 mmHg
Default Inflation Pressure	Adult: 160 mmHg Ped: 120 mmHg Neonate: 90 mmHg
Normal Overpressure Limit (results in up to 2 retries)	Adult: 280 mmHg Ped: 200 mmHg Neonate: 141 mmHg
Single Fault Overpressure Limit	Adult: 308 mmHg Ped: 220 mmHg Neonate: 154 mmHg
Leak Rate	After a 1 minute settling period, leak rate is ≤4 mm/Hg over a 3-minute period at 270 mm/Hg.
Pulse Rate Range	30 to 220 beats per minute
Maximum Determination Time (with retries)	Adult: 4.5 minutes Ped: 4 minutes Neonate: 3 minutes
Maximum Determination Time (no retries)	Adult: 3 minutes Ped: 2 minutes Neonate: 1.5 minutes
Typical Determination Time without Artifact	30 to 45 seconds
Minimum Time between automatic measurements	30 seconds (Auto Mode) 2 seconds (Turbo Mode)
Artifact Filtering	Smartcuf software algorithm (may be be enabled or disabled; requires ECG monitoring). NIBP measurements can still be taken if Smartcuf is disabled.
Electrosurgery Interference Suppression	Included in all models.
NIBP Performance	Per EN 1060-1, EN 1060-3 and ANSI/AAMI SP10-1992
NIBP Safety	Per EN 60601-2-30

Temperature Specifications

Characteristic	Specification
Range	0° to +50°C; 32° to +122°F
Displays	T1, T2, and ΔT
Probes	Compatible with YSI Series 400 and 700 probes. HP side panel only compatible with YSI 400 and has HP connector.
Units	°C and °F selectable
Channel Accuracy	Temperature Range — Tolerance 0° to +10°C — ±0.2°C >10° to +50°C — ±0.1°C +32° to +50°F — ±0.4°F >50° to +122°F — ±0.2°F
Resolution	0.1°C or °F
Electrosurgery interference suppression	Included in all models.

Pulse Oximetry (SpO_2) Specifications

Characteristic	Specification
Range	0% to 100%
Probe Accuracy (specified at 28° to 42° C)	Adults: 70% to 100% ±2 digits 50% to 69% ±3 digits 0% to 49% unspecified Pediatrics: 70% to 100% ±3 digits Neonates: 70% to 95% ±3 digits
Pulse Rate Range	25 to 250 beats per minute
Pulse Rate Accuracy	±3 beats per minute or 3%, whichever is greater
Sensor Compatibility	Compatible only with NELLCOR sensors listed in the Protocol Systems *Products and Accessories* booklet.
Electrosurgery interference suppression	Included in all models.
Alarm Hold-Off Time Period	10 seconds; reset if the sensor reports levels within limits before 10 seconds elapses.

Capnography (CO_2) Specifications

General CO_2 Specifications (Mainstream CO_2 and Sidestream CO_2)

