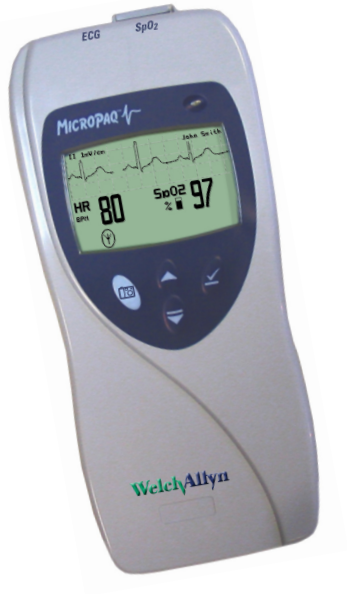
Micropaq® Monitor



Directions for use

Model 406 and Model 408
Software version 1.7X

WelchAllyn®
Advancing Frontline Care™

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USA	+ 1 315 685 4560 800 535 6663	Australia	+ 61 2 9638 3000 800 074 793
Canada	800 561 8797	China	+ 86 216 327 9631
European Call Center	+ 35 3 46 906 7790	France	+ 33 1 60 09 33 66
Germany	+ 49 7477 92 71 86	Japan	+ 81 3 3219 0071
Latin America	+ 1 305 669 9003	Netherlands	+ 31 15 750 5000
Singapore	+ 65 6419 8100	South Africa	+ 27 11 777 7555
United Kingdom	+ 44 20 7365 6780	Sweden	+ 46 8 58 53 65 51

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Welch Allyn Protocol, Inc.
8500 SW Creekside Place
Beaverton, OR 97008-7107 USA

EC REP
Welch Allyn Ltd
Navan Business Park
Dublin Road, Navan
County Meath, Republic of Ireland

www.welchallyn.com

CE 0297

Contents

1 - General information 1
- Intended use 1
- General warnings and cautions 4
- Introducing the monitor 7
- Understanding the monitor and the FlexNet Network 8
- Monitor features 9
- Accessories 16
- Operating settings 16
- Demonstration mode 17

2 - Monitoring 19
- Connect a new patient 19
- Monitor a patient out of range of Acuity 29
- Stop monitoring a patient 30
- Reconnect a recently monitored patient 31
- Reassign a monitored patient to a new room in the same unit 32
- Transfer a monitored patient to a new room in a different unit 33
- Reassign the monitor to a new patient 34

3 - Alarms & alerts 35
- About alarms and alerts 35
- Alarm holdoffs 35
- Respond to a patient alarm at monitor 36
- Customize patient alarm limits at the monitor 37
- Respond to an equipment alert at the monitor 38
- Alert messages and display information 40

4 - Monitor patient at Acuity 41

5 - Maintenance 43
- Change the battery 43
- Recharge a battery 43
- Inspect the monitor, batteries, battery charger, and accessories 45
- Clean the monitor, batteries, and battery charger 45
- Clean the accessories 46
- Recycling monitor components 47
- Change the network name 48

6 - Reference 51
Operating settings 51
Specifications 52

7 - Compliance 63

Index 75

1 General information

Intended use

The Micropaq® monitor is intended to be used by clinicians for single or multiparameter vital signs monitoring of ambulatory and nonambulatory pediatric and adult patients in health care facilities. The monitor is able to withstand light rain exposure over short periods of time (uniform distribution of approximately 1 mm of water per minute for 10 minutes or less).

The Micropaq monitor is intended to operate with an Acuity® Central Monitoring System through wireless communication over the Welch Allyn® FlexNet® network. FlexNet connects multiple devices to the Acuity Central Monitoring System through hardwired Ethernet networks and Wireless Local Area Networks (WLANs). If the Micropaq monitor is moved out of range or loses communication with the FlexNet network, it continues to monitor the patient, display patient data, and generate local patient alarms or alert messages.

- The ECG channel is intended primarily for five-lead ECG monitoring, although three-lead ECG monitoring is supported.
- The Pulse Oximetry channel is intended for continuous noninvasive monitoring of functional oxygen saturation of arterial hemoglobin (SpO_2) and pulse rate (measured by an SpO_2 sensor).

The most likely locations for patients monitored by this device are step-down units, telemetry departments, general medical/surgical floors, emergency departments, and in-hospital transport.

This guide was written for clinicians. Although this guide may describe some monitoring techniques, Welch Allyn expects that the operator is a trained clinician who knows how to take and interpret a patient's vital signs.

Federal USA law restricts sale of the device identified in this manual to, or on the order of, a licensed medical practitioner.

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.
	**Caution** On the product, means "Consult the accompanying documentation."

The following symbols appear on the monitor or accessories.

Symbol	Definition	Symbol	Definition
	Direct current	IPX1	Enclosure Protection Drip proof: Classification IPX1 per EN60529: 1991
	Alternating current (battery charger)		Fuse
CE 0297	The CE Mark and Notified Body Registration Number signify the device has met all essential requirements of European Medical Device Directive 93/42/EEC		This device has been tested and certified by the Canadian Standards Association International to comply with applicable U.S. and Canadian medical safety standards.
	Restrictions for use of wireless device in Europe. European Communities Class 2 radio equipment	CE	Signifies the device has met all essential requirements of European Medical Device Directive 93/42/EEC for a Class 1 product (battery charger)
	Protective earth ground (battery charger)	 Li++	Separate batteries from other disposables for recycling
Li++	Lithium Ion battery		For indoor use only (battery charger)
	Caution: Refer to Directions For Use and accompanying documentation		Keep away from rain
	See the accompanying manual		Recycle the monitor and battery separately from other waste. Refer to www.welchallyn.com/weee for collection point and additional information.
	Alarm(s) off		Patient connections are Type CF, isolated for direct cardiac application, and protected against defibrillation
	This way up		Stacking limit (by number)
95%	Humidity limit		Altitude limit
	Fragile		IATA/ICAO Hazard Class 9 Package (International Air Transport Association/ International Civil Aviation Organization)
	Temperature limits		Single use only

Symbol	Definition	Symbol	Definition
	Non-ionizing electromagnetic radiation. This device contains an approved RLAN module frequency 2402 to 2480 MHz		Non-ionizing electromagnetic radiation. This device contains an approved RLAN module frequency 5150 to 5825 MHz
	The monitor is connected to Acuity		The monitor is not connected to Acuity
	(Flashing) The monitor is searching for a connection to Acuity	FCC ID: PGUWA11A07 IC: 4168a-WA11A07	This device complies with FCC and Industry Canada requirements for international radiators (802.11 wireless)
	Not magnetic resonance safe.		

Monitor Front Panel Keys			
	Select Key and Silence Patient Alarm/ Equipment Alert Key- Selects the choice highlighted on the menu. During patient alarms, silences the tone at the monitor and at Acuity (if connected) for 90 seconds. During equipment alerts, silences or acknowledges (dismisses) the alert.		Scroll Up Key and Reset Alarm Tone Key- Scrolls up menus on the display. During patient alarms, resets the tone at the monitor and at Acuity (if connected).
	Snapshot Key - When connected to Acuity, pressing this key sends Acuity a snapshot print to the Acuity central station printer. A total of 21 seconds of patient numeric and waveform data (14 seconds of history, 7 seconds after the key is pressed) will be sent to the printer. See "Snapshot key" on page 10 for more information.		Scroll Down Key and Main Menu Key- Pressing this key scrolls down menus on the display, or causes the Main Menu to appear if no menu is displayed.

Battery charger labels and LEDs

Eight-bay battery charger (008-0651-XX)		
Green LED on continuously		Battery is fully charged.
Green LED flashing		Battery is charging.
Green LED flashing very slowly		Battery detected and waiting to be charged.
Yellow LED on continuously		Something is wrong with the battery or the charger. (See "Battery Status and Possible Response" on page 44.)

General warnings and cautions

Familiarize yourself with all warnings and cautions before using the monitor.

WARNING When considering a treatment protocol that involves wireless communication of patient data, be sure to recognize some limitations inherent in wireless communications. When the monitor is not connected to the network:

- There are no patient alarms or alerts at the Acuity Central Station.
- Acuity does not perform arrhythmia and ST analysis on the patient data and does not generate related alarms.
- Patient data is not saved.

WARNING Do not try to monitor neonatal patients with the monitor. The monitor is intended for adult or pediatric patients. It is not intended for use with pediatric patients (or infants) weighing less than 22 lbs (10 kg).

WARNING Always check the patient mode at Acuity when monitoring a new patient. The patient mode determines default alarm limits and internal algorithm settings.

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

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

WARNING During defibrillation, keep the discharge paddles away from ECG and other electrodes, as well as other conductive parts in contact with the patient.

WARNING Do not operate this product in the presence of flammable anesthetics or other flammable substances in combination with air, oxygen-enriched environments, or nitrous oxide; explosion can result.

WARNING Do not use the 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.

WARNING Magnetic Resonance (MR) Safety. This monitor is designated Not MR Safe, as defined in the ACR Guidance for Safe MR Practices, 2007. Do not place this monitor in Zones 3 or 4, in MR environments for which Zones have been established and marked in accordance with the Guidance. In MR environments for which Zones have not been designated, do not place this monitor into a magnetic field with field strength larger than the field strength that your facility permits to exist in areas that are accessible by personnel, patients, and guests without MR safety precautions. Failure to follow these precautions creates a risk that the magnetic field will damage the monitor, causing it to overheat and potentially burn patents and cause a fire. The damage to the monitor caused by exposure to magnetic fields may be immediate or latent. If the damage is latent, it can cause the monitor to overheat at some time subsequent to its exposure to the magnetic field.