Characteristic	Specification
CO_2 Display	
Screen Display	CO_2 waveform and $ETCO_2$ and $INCO_2$ (when in alarm) numerics
Numeric Display Ranges	$ETCO_2$: 0-99 mmHg, 0-13.2 kPa, 0-23.1% $INCO_2$: 8[1]-25 mmHg, 1.1[1]-5 kPa, 1.1[1]-5%
Waveform Scale (Maximum)	0-100 mmHg, 0-14 kPa, 0-14%
Units	mmHg, kPa,%; user-selectable
Sweep Speed	3.13, 6.25, 12.5 mm/s; user-selectable
Response Modes	**Fast**: 15 s sampling time period **Normal**: 30 s sampling time period **Slow**: 45 s 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%:** CO_2 value = calculated CO_2 value x 0.952
Alarm Limit Ranges	$ETCO_2$: 0-99 mmHg, 0-13.2 kPa, 0-13.2% $INCO_2$: 2-25 mmHg, 0.2-5 kPa, % (no lower limit)
Resolution	1 mmHg
Accuracy	**Mainstream[2]:** 0-30 mmHg, ±3 mmHg 31-99 mmHg, ± 10% of value **Sidestream[3]:** 0-30 mmHg, ±3 mmHg 31-99 mmHg, ± 10% of value
Altitude Error	±0.4%/1,000 ft (304.8 m)
Breath Rate Display	
Screen Display	Numeric
Breath rate (BR) source	When CO_2 is active, CO_2 is BR source. Otherwise, RESP from ECG is RR source.
Units	Breaths/Minute
Range	Adult/Ped: 0 (apnea), 2 to 150 breaths/min Neonate: 0 (apnea), 3 to 150 breaths/min
Resolution	±1 breaths/min
Accuracy	±1 breaths/min or ±5%, whichever is greater[4]
Alarm Limits Range	Adult/Ped: 2 to 150 breaths/min Neonate: 3 to 150 breaths/min
Apnea Alarms and Tickets	
Apnea Ticket	Set to auto print after apnea event and after 1 minute continued apnea
Apnea Alarm Accuracy	± 2 s
Apnea delay setting	Adult/Ped = 6, 10, 15, 20, 25, 30 seconds Neonate = 6, 10, 15, 20 seconds
Barometric Pressure	
Pressure Compensation	Automatic
Operating Range	-2,000 to 15,000 ft (-610 to 4572 m) 817 to 429 mmHg
Screen Display	Numeric (CO_2 Status Window)
Units	mmHg, kPa, or %
Accuracy	±3 mmHg or 2.5% of difference from calibration pressure, whichever is greater
CO_2 Performance	
Specification	Per ISO 9918:1993 (E) / EN 864:1996

1. Lower if in alarm.

2. Based on these airway conditions: sensor temperature = 42°C, airway adapter temperature = 33°C, water vapor pressure = 38 mmHg; standard gas mixture = CO_2 in balance air, fully hydrated at 33°C; barometric pressure = 760 mmHg and flow = 60 ml/min.

3. Based on the following additional airway conditions: Sample line = 7 ft, 0.055 in ID (2.13 m, 1.4 mm ID); Sample flow rate = 175 ml/min; Protocol watertrap (new/unused); Respiratory rate ≤50 bpm, stable to ±3 breaths/min; Inspired/Expired time ratio = 1:2; Barometric pressure = 760 mmHg.

4. For Sidestream CO_2, this applies only for BR≤50.

Mainstream CO_2 Specifications

Characteristic	Specification
Mainstream CO_2 Sensor	
Sensor Type	Mainstream
Principle of Operation	Non-dispersive, infrared, single-beam, single path/wavelength, ratiometric
Warm-up time (CO_2 sensor and monitor)	45 s typical, 3 min maximum
Response Time	30 ms typical, 60 ms maximum
Waveform Rise Time	<120 ms to 90% after step change
Calibration	Verify semi-annually, calibrate only as required
Sensor Housing Temperature	42°C nominal
Mainstream CO_2 Sensor and Cable Dimensions and Weight	
Sensor Height [1]	1.003 in (2.548 cm)
Sensor Width [1]	1.036 in (2.631 cm)
Sensor Depth [1]	0.78 in (1.981 cm)
Sensor Weight [1]	< 0.53 oz (15.03 g)
Cable Length	10 ft (3.05 m) nominal
Mainstream CO_2 Airway Adapter	
Type	Per ISO 3040, single-use
Size	15 mm ID, (meets ISO specifications)
Material	clear polycarbonate, with sapphire windows
Added Deadspace	< 6cc (0.37 cubic inches) for adult model, <0.6 cc (0.037 cubic inches) for low deadspace model
Mainstream CO_2 Sensor Environmental Specifications	
Operating Ambient Temperature	10° to 40°C
Storage Temperature	-20° to 60°C
Operating Altitude	-2,000 to 15,000 ft (-610 to 4,572 m), 817 to 429 mmHg
Storage Altitude	-2,000 to 40,000 ft (-610 to 12,192 m), 817 to 141 mmHg
Operating and Storage Humidity	0% to 95%, noncondensing
Shock	100 g for 4 ms
Vibration	5-35 Hz, 0.015 in (0.038 cm) 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)