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

WARNING Exposure to Radio Frequency (RF) radiation. To comply with Federal Communications Commission (FCC) RF exposure requirements, this device shall be used in accordance with the operating conditions and instructions provided in this manual, including the section "Install the carrying pouch" on page 28.

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." See "ECG specifications" on page 53 for disclosure of the pacemaker pulse rejection capability of this instrument.

WARNING This wireless medical device was tested and, when used with a metal-free accessory between the monitor and the patient, complies with FCC RF Exposure (SAR) guidelines. The use of accessories containing metal may not ensure compliance with FCC RF exposure guidelines. Specific Absorption Rate (SAR) is a measurement of radio frequency energy. The FCC permits a maximum SAR value of 1.6 mW/g. The highest SAR value for this patient monitor, when worn by a patient in accordance with the directions for use, is 0.560 mW/g.

WARNING Military radars are allocated as primary users in the bandwidths between 5.25 - 5.35 GHz and 5.47 to 5.725 GHz. In the event a radar signature is detected, the Access Point moves to a new channel, which can temporarily interrupt patient monitoring. If the device is operated near a military radar, the radar could cause damage to the device.

WARNING Changes or modifications not expressly approved by Welch Allyn could void the purchaser's authority to operate the equipment. This product does not contain any user serviceable components. Any unauthorized product changes or modifications will invalidate Welch Allyn's warranty and all applicable regulatory certifications and approvals.

WARNING Motion artifact can affect the accuracy of patient vital sign measurements. Minimize patient motion whenever possible.

WARNING For patients with a pacemaker, position the monitor to maintain a minimum 6-inch distance between the monitor and pacemaker. Immediately turn the monitor off and provide appropriate patient care if you have any reason to suspect that the monitor is interfering with the pacemaker. The Health Industry Manufacturers Association recommends this minimum 6-inch distance between a hand-held wireless radio and a pacemaker, which is consistent with the independent research by, and recommendations of, Wireless Technology Research.

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

WARNING 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.

WARNING Use of ECG and SpO_2 cables not specified by Welch Allyn may negate defibrillator protection and risk patient injury.

WARNING Use of Masimo LNOP® sensors/cables will not provide protection in accordance with IEC defibrillation standards when used with this device.

WARNING 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.

WARNING Use only accessories supplied by Welch Allyn or recommended in the Welch Allyn *Products and Accessories* booklet (810-0409-XX). The monitor will only meet the listed specifications when using accessories listed by Welch Allyn. Use accessories according to your facility's standards and the manufacturer's recommendations. Always refer to the manufacturer's Directions for Use.

WARNING As with all medical equipment, carefully route the patient cabling to reduce the possibility of patient entanglement or strangulation. Use the supplied garment clips to secure the cable properly.

WARNING When positioning the monitor pouch on the patient, make sure the straps do not entangle the patient's neck or cause choking. Make sure the straps do not restrict the movement of the patient's limbs or create a hazard when walking or moving.

WARNING If a product has been dropped or severely abused, send it to a qualified service person to confirm proper operation.

WARNING Do not use the pulse oximeter as a replacement or substitute for ECG-based arrhythmia analysis.

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

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 Welch Allyn. The monitor should be serviced only by a Welch Allyn service technician while under warranty. Contact Welch Allyn for information about post-warranty period service.

Introducing the monitor

The monitor is a patient-worn vital signs monitor for use by adult or pediatric ambulatory patients.

- One or two ECG channels displayed
- Up to 2 ECG leads displayed at the monitor: I, II, III, V, aV_R, aV_L, or aV_F with 5-lead cable
- Up to 7 ECG leads displayed at Acuity: I, II, III, V, aV_R, aV_L, or aV_F with 5-lead cable
- One ECG lead displayed at the monitor and at Acuity: Fixed lead II with 3-lead cable, or 5-lead cable with only RA, LA and LL electrodes attached.
- Pulse oximetry (SpO_2) monitoring (Model 408 only)
- Two-way wireless communication within Welch Allyn's FlexNet network
- LCD for display of ECG waveforms, SpO_2 and heart rate/pulse rate data, and messages from Acuity
- Standalone operation with patient alarms when out of range of the network
- Patient alarm limits that can be set at the monitor or at Acuity
- Configurable formats for single- or dual-waveform ECG display
- Internal antenna
- Snapshot key
- Lightweight (less than two pounds with battery)
- Rugged and tolerant of brief water exposure
- Rechargeable battery
- Sleep mode to extend battery life
- Your model may be shipped with an attached identification number on the front of the monitor.

Model 406

ECG monitoring

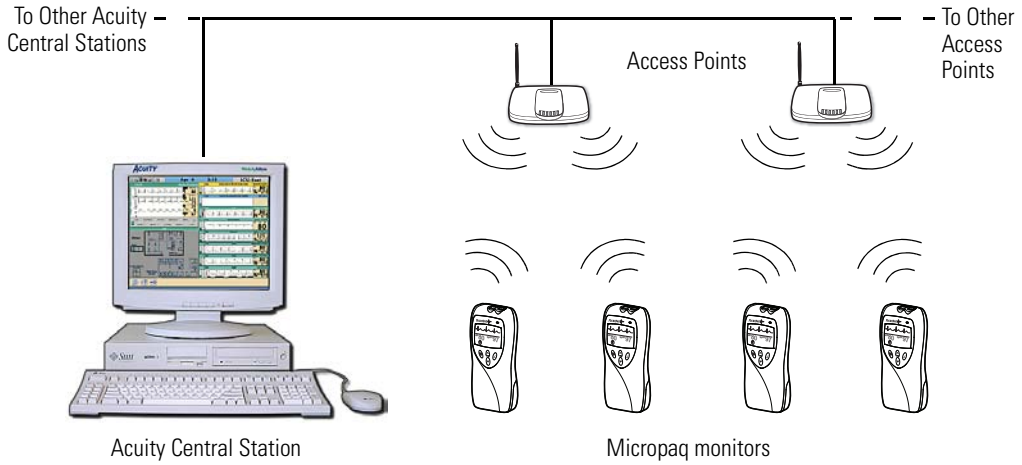
Model 408

ECG monitoring and either one of two pulse oximetry (SpO_2) monitoring options:

- SpO_2 with Masimo® SET® technology, indicated by: Masimo SET
- SpO_2 with NELLCOR® OxiMax® technology, indicated by: Nellcor OxiMax

Understanding the monitor and the FlexNet Network

The monitor is intended to operate with an Acuity® Central Station as part of Welch Allyn's FlexNet network. FlexNet allows multiple devices to communicate through hardwired Ethernet networks and Wireless Local Area Networks (WLANs). The Acuity Central Station provides the primary display and entry of patient data for a patient connected to the monitor.



FlexNet Network

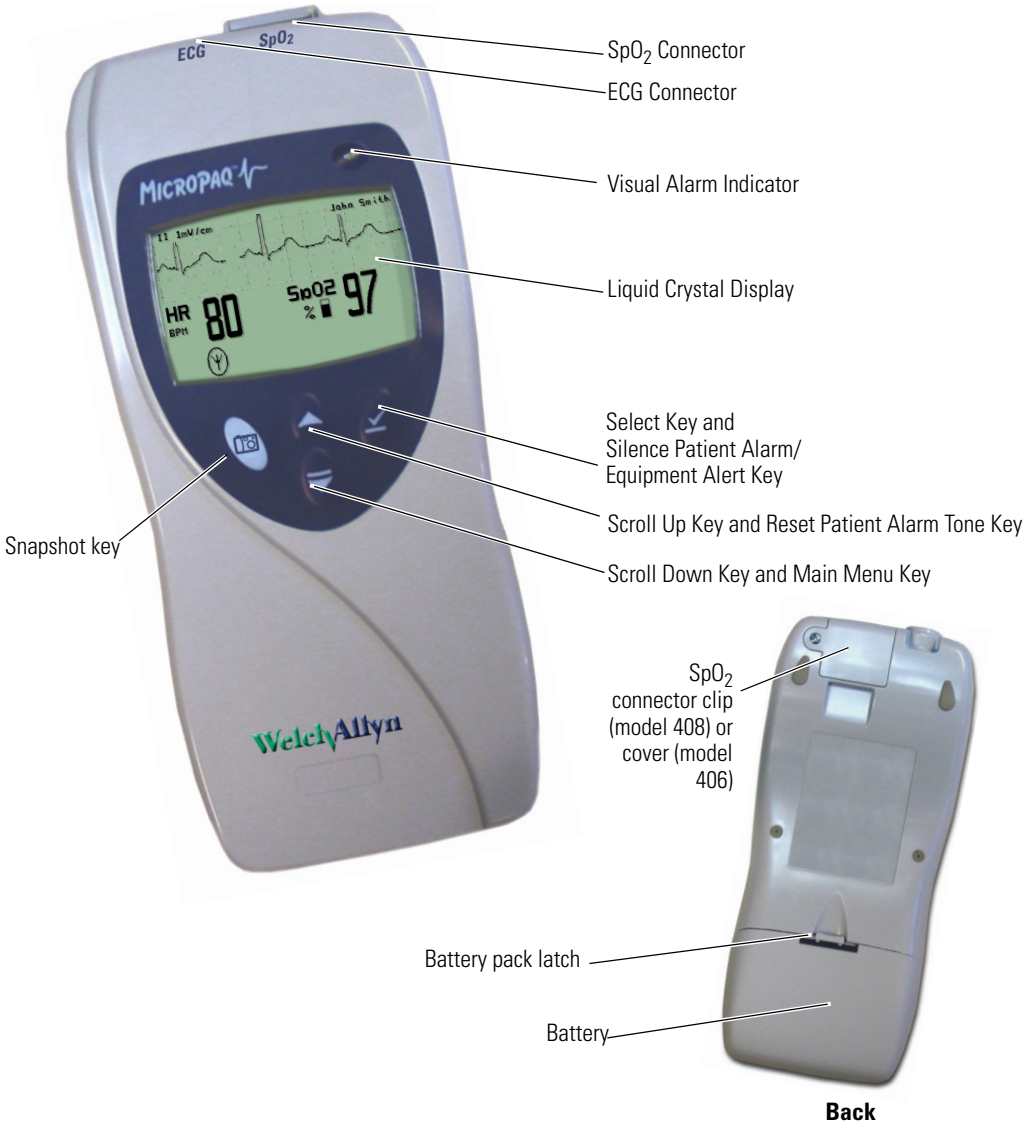
Each patient-worn monitor supports two-way communication with an Acuity Central Station through an access point in the FlexNet network. The access point is a digital radio transceiver that connects to the FlexNet network. During monitoring, the monitor sends the patient data to Acuity. Acuity and the monitor continuously analyze the data. Acuity provides appropriate alarm or alert messages at the Central Station and other network devices such as a hallway message panel and the monitor itself. Acuity also stores the patient data for viewing or report printing.