1. Not including cable

Sidestream CO_2 Specifications

Characteristic	Specification
Sensor Type	Sidestream, internal
Principle of Operation	Non-dispersive, infrared, single-beam, single path/wavelength, ratiometric
Operating Ambient Temperature	5° to 40°C
Startup Time	30 seconds typical, 3 minutes maximum
Rise Time	240 ms (10% to 90%) at 175 ml/min
Delay Time	1.12 seconds maximum[1]
Total System Response Time	1.36 seconds maximum (Rise Time and Delay Time)
Calibration	Verify semi-annually, calibrate only as required
Sampling Chamber	Internal (replaceable by service technician)
Pneumatic and Exhaust System	Integral
Barometric Pressure Compensation	Automatic
BTPS, ATPS, STPD[2]	CO_2 value = calculated CO_2 value x 0.977
Sampling Line	7-foot sampling line, ID 0.055 in (1.4 mm), for use with disposable single-use cannula (CO_2 only or CO_2 sampling/O_2 delivery)
Watertrap	Disposable single-use
Flow Rate	90 or 175 ml/min, user-selectable

1. Based on the following additional airway conditions: Sample line = 7 ft, 0.055 in ID (2.13 m, 1.4 mm ID); Sample flow rate = 175 ml/min; Protocol watertrap (new/unused).

2. BTPS (Body Temperature and Pressure, Saturated), ATPS (Ambient Temperature and Pressure, Saturated), STPD (Standard Temperature and Pressure, Dry).

Alarms Specifications

Characteristic	Specification
Indicators (see table below)	**Red indicator light:** flashing light indicates patient alarm; continuously on indicates patient alarms are suspended. **Yellow indicator light:** continuously on indicates one or more alarm limits have been disabled; flashing light indicates an equipment alert.
Tone Frequency	900 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 Priority	Highest priority: Apnea, then patient alarms Lowest priority: Equipment alerts
Alarm on Tachycardias	Most tachycardias will alarm in less than 8 seconds. These include AAMI 3.1.2.1 part f. waveforms. Certain multifocal tachycardias may initially alarm as “low rate.”
Apnea delay setting	Adult/Ped = 6, 10, 15, 20, 25, 30 seconds Neonate = 6, 10, 15, 20 seconds
Alarm Holdoff Time Period[1]	HR/PR = 3 seconds (except NIBP PR) SpO_2 = 10 seconds RR/BR = 5 seconds
Audio Alarm Holdoff with Acuity	When a Propaq CS monitor in Adult or Pediatric Mode is connected to an Acuity System, the audio alarms at the bedside monitor can be delayed up to 4 minutes and 15 seconds. The delay time is selected in Acuity software at the time of Acuity installation. Visual alarm indications and Nurse Call alarm are not delayed.

1. To help minimize false alarms, the monitor briefly delays or “holds off” triggering alarms for limit violations for these vital signs. After the alarm holdoff period begins, if the monitor detects that the patient’s vital sign has returned to acceptable limits, the monitor cancels the alarm holdoff. The next time a vital sign limit is violated, the monitor starts a new holdoff period.

Propaq CS Monitor Alarm Indications

Patient and Alarm Limit Status	Red  Alarm	Yellow  Alarm(s) Off	Nurse Call	Tone
Patient in alarm condition, and all alarm limits on	FLASH	OFF	ON	ON
Patient in alarm condition, and at least one alarm limit is off	FLASH	ON	ON	ON
Patient alarms suspended (whether in alarm condition or not) and at least one alarm limit is off	ON	ON	OFF	OFF
Patient alarms suspended (whether in alarm condition or not) and all alarm limits are on	ON	OFF	OFF	OFF
Patient not in alarm condition, and at least one alarm limit is off.	OFF	ON	OFF	OFF
Equipment alert, patient not in alarm condition	OFF	FLASH	OFF	ON 1 s, OFF 4 s
Equipment alert, patient alarms suspended	ON	FLASH	OFF	OFF