If the monitor is moved out of range or loses communication with the FlexNet network and Acuity, it continues to monitor the patient and display patient data. While not communicating with Acuity, the monitor continues to generate local patient alarms or alert messages. Patient data is not stored and Acuity does not perform waveform analysis or generate arrhythmia messages while the monitor is not communicating with Acuity.

When the monitor is returned to within range of the FlexNet network, it automatically reconnects to Acuity.

Monitor features

Controls and connectors



Visual alarm indicator

Green	Flashes slowly during normal operation.
Red	Flashes during patient alarm, remains on continuously when alarms are silenced or suspended.
Yellow	Flashes during an equipment alert or while not connected to the network. Remains on continuously if the operator suspends an alert at Acuity for 90 seconds or acknowledges (dismisses) a low battery alert from the monitor or Acuity.

Note The flashing green LED indicates that the monitor is connected to the network but not necessarily connected to a patient. If the monitor is actively monitoring a patient, the green LED indicates no alarms or alerts are detected.

Audible alarm indicator

Beeps to indicate a patient alarm, and beeps faster for life-threatening arrhythmia alarms (see "Patient alarm and equipment alert specifications" on page 58).

Beeps to indicate when the equipment needs attention. This beep tone is slower than patient alarm tones (see "Patient alarm and equipment alert specifications" on page 58).

Volume can be configured as high, low, or off (configured at Acuity).

Volume can be configured differently for network connection or stand-alone operation (configured at Acuity).

Snapshot key

When connected to Acuity, pressing this key sends a snapshot of the patient's numeric and waveform data to the Acuity Central Monitoring System. Depending on how Acuity is configured, this will cause Acuity to print a 21-second snapshot (14 seconds of history, 7 seconds of data after the button is pressed) to the Acuity central station printer.

Note Snapshot is the default selection of the monitor. However, the connected monitor will inherit the configuration previously defined by Acuity. For example, if Acuity has defined the Snapshot key to respond with a Nurse Call function and a new monitor is introduced to the system, the Snapshot key definition will remain as Nurse Call.

For more information about using the Acuity Central Monitoring System, refer to *Acuity Directions For Use.*

Scroll Up key and Reset Patient Alarm Tone key

Scrolls up menus on the display.

Resets a silenced patient alarm tone.

Scroll Down key and Main Menu key

Scrolls down menus on the display.

Displays the Main Menu.

Select key and Silence Patient Alarm/Equipment Alert key

Selects the choice highlighted on the menu.

During patient alarms, silences the tone at the monitor and Acuity (if connected) for 90 seconds. During equipment alerts, silences or acknowledges (dismisses) the alert at the monitor and Acuity.

Battery

Insert the battery to turn on power. Remove the battery to turn off power. (While the battery is removed, the monitor does not perform patient monitoring.)

Note If you do not use END TELE to disconnect from the network as described above, the Acuity Central Station generates a DROPOUT equipment alert at Acuity.

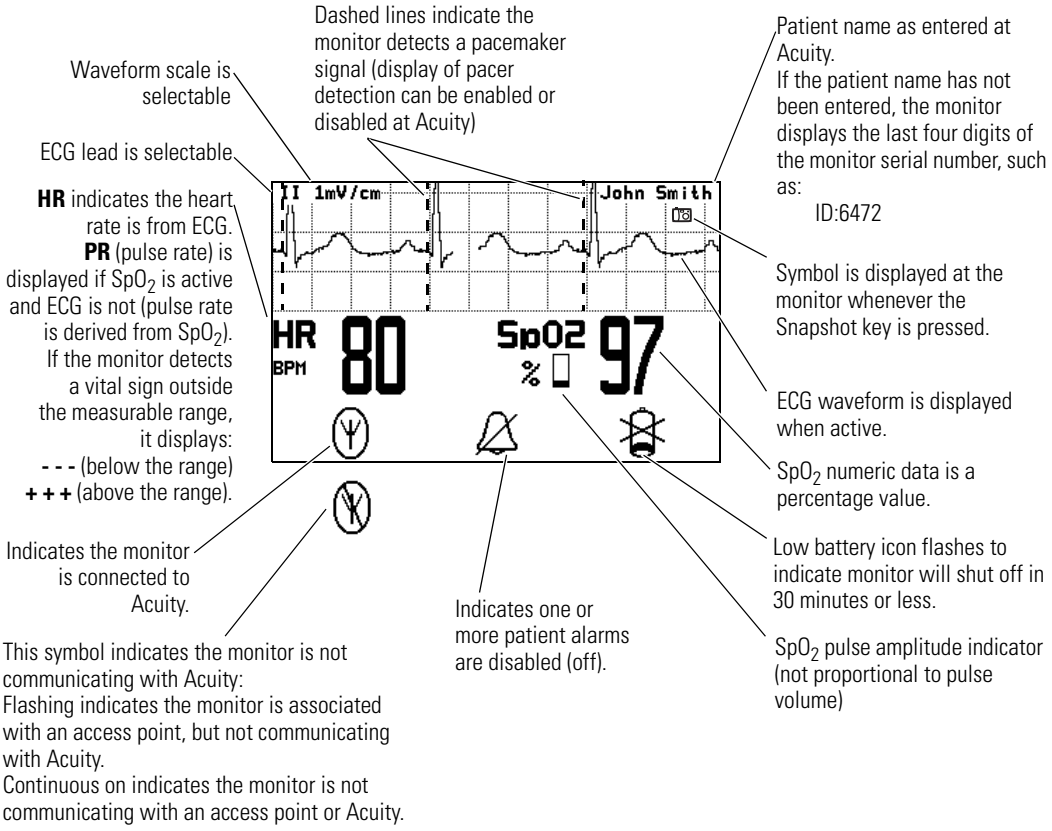
If you want to monitor this same patient at a later time, you will need to reselect the patient name from the monitor or confirm the patient ID at Acuity.

Recharge the battery while it is removed from the monitor. (See "Recharge a battery" on page 43.)

To order a new battery, see "Battery Status and Possible Response" on page 44.

Display

Although the Acuity Central Station is the primary location for viewing patient data, the monitor provides information to support patient care.



Display sleep mode

In order to extend battery life, the display becomes blank after two minutes if no keys are pressed. The display becomes active again if an alarm or alert occurs, a key is pressed, the initial Acuity connection occurs, a cable is inserted, or an electrode is attached.

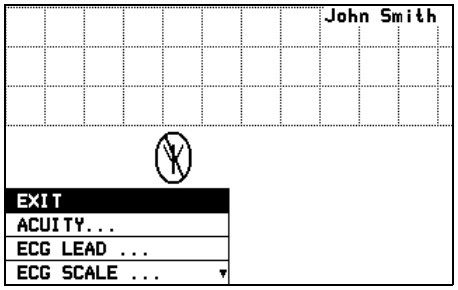
The display will not become blank if a patient alarm is occurring, an Acuity message is displayed, or the monitor is in Demo mode or Service mode.

Main Menu

When you first press ▼, the Main Menu appears:

Press ▼ to move through the menu.

Press ✓ to select or change the highlighted choice.



EXIT	Exit the Main Menu (the menu disappears).
ACUITY...	Access the Acuity Menu with network options. The Acuity Menu is only accessible while connected to Acuity.