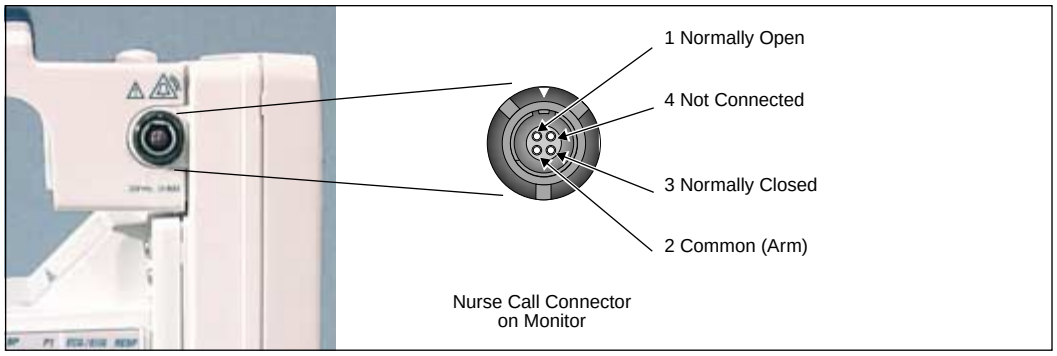
Propaq CS Monitor Audible Alarm Indications

Alarm Condition	Tone
Patient alarm	Continuous ON
Apnea alarm	ON for 1 second, OFF for 1 second
Equipment alert	ON for 1 second, OFF for 4 seconds

Nurse Call Specifications

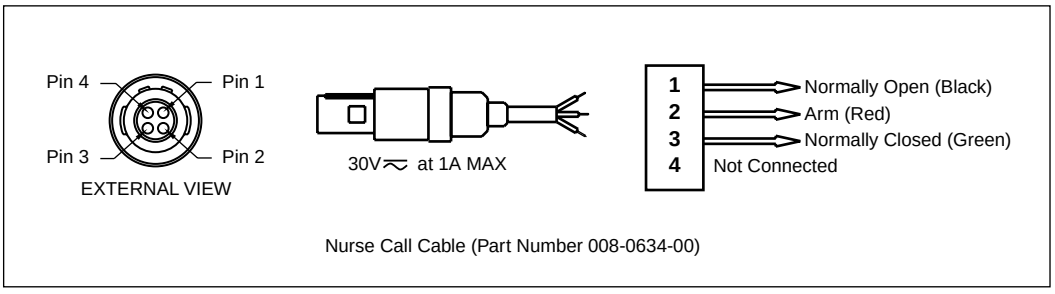
Characteristic	Specification
Maximum switch current	1 A
Maximum switch voltage	30 V ac/dc
Isolation	1500 Vrms
Alarm relay	Energized during apnea alarm or patient alarm[1]
Customized cable[2] (Protocol Systems Part Number 008-0634-XX); see below.	One end is a 4-pin plug compatible with the monitor Nurse Call connector; the other end must be customized to connect to the local Nurse Call system.

1. Pressing the **Suspend/Resume Alarm** key or **SUSPEND** suspends the Nurse Call alarm for 90 seconds.
2. Refer to the Protocol Systems *Products and Accessories* booklet to order the cable.



Nurse Call Cable Specifications

This cable (Part Number 008-0634-XX) must be customized by a biomedical technician to connect to the local Nurse Call system.



Trends Specifications

Characteristic	Specification [1]
Model 242 Parameters	NIBP, T1, T2, ΔT, HR (heart rate/pulse rate), SpO_2, End-tidal CO_2, Inspired CO_2, Breath Rate/Resp Rate
Model 244 Parameters	NIBP, P1, T1, T2, ΔT, HR (heart rate/pulse rate), SpO_2, End-tidal CO_2, Inspired CO_2, Breath Rate/Resp Rate
Model 246 Parameters	NIBP, P1, P2, T1, T2, ΔT, HR (heart rate/pulse rate), SpO_2, End-tidal CO_2, Inspired CO_2, Breath Rate/Resp Rate
Duration	5 hours for non-NIBP trends (up to 150 readings) A maximum of 128 readings (up to 8 hours) for NIBP trends
Resolution	All channels except NIBP sample data at 2-minute intervals. For NIBP trends, a new entry is placed in the table each time an NIBP determination is made.

1. Assumes SpO_2 and CO_2 functions are present.

Display Specifications

Characteristic	Specification
Type	Color active matrix; TFT (Thin Film Transistor) LCD module
Resolution	640 x 480 pixels; 1 pixel = R + G + B dots
Active Viewing Area	6.73 x 5.10 inches (170.9 x 129.6 mm)
Pixel Pitch	0.0105 inches (0.267 mm)
Viewing Angle	U/D 40°, R/L 60° (typical), ≥ 10:1 contrast ratio
Contrast Ratio	150:1 (typical); measured in dark room at center of screen
Display Color	18-bit (6 bits per primary color)
Luminance	200 cd/m^2 (typical); measured at saturation point
Response Time	40 ms (maximum); “white to black”

Monitor (Environmental) Specifications

Characteristic	Specification
Operating Temperature	0° to 40° 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	15% to 95%, noncondensing per MIL STD 810E, Procedure 1-natural
Shipping and Storage Relative Humidity	15% to 95%, noncondensing per MIL STD 810E, Procedure 1-natural
Shock	50 g
Vibration, Random	0.02 g^2/Hz from 10 to 500 Hz, ramping down to 0.002 g^2/Hz at 2000 Hz. Operating 1 hour per axis, 3 hours per test. Designed to meet RTCA DO-160D, Category C.
Electromagnetic Compatibility (EMC)	EN 60601-1-2: 1993

Caution

The monitor may not meet performance specifications if it is not used or stored within these environmental specifications.

Monitor (Physical) Specifications

Characteristic	Specification
Protection Classifications, all Configurations [1]	
Type of Protection against Electric Shock—Power Adapter	Power adapter class 1
Type of Protection against Electric Shock—Monitor (connected to power adapter or internal battery)	Protective earth not available in monitor. Monitor designed and tested to meet Double Insulation Requirement.
Degree of Protection Against Electric Shock, for Parts Applied to Patients	See monitor labels
Method of Disinfection	Not suitable for autoclaving (see cleaning instructions, page 91)
Flammable Anesthetics	Not suitable for use with flammable anesthetics
Monitor Only	
Height	8.2 in (20.8 cm) with handle
Width	9.6 in (24.4 cm)
Depth	5.6 in (14.1 cm)
Weight	7.6 lb (3.4 kg)
Monitor with SpO_2 Module	
Height	8.2 in (20.8 cm) with handle
Width	9.6 in (24.4 cm)
Depth	7.7 in (19.7 cm)
Weight	10.8 lb (4.9 kg)
Monitor with Expansion Module (Printer / SpO_2 / MCO_2)	
Height	11.4 in (28.8 cm)
Width	9.6 in (24.4 cm)
Depth	7.7 in (19.7 cm) with back feet
Weight with Printer, SpO_2, and MCO_2	14.4 lb (6.5 kg)

1. Per EN 60601-1 unless otherwise stated.

Printer Specifications

Characteristic	Specification
Operation	
Operating Modes	Continuous, Snapshot, Auto Print, Auto Trend, Tabular Trend, Alarm Print, NIBP Ticket, Apnea Ticket, OxyCRG, OxyCRG on Alarm
Auto Print Intervals	15 min, 30 min, 1 hour, 2 hours, 4 hours
Auto Trend Shifts	Once every 4 hours
Number of Waveforms	Up to three: ECG1, P1, P2, SpO_2, CO_2, RESP
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, ΔT, Pacer Status, Company Logo, ECG Bandwidth, Patient Mode, scale factors for all traces and, if Acuity is connected, patient name and identification.
Printing Speeds	6.25, 12.5, 25.0 mm/s, simulated 6.25 mm/s for CO_2 and RESP in Snapshot mode