EXIT	Exit all menus and return to the monitoring screen.
END TELE	Discontinue monitoring a patient.
NEW ROOM	Reassign a patient to a new room in the same unit.
TRANSFER	Transfer a patient to a new room in a new unit.
NEW PATIENT	Assign the monitor to a new patient.
PATIENT INFO	Display patient information such as ID, name, unit and room.

Whenever the monitor is connected to Acuity and you select ACUITY... from the Main Menu, the monitor displays the message ACUITY CONTACTED to confirm that Acuity has been contacted. The monitor continues to display this message until Acuity responds, or you press ✓ to acknowledge the message and clear the screen. If the monitor detects an alarm or alert, it clears the screen to display the appropriate alarm or alert message. The length of time required for Acuity to respond to your selection at the monitor can vary widely depending on the amount of network traffic and other conditions.

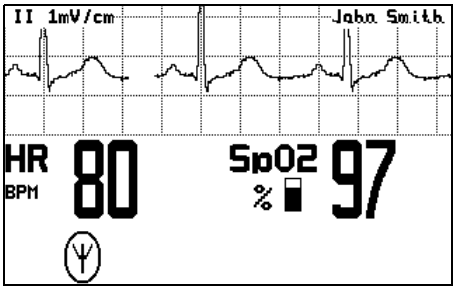
ECG LEAD...	Access a menu to change the ECG 1 or ECG 2 lead selection (I, II, III, aV_R, aV_L, aV_F, or V). Available vectors depend on the connected electrodes.

ECG SCALE...	Change the scale of the ECG waveform. If two waveforms are displayed, both have the same scale.
1 WAVEFORM	There are four possible ECG waveform display selections: 1 WAVEFORM the default selection 2 WAVEFORMS 5 SECONDS FULL SCREEN Pressing ✓ changes to the next selection. This change does not take effect until after you exit the Main Menu. See "Display" on page 12 for descriptions.
LIMITS...	Enter the Alarm Limits Menu ("Customize patient alarm limits at the monitor" on page 37) and change alarm limits.
SYSTEM INFORMATION	Display information about the network connection and SpO_2 module.
SERVICE MENU	Enter Service Mode for a demonstration mode (Demo, see "Demonstration mode" on page 17) or service functions for technicians. Service Mode is not available if any cables are plugged in.

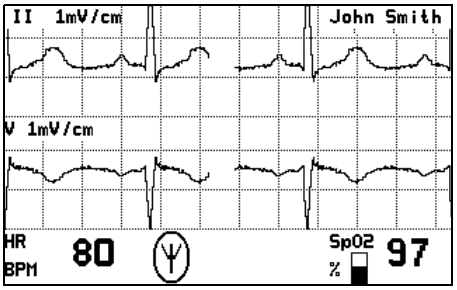
Note To restrict access to the Main Menu, a Menu Lock option can be configured for the monitor at the Acuity Central Station. When the Menu Lock is enabled, the operator must press and hold down ✓ and ▼ for two seconds to gain access to the Main Menu. The Menu Lock is disabled if the monitor loses communication with Acuity.

Waveform options

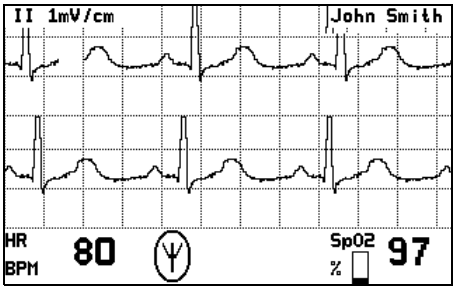
There are four ECG waveform options as shown:



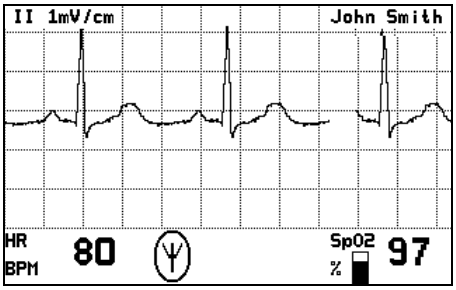
1 Waveform
The single ECG 1 (lead II) waveform is displayed.



2 Waveforms
ECG 1 (lead II) and ECG 2 (lead V) are both displayed.



5 Seconds
ECG 1 (lead II) cascades from one line to the other.



Full Screen
The single ECG 1 (lead II) waveform is allowed to occupy most of the screen.

To change the waveform selection during operation:

1. Press ▼ to display the Main Menu.
2. Press ▼ as needed to highlight the current waveform selection. Then press ✓ as needed to select the desired display.

Messages from Acuity

The monitor displays messages sent from Acuity as needed, including patient alarms and equipment alerts. When Acuity messages are displayed, they temporarily override information displayed on the lower half of the monitor screen.

Accessories

Battery charger (8-battery)	*Micropaq Directions For Use*
Battery	ECG electrodes
3-lead ECG cable (optional)	5-lead ECG cable
ECG extension cable (optional)	Carrying pouch
SpO_2 sensors (Masimo or Nellcor)	SpO_2 cable (Masimo or Nellcor)

WARNING Use only accessories supplied by Welch Allyn or recommended in the Welch Allyn *Products and Accessories* booklet (810-0409-XX). The monitor will only meet the listed specifications when using accessories listed by Welch Allyn. Use accessories according to your facility's standards and the manufacturer's recommendations. Always refer to the manufacturer's Directions for Use.

Operating settings

The following monitor operating settings can be set at the monitor or at the Acuity Central Station:

- Patient alarm limit settings (ECG and SpO_2).
- ECG lead and scale selection
- ECG display format

Many other monitor operating settings (such as patient mode and alarms volume) can only be set at the Acuity Central Station. See "Operating settings" on page 51 for a list of all settings and where they are set.

Default settings

When the monitor connects to Acuity for a new patient, the Acuity Central Station downloads the appropriate default settings stored at Acuity. While the monitor is connected to Acuity, settings can be changed either at the monitor or at the Acuity Central Station.

If the monitor is temporarily disconnected from Acuity and the operator changes settings at the monitor, those settings are transmitted to and stored at Acuity when the monitor reconnects.

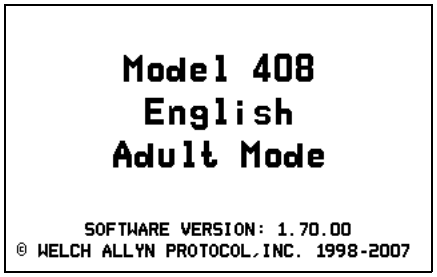
Demonstration mode

You can practice using the monitor with the Demo mode of operation, including connection to Acuity.

The Demo mode cannot be activated while you are monitoring a patient or if any cables have been plugged into the monitor. During the Demo mode, the monitor and Acuity display the message SIMULATION.

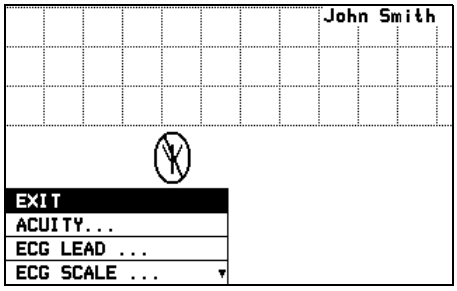
To practice with the monitor in Demo mode:

1. Disconnect all patient cables connected to the monitor.
2. Remove the battery (if installed).
3. Insert the battery and watch for the Power-Up screen.



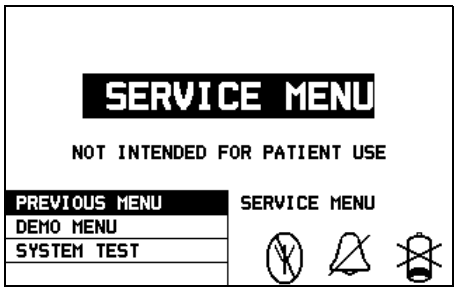
Power-Up Screen

4. After the Power-Up screen disappears, press ▼ to display the Main Menu.



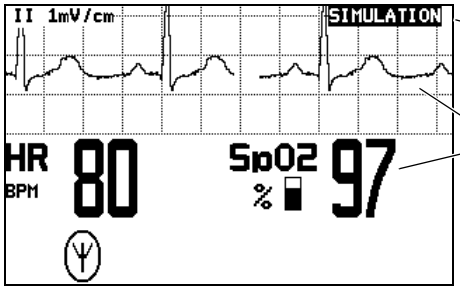
Main Menu

5. Press ▼ to highlight SERVICE MENU, then press ✓ to display the Service Menu.



Service Menu

6. Press ▼ to highlight **DEMO MENU**, then press ✓ to display the Demo Menu.
7. Press ▼ to highlight **DEMO 1** or **DEMO 2**, then press ✓ to start.



Demonstration Mode

Demo Mode Display Values and Alarm Limits

Display	Demo 1	Demo 2[a]	Alarm Limits (On)
ECG Waveform	Normal sinus rhythm, normal ST	Normal sinus rhythm, normal ST	(not applicable)
ECG Heart Rate SpO_2 Pulse Rate	80	125	Lower 50 Upper 120
SpO_2 Saturation%	97	88	Lower 90 Upper 100

a. Demo 2 will cause patient alarms.

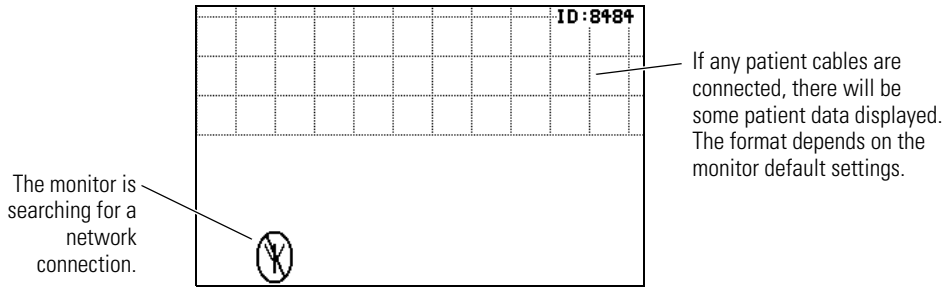
8. While in Demo mode you can practice changing settings such as ECG lead selection and alarm limit adjustment. (These changes only affect the Demo mode and are erased when you exit the Demo mode.)
9. To change to the other Demo selection, press ▼ to display the menu, then scroll down to highlight **TOGGLE DEMO MODE** and press ✓.
10. To exit the Demo mode, either insert a patient cable or remove and insert the battery. The monitor restarts and enters the normal monitoring mode.

2 Monitoring

Connect a new patient

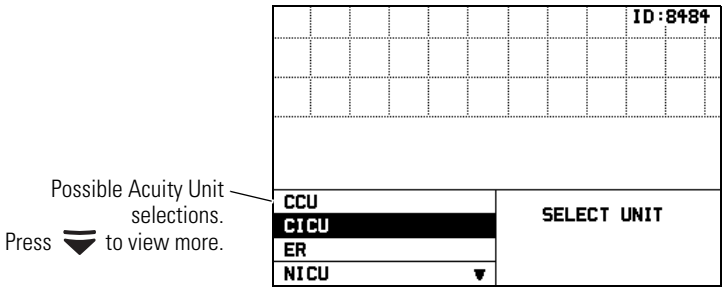
Connect to the network

1. Insert a battery into the monitor to turn it on. After a few seconds the monitor Power-Up Screen is replaced by an initial monitoring screen.



Example of Initial Monitor Screen

2. After the network connection is established, the monitor may prompt you to select an Acuity Unit (if your facility has more than one Acuity unit):



Example of Acuity Unit Selection

3. Press ▼ or ▲ to highlight the desired Acuity unit, then press ✓.

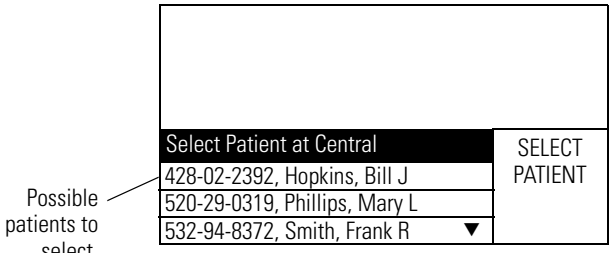
   When you press ▼ or ▲ to highlight the desired Acuity unit and then press ✓, your selection will begin to flash between normal and reverse video to confirm that the monitor is communicating your selection to Acuity. You cannot scroll to another selection during this time. The selection continues to flash until Acuity responds back to the monitor. Then the monitor displays the next appropriate screen (such as a list of possible patients). The length of time required for Acuity to respond to your selection at the monitor can vary widely depending on the amount of network traffic and other conditions.

   Be sure to select an Acuity unit. Even though the monitor is connected to the network (as indicated by the green LED and network connection symbol), the Acuity Central Station may not display any indication of this monitor until after you have selected an Acuity unit.

Network Connection Symbol

4. The monitor displays a list of possible patients.

   If your patient has been pre-admitted to the selected Acuity unit, they will be included in the list.



Example of Patient List

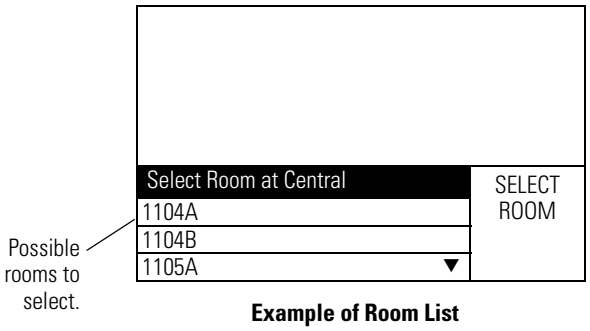
5. Scroll through the patient list to look for your patient's name.

   - If your patient is not in the list, highlight **Select Patient at Central** and press ✓. The patient name will need to be entered later at the Acuity Central Station.

WARNING If you do not select the patient name at the monitor at this time, do not adjust any alarm limits until **after** the patient name and ID are confirmed at Acuity. When the patient name and ID are confirmed at Acuity, Acuity downloads the default settings and patient alarm limits for that Acuity unit to the monitor, thereby overriding any previous settings and alarm limits.

Note At power-up, the monitor retains the most recent patient mode. The patient mode can only be changed at Acuity. If the patient is being monitored when the patient mode is changed, there is a brief interruption in the display and recording of ECG and SpO_2 patient data.

- If your patient is in the list, highlight the name and press ✓. Within a few seconds the monitor displays a list of unassigned rooms.



Example of Room List

- If you want to assign the patient to a room, highlight the room and press ✓.
- If you do not want to assign a room at this time, highlight **Select Room at Central** and press ✓. The patient room will need to be entered later at the monitor (see "Reassign a monitored patient to a new room in the same unit" on page 32) or at Acuity (see "Monitor patient at Acuity" on page 41).

6. If you need to customize alarm limits for your patient, see "Customize patient alarm limits at the monitor" on page 37.

Perform ECG monitoring

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

WARNING If a disconnected lead is in too close proximity to other electrical devices, it may cause false heart rate readings.

WARNING The monitor does not provide internal arrhythmia analysis. Therefore, arrhythmias may cause the monitor to display inaccurate heart rates.

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

WARNING Do not use the 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.

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." See "ECG specifications" on page 53 for disclosure of the pacemaker pulse rejection capability of this instrument.

WARNING For patients with a pacemaker, position the monitor to maintain a minimum 6-inch distance between the monitor and pacemaker. Immediately turn the monitor off and provide appropriate patient care if you have any reason to suspect that the monitor is interfering with the pacemaker. The Health Industry Manufacturers Association recommends this minimum 6-inch distance between a hand-held wireless radio and a pacemaker, which is consistent with the independent research by, and recommendations of, Wireless Technology Research.

WARNING High-intensity radio frequency (RF) energy from external sources, such as an improperly connected electrosurgical unit, can induce heat into electrodes and cables which can cause burns on the patient. Reading errors and damage to equipment may also result. This hazard can be reduced by (1) avoiding the use of small ECG electrodes, (2) selecting ECG electrode attachment points remote from the 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.

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

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

WARNING Use of ECG cables with loose or faulty detachable lead wires may cause erratic behavior of the ECG waveform due to intermittent ECG lead wire connections.

WARNING 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.

Caution To protect the 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 Welch Allyn (these cables have the required current-limiting resistors). Follow recommended application procedures.

Caution Do not use an ECG cable longer than 10 feet (3 meters). If the nominal length of the ECG cable, including extensions, exceeds this length, the monitor is not guaranteed to meet published electromagnetic compatibility (EMC) performance specifications.

- Even though the 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 Welch Allyn *Products and Accessories* booklet (810-0409-XX).
- 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.

Perform 5-Lead ECG monitoring

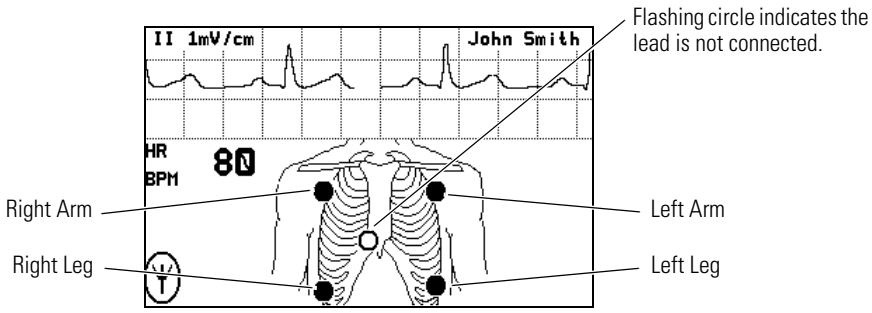
1. Inspect the ECG cable and replace it if it shows any signs of wear, breakage, or fraying. Plug the cable into the monitor.
2. Select electrode sites on the patient.

   Choose flat areas; avoid fatty or bony areas and major muscles.
3. 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.
4. 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 electrodes.

   If you are using ungelled 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. Due to polarization, such electrodes can generate offsets beyond the monitor's capabilities. Do not use electrodes from more than one manufacturer on the same patient.
5. Attach lead wires to the electrodes before applying them to the patient. Apply the electrodes to the patient in the proper locations.