Characteristic	Specification
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
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	15% to 90% noncondensing
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)
Shock	30 g
Vibration, Random	0.02 g^2/Hz from 10 to 500 Hz, ramping down to 0.002 g^2/Hz at 2000 Hz. Operating 1 hour per axis, 3 hours per test.
Electromagnetic Compatibility (EMC)	Per IEC/EN 60601-1-2, which is a collateral standard of IEC/EN 60601-1, for electromagnetic compatibility.
Paper Storage	
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 Specifications

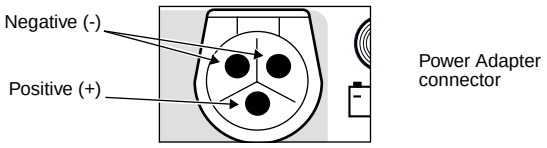
Characteristic	Specification
Mode of Operation	Continuous
Battery Pack Type	Sealed, gel-type lead acid
Battery Pack Capacity	Monitor only: 8 V, 2.7 Ampere-Hours; Monitor with Expansion Modules: 8 V, 5.4 Ampere-Hours
Battery Recharger Circuitry	Internal, powered by external power adapter
DC Input Power Required	12 to 28 V, 25 Watts
Input Fuse Rating	3A/250V, Type 2AG (0.57x 0.177 in)
Operating Times on Battery	Typically 2 hours for monitor without Expansion Module, about 3 hours for monitor with Expansion Module with printer, SpO_2 and CO_2 options, and about 4 hours for monitor without Expansion Module but with the SpO_2 option.
Battery Recharge Time with instrument 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
Recharge time until monitor is usable, starting with discharged but non-faulty battery	≤ 2 minutes typically (longer time required before NIBP, printer, and CO_2 are available)

Characteristic	Specification
Low Battery Voltage and Operation	< 7.8 V: Caution message LOW BATTERY. < 7.6 V: Caution messages LOW BATTERY, PRINTER DISABLED and LOW BATTERY, NIBP DISABLED. < 7.4 V: Equipment alert VERY LOW BATTERY < 7.3 V: Equipment alert LOW BATTERY, HEATER DISABLED (MCO_2) < 7.0 V: Monitor automatically turns off.

Power Adapter Specifications

Characteristic	Specification
Protection Classifications, all Adapters [1] [2]	
Type of Protection Against Electric Shock	Class I, (Protectively Earthed)
Degree of Protection Against Harmful Ingress of Water	For ordinary, indoor locations only.
Method of Disinfection	Not suitable for autoclaving
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	15% to 95%, noncondensing
Shipping, Storage Relative Humidity	15% to 95%, noncondensing
Shock	50 g
Vibration	Random Vibration, 0.02 g^2/Hz from 10 to 300 Hz, ramping down to 0.002 g^2/Hz at 500 Hz. Operating 1 hour per axis, 3 hours/ test.
Physical Specifications	
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)
Universal Power Adapter, Part No. 503-0054-00	
Rated Input	100-120 V ac, 500 mA, 50/60 Hz
Rated Fuses	T800 mA/250 V, Time-Delay, 5x20mm
Rated Output (Continuous)	16-24 V dc, 25 VA
Additional Features	Detachable power cord, pilot light
Universal Power Adapter, Part No. 503-0054-01	
Rated Input	200-240 V ac, 250 mA, 50/60 Hz
Rated Fuses	T400 mA/250 V, Time-Delay, 5 x 20mm
Rated Output (Continuous)	16-24 V dc, 25 VA
Additional Features	Detachable power cord, pilot light

1. Per EN 60601-1 unless otherwise stated.
2. See the Protocol Systems *Products and Accessories* booklet for model numbers.



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