   If the monitor detects that some lead wires are not properly connected, the monitor displays a chest diagram and indicates which leads are disconnected.

   The locations of the circles displayed on the monitor for each lead are fixed, and are not affected by the exact placement of the electrodes on the patient. For example, the C lead can be placed on the patient in any one of the V1-V6 locations desired, but will only be displayed on the monitor in the location shown above.
6. After leads are properly connected, confirm that the monitor displays the ECG waveform, heart rate, and other patient data.

   To change the ECG lead selection, press ✓ to display the Main Menu. Then press **Scroll Down** to highlight **ECG LEAD . . .** , then highlight **ECG 1** or **ECG 2** and press ✓ to change the lead.

3-Lead ECG application with the 5-Lead ECG cable

Note Be aware that there are some inherent limitations with this application, especially when compared to 5-lead ECG monitoring. These limitations include the restriction to only one displayed lead, ECG lead II. Because only one displayed lead is available (ECG lead II), factors such as a poor electrode connection at RA, LA, or LL can significantly affect performance. To overcome these limitations, the 5-lead ECG monitoring is preferred.

The monitor's 3-lead ECG monitoring is only available for use with Acuity software versions 6.1 or later.

You can perform 3-lead ECG monitoring in a similar manner as 5-lead ECG monitoring. You may use the 5-lead ECG cable with detachable electrode lead wires, and connect only the lead wires and electrodes for RA, LA, and LL. Refer to the Welch Allyn *Product and Accessories* booklet (810-0409-XX) for part numbers.

Follow these steps:

1. Perform Step 1 through Step 4 on page 23 as described for 5-lead ECG monitoring.
2. Before attaching electrodes to the patient, attach only lead wires for RA, LA, and LL to the 5-lead ECG trunk cable and to the electrodes. Make sure that lead wires for C and RL are DETACHED from the 5-lead ECG trunk cable.
3. Apply the electrodes for RA, LA, and LL to the patient in the proper locations.

   The monitor displays the chest diagram with two circles blinking confirming that the C and RL electrodes are not connected.
4. Observe the monitor and visually confirm that within about 30 seconds, the two circles disappear and the monitor displays the ECG waveform, heart rate, and other patient data.

   Be aware that if you connect the C or RL lead wires to the 5-lead ECG trunk cable and apply the C or RL electrodes to the patient, the monitor defaults to 5-lead ECG monitoring and does not enable 3-lead ECG monitoring. To enable 3-lead ECG monitoring, you must disconnect the ECG cable from the monitor for a few seconds, and then begin this procedure again.

Be aware that only ECG lead II is available for display with the monitor's 3-lead ECG monitoring. No other ECG lead selections are available.

WARNING Do not try to perform this 3-lead ECG monitoring with any 5-lead ECG cable that does not have detachable electrode lead wires as described above. Attempting to perform this procedure with a 5-lead ECG cable which has lead wires cut off or hanging loose and not connected to the patient would present a shock hazard to the patient or clinician.

3-Lead ECG application with the 3-Lead ECG cable

Note Be aware there are some inherent limitations with this application, especially when compared to 5-lead ECG monitoring. These limitations include the restriction to only one displayed lead, ECG II lead. Because only one displayed lead is available (ECG lead II), factors such as poor electrode connection at RA, LA, or LL can significantly affect performance. To overcome these limitations, the 5-lead ECG monitoring is preferred.

The monitor's 3-lead ECG monitoring is only available for use with Acuity software versions 6.1 or later.

Refer to the *Welch Allyn Product and Accessories* booklet (810-0409-XX) for part numbers.

Follow these steps:

1. Perform Step 1 through Step 4 on page 23 as described for 5-lead ECG monitoring.
2. Attach lead wires to the electrodes before applying them to a patient.
3. Apply the electrodes for RA, LA, and LL to the patient at the proper locations. If the monitor detects one of the lead wires is not properly connected, it will display a chest diagram indicating which lead is disconnected.
4. Observe the monitor and visually confirm it displays the ECG waveform, heart rate, and other patient data.

   Be aware that only ECG lead II is available for display with the monitor's 3-lead monitoring. No other ECG lead selections are available. The monitor will not detect the presence of a 3-lead cable until two or more of its leads are connected to the patient.

3-Lead ECG application with the 3-Lead ECG cable and cable extension

This combination functions the same way as the 3-lead ECG application with the 5-lead cable. For electromagnetic compatibility (EMC) reasons, do not use an ECG cable and extension cable length of more than approximately 10 feet total.

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 on a co-oximeter.

WARNING Use only accessories as listed in the Welch Allyn *Products and Accessories* booklet (810-0409-XX). Use only Masimo accessories and sensors with the Masimo SpO_2 option. Use only Nellcor accessories and sensors with the Nellcor SpO_2 option. The monitor will only meet the listed specifications when using accessories listed by Welch Allyn.

WARNING Use of Masimo LNOP® sensors/cables will not provide protection in accordance with IEC defibrillation standards when used with this device.

WARNING 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.

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

WARNING Inaccurate measurements may be caused by venous pulsations.

WARNING The pulse oximeter can be used during defibrillation, but the readings may be inaccurate for a short time.

WARNING The pulse oximeter should NOT be used as an apnea monitor.

WARNING A very sudden and substantial change in pulse rate can result in erroneous pulse rate readings. Be sure to validate the patient data and patient condition before intervention or change in patient care.

WARNING Interfering Substances: Carboxyhemoglobin may erroneously increase readings; the level of increase is approximately equal to the amount of carboxyhemoglobin present. Methemoglobin may also cause erroneous readings. Dyes, or any substances containing dyes, that change usual arterial pigmentation may cause erroneous readings.

1. Attach the SpO_2 sensor to the patient according to the manufacturer's directions for use, observing all warnings and cautions.

   Each SpO_2 sensor is designed for application to a specific site on the patient within a certain size range. To obtain optimal performance, use an appropriate sensor and apply it as described in the sensor's directions for use.

   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. For optimal measurements, avoid placing the SpO_2 sensor on the same limb as an arterial catheter or intravascular line.

   Loss of pulse signal can occur if the sensor is too tight, there is excessive ambient light, an NIBP cuff is inflated on the same limb as the sensor, there is arterial occlusion proximal to the sensor, the patient is in cardiac arrest or shock, or the patient has hypotension, severe vasoconstriction, severe anemia, or hypothermia.

2. Inspect the SpO_2 cable. Replace it if it shows any signs of wear, breakage, or fraying. Plug the cable into the sensor and the monitor.

3. After the cable is connected, confirm that the monitor displays SpO_2 data within a few seconds.

4. If excessive 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

   The SpO_2 system is designed to work satisfactorily during normal patient motion.

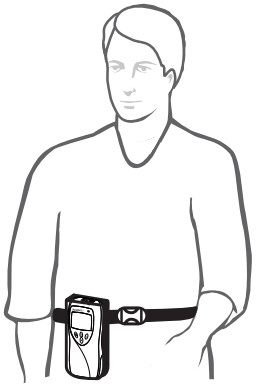
Install the carrying pouch

WARNING As with all medical equipment, carefully route the patient cabling to reduce the possibility of patient entanglement or strangulation. Use the supplied garment clips to secure the cable properly.

WARNING When positioning the monitor pouch on the patient, make sure the straps do not entangle the patient's neck or cause choking. Make sure the straps do not restrict the movement of the patient's limbs or create a hazard when walking or moving.

Adult carrying pouch

The Adult Carrying Pouch is intended for ambulatory adult patients. It is not intended for use while the patient is in bed.

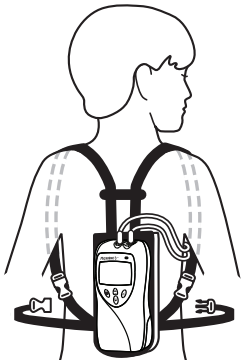


1. Put the carrying pouch on the patient and insert the monitor.
2. Carefully arrange the pouch and monitor on the patient to avoid bruising or other skin injuries.

   To maximize the monitor's wireless transmission range, always make sure that the monitor display is facing out and away from the patient's body.

Pediatric carrying pouch

The Pediatric Carrying Pouch is intended for ambulatory pediatric patients (40 to 80 lbs., 18 to 36 kg.). It is not intended for use while the patient is in bed.



1. Insert the monitor into the pouch.
2. Carefully arrange the pouch and the monitor on the patient to avoid bruising or other skin injuries.

   To maximize the monitor's wireless transmission range, always make sure that the monitor display is facing out and away from the patient's body.

Monitor a patient out of range of Acuity

While out of range of Acuity, the monitor continues to monitor the patient and provide local HR/PR and SpO2 alarms or alerts at the monitor as needed.

When the patient wearing the monitor goes out of range of Acuity, do the following:

1. A DROPOUT equipment alert occurs at the Acuity Central Station. Acknowledge the alert at Acuity.
2. An equipment alert occurs at the monitor with this message:

   ACUITY CONNECTION LOST

   Depending on how the monitor is configured (as controlled by Acuity), this alert can also cause the monitor to emit audible alert tones.

   If tones are enabled, the authorized person should press ✓ on the monitor to acknowledge (dismiss) the alert and silence this instance of the alert tone.

Note The person authorized to press ✓ to acknowledge the alert may vary, depending on the local protocol. Follow the protocol established by your institution.

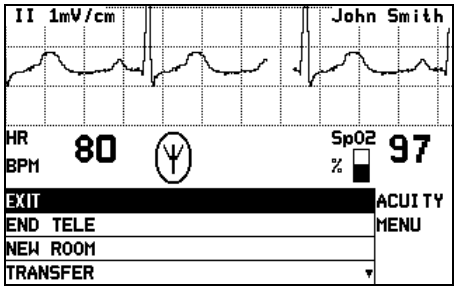
When the patient returns within range of Acuity, the monitor automatically reconnects to Acuity. No clinician intervention is required.

WARNING When the monitor moves out of range of the Acuity network, communication with Acuity is broken immediately, stopping the communication of patient vital-signs data. If the monitor is out of range of the Acuity network for several minutes, the radio enters a low-power state. When the monitor is again within range of the Acuity network, it can take as long as three minutes to restore communication with Acuity and resume the communication of patient vital-signs data.

Stop monitoring a patient

If you want to discontinue monitoring the patient, follow these steps.

1. Press ▼ to display the **Main Menu**.
2. Press ▼ to highlight **ACUITY**, then press ✓.



Acuity Menu

3. Press ▼ to highlight **END TELE**, then press ✓.
4. When the monitor displays the message SAFE TO REMOVE BATTERY, remove the battery.

   If the battery is not removed within 30 seconds, the monitor will automatically try to reconnect to the network.
5. Disconnect the leads and sensors from the patient.

Note If you do not use END TELE to disconnect from the network as described above, the Acuity Central Station generates a DROPOUT equipment alert at Acuity.

If you want to monitor this same patient at a later time, you will need to reselect the patient name from the monitor or confirm the patient ID at Acuity.

Reconnect a recently monitored patient

1. Insert a battery into the monitor to turn on the monitor. Confirm that after a few seconds the monitor Power-Up Screen is replaced by the initial monitoring screen.
2. The monitor will then present a series of menus and messages requesting you to provide information about the connection and patient. The actual screens presented depend on how long the patient has been disconnected. Provide the information as requested. This may include:
   - Select an Acuity unit.
   - Select a patient from the patient list.
   - Select a patient room from the room list.

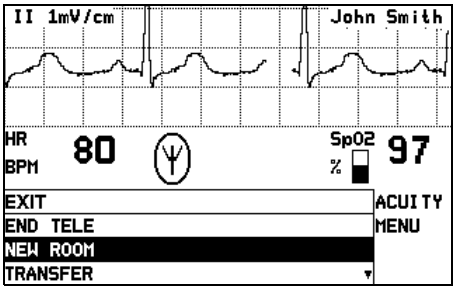
Note If you do not select the patient name or room while connecting the patient, you will need to do that later at the Acuity Central Station. See "Monitor patient at Acuity" on page 41 for more information.

- To perform ECG monitoring, see "Perform ECG monitoring" on page 21.
- To perform SpO_2 monitoring, see "Perform SpO2 monitoring" on page 26.

Reassign a monitored patient to a new room in the same unit

If a patient is being monitored and you want to assign them to a new room in the same unit, follow these steps.

1. Press ▼ to display the Main Menu.
2. Press ▼ again to highlight **ACUITY** and press ✓ to display the Acuity Menu screen.
3. Press ▼ to highlight **NEW ROOM**, then press ✓.



New Room Selection

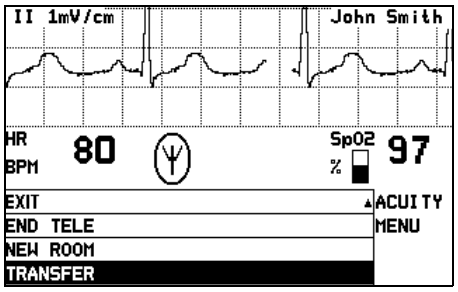
Within a few seconds the monitor displays a list of all available rooms, including the patient's current room.

- If you decide not to change the patient's current room assignment, press ✓ (the patient's current room is the default selection in the list).
- To assign the patient to a new room, highlight the room and press ✓.
- If you want to cancel the patient's current room assignment, but do not want to assign a new room at this time, you can highlight **Select Room at Central** and press ✓. You can then assign the room later from the Acuity Central Station, or you can repeat this procedure and assign a new room from the monitor.

Transfer a monitored patient to a new room in a different unit

If a patient is being monitored and you want to assign them to a new room in a different unit, follow these steps.

1. Press ▼ to display the Main Menu.
2. Press ▼ again to highlight **ACUITY** and press ✓ to display the Acuity Menu screen.
3. Press ▼ to highlight **TRANSFER**, then press ✓.



Transfer a Patient

Within a few seconds the monitor displays a list of units.

4. Press ▼ to highlight the new unit, then press ✓.

   The patient is not monitored at Acuity during the short time required by Acuity to process the transfer to the new unit (typically less than one minute). However, the patient continues to be monitored by the monitor.

   (If the selected unit is currently not available, the monitor displays an appropriate message; press ✓ to acknowledge the message and cancel the transfer.)

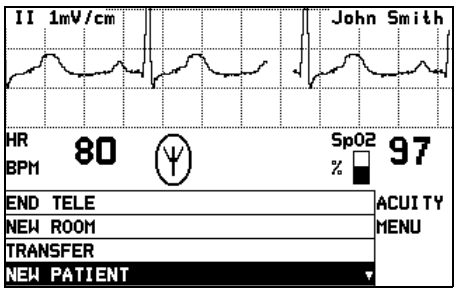
5. After the patient is assigned to the new unit, the monitor displays a list of unassigned rooms. (The patient's previous unit and room assignment is cancelled.)

   - To assign the patient to a new room, highlight the room and press ✓.
   - If you decide not to assign the patient to a new room at this time, you can highlight **Select Room at Central** and press ✓. You can then assign the room later from the Acuity Central Station, or you can assign a new room from the monitor later using the procedure on "Reassign a monitored patient to a new room in the same unit" on page 32.

Reassign the monitor to a new patient

If you want to discontinue monitoring a patient and reconnect the monitor to a new patient, follow these steps.

1. Press ▼ to display the Main Menu.
2. Press ▼ again to highlight **ACUITY** and press ✓ to display the Acuity Menu screen.
3. Press ▼ to highlight **NEW PATIENT**, then press ✓.



Select a New Patient

The monitor then presents a series of menus and messages requesting you to provide information about the connection and patient. The actual screens presented depend on how the Acuity System is configured.

Provide the information as requested. This may include:

- Select an Acuity unit.
- Select a patient from the patient list. (After you select a new patient, all monitor operating settings are reset to the Acuity System default power-up settings.)
- Select a patient room from the room list.

If you do not select the patient name or room while connecting the patient, you will need to do that later at the Acuity Central Station. See "Monitor patient at Acuity" on page 41 for more information.

- To perform ECG monitoring, see "Perform ECG monitoring" on page 21.
- To perform SpO_2 monitoring, see "Perform SpO2 monitoring" on page 26.

3 Alarms & alerts

About alarms and alerts

Alarms provide a warning about a patient condition (such as a vital sign limit violation).

Alerts provide a warning about an equipment condition that needs attention (such as a low battery or detached ECG lead).

Alarms and alerts may be detected either by the monitor or by the network. While connected to the network, alarms or alerts are displayed at the monitor and at the Acuity Central Station. Alarms have a higher priority than alerts.

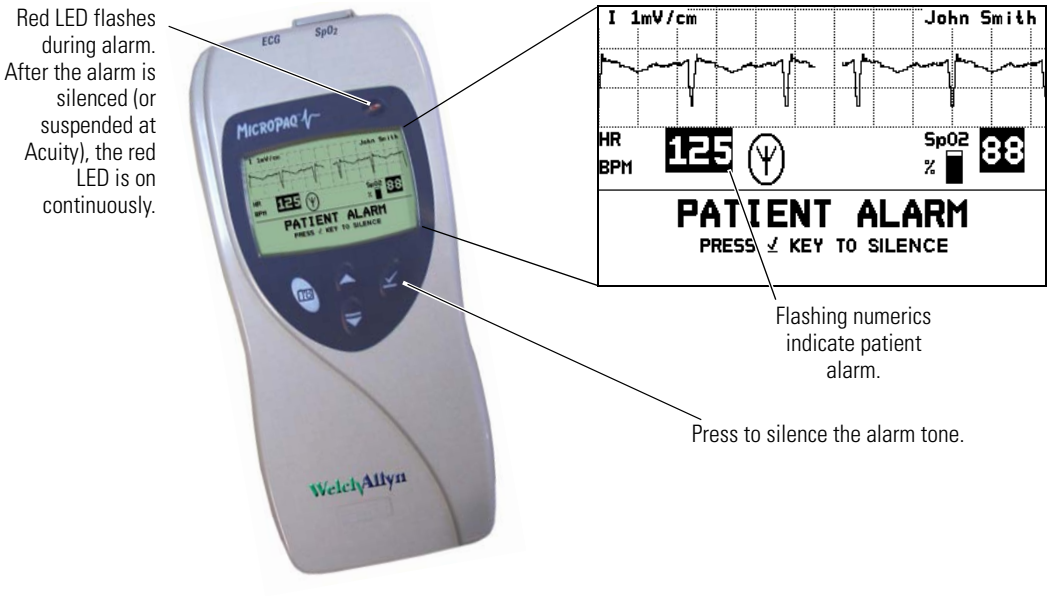
Alarm holdoffs

To help minimize false alarms, the monitor briefly delays or "holds off" triggering alarms for limit violations for HR/PR or SpO_2. 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 Period
HR	3 seconds
% SpO_2 or PR	10 seconds

Respond to a patient alarm at monitor

When a patient alarm occurs, the monitor produces an audible tone (if audible tones are enabled). Life-threatening arrhythmia alarms beep at a faster pace than other vital sign alarms (see "Patient alarm and equipment alert specifications" on page 58). The monitor also displays a message similar to the following:



1. Check the patient and provide appropriate care.
2. To silence the alarm tone at the monitor and the Acuity Central Station for 90 seconds, press ✓.

   While the alarm tone is silenced, visual alarm indications continue, and the red alarm indicator on the monitor changes from a flashing display to a continuous display.

   If the alarm condition still exists after 90 seconds, the alarm tone resumes.

Note If you silence an alarm at the monitor and another patient alarm or an equipment alert occurs during the silence period, the tone resumes at the monitor. At Acuity, only life-threatening arrhythmia alarms interrupt the silence period.

If you suspend an alarm at *Acuity*, only life-threatening arrhythmia alarms interrupt the silence period at the monitor and Acuity.

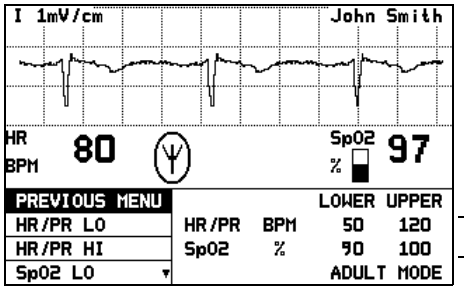
To access the Main Menu during silencing, press ▼.

3. To reset the alarm tone at the monitor and Acuity before the 90 seconds has elapsed, press ▲ at the monitor, or press **Resume** at the Acuity Central Station.
4. After caring for the patient, make sure that the appropriate alarm limits are set and that alarms are on.

Customize patient alarm limits at the monitor

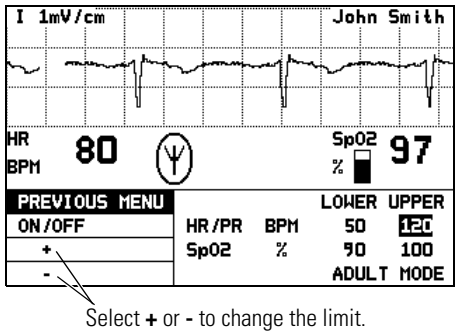
WARNING If the patient's name has not yet been assigned to the monitor, do not adjust any alarm limits until **after** the patient name and ID are confirmed at Acuity. When the patient name and ID are confirmed at Acuity, Acuity downloads the default settings and patient alarm limits for that Acuity unit, thereby overriding any custom alarm limits that were set at the monitor before selecting the patient.

1. Press ▼ to display the Main Menu.
2. Press ▼ to highlight **LIMITS**, then press ✓ to display the Alarm Limits Adjust Menu:



Alarm limits can be adjusted for HR/PR and SpO_2.

3. To change an alarm limit, press ▼ or ▲ to highlight the desired limit, then press ✓ to display the Threshold Adjustment Menu:



Select **+** or **-** to change the limit.

- Scroll and select the **+** or **-** selections to change the limit as desired.
- To turn the highlighted limit on or off, scroll to **ON/OFF** and press ✓.

WARNING If you turn off any alarm limits, be sure to restore the appropriate alarm limits before you resume monitoring. *Only life-threatening arrhythmias will be indicated at the monitor and Acuity* (if connected) when alarms are turned off.

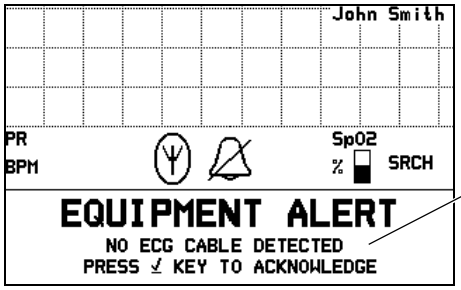
4. To change other limits, scroll to **PREVIOUS MENU**, press ✓, then select another limit to change.
5. When you have completed all changes, scroll to **PREVIOUS MENU**, then **EXIT** on the Alarm Limits Adjust Menu and press ✓ to return to the normal monitoring screen.

Note While the monitor is connected to Acuity, settings can be changed either at the monitor or at Acuity.

Respond to an equipment alert at the monitor

When the network or the monitor detects an equipment problem, the monitor produces a an audible alert tone (if audible tones are enabled). Equipment alerts beep at a slower pace than patient vital sign alarms (see "Patient alarm and equipment alert specifications" on page 58).

The monitor also displays a flashing yellow light (LED) and an equipment alert message similar to the following:



The monitor has detected that the ECG cable has been disconnected from the monitor.

1. In this instance, press ✓ to acknowledge (dismiss) the alert tone and clear the message.

   If the message says "PRESS ✓ TO SILENCE," when you press ✓, the tone is silenced for 90 seconds instead of dismissed.

   If the monitor displays a chest diagram with a missing lead flashing, you can press ✓ to silence the tone.

   Some alerts do not give you the option to acknowledge the alert or silence the tone. For these alerts, to remove the message and tone, you must correct the problem.

2. If possible, determine what caused the problem and correct it.

Note After you press ✓ to acknowledge or silence some types of alerts, the yellow LED remains on (either flashing or steady yellow) until you correct the problem.

For low battery alerts and no Acuity connection alerts, specific icons also flash.

For a list of possible messages and suggested responses, see "Alert messages and display information" on page 40.

Alert messages and display information

Message and Display Information	Possible Cause(s) and Suggested Response
LOW BATTERY	The monitor will shut down within approximately 30 minutes or less due to a low battery. • Replace the battery as soon as possible.
VERY LOW BATTERY	The monitor will shut down within approximately 5 minutes or less due to a low battery. • Replace the battery as soon as possible.
BATTERY TOO LOW SHUT DOWN IN PROGRESS	The battery is so low the monitor has to shut down operation. • Replace the battery immediately.
ACUITY CONNECTION LOST	The monitor is not connected to the network. • Press ✓ to acknowledge and silence the tone and cancel the message. While disconnected from the network, the off-network icon and the yellow LED continue to flash. NOTE: The monitor will continue to attempt to reconnect until it is successful.
EXCESSIVE ECG OFFSET REPLACE ELECTRODES[a]	The monitor detects poor ECG electrode contact. • Check and replace ECG electrodes as needed.
Chest icon is displayed with flashing ECG electrode(s).[a]	The monitor detects that one or more ECG electrodes are disconnected. • Check and replace or reconnect electrodes as needed.
NO ECG CABLE DETECTED	• If the ECG cable has been intentionally removed from the monitor, press ✓ to cancel the alert tone. • If the ECG cable has been unintentionally removed, plug it back into the monitor. Check the patient and monitor to make sure ECG monitoring resumes properly. • It is normal for this alert to appear with a 3-lead ECG cable when two or more of its leads are disconnected from the patient. Reconnect the disconnected lead wires.
NO SPO2 SENSOR DETECTED	The SpO_2 sensor has been disconnected for more than 5 seconds. • If disconnection is intentional, press ✓ to acknowledge and silence the tone. • If disconnection is not intentional, reconnect the sensor or replace the sensor and reconnect.
DEFECTIVE SPO2 SENSOR[a] *or* UNRECOGNIZED SPO_2 SENSOR[a]	The SpO_2 sensor is either defective or not recognized. • Replace the SpO_2 sensor with a new, compatible SpO_2 sensor.
<*key name*> KEY STUCK[a]	During the power-up self test, the monitor detected that a key is stuck (▼, ▲, 🔊, or ✓). This can happen if you accidentally press a key down before the Main Menu is displayed during power-up. • Remove and then reinsert the battery to power up again and see if the key is still stuck. If it is, contact your biomedical engineering department.
System Error Thread: <*nnn*> Error ID: <*nnn*>	The equipment problem is so serious the monitor cannot be used. • Contact your biomedical engineering department.

a. This alert message can be acknowledged from Acuity, but not from the monitor.

4 Monitor patient at Acuity

While the Micropaq is connected to the FlexNet network, patient data gathered by the monitor is continuously stored at Acuity. You can access this patient information at the Acuity Central Station and perform administrative functions, including:

- Admit (and discharge) a patient in the Acuity unit.
- Edit the patient description (name, physician, etc.).
- Review and print patient data such as trends and waveforms.
- Suspend patient alarm tones for 90 seconds and resume the alarm tones

WARNING When the monitor moves out of range of the Acuity network, communication with Acuity is broken immediately, stopping the communication of patient vital-signs data. If the monitor is out of range of the Acuity network for several minutes, the radio enters a low-power state. When the monitor is again within range of the Acuity network, it can take as long as three minutes to restore communication with Acuity and resume the communication of patient vital-signs data.

For more information about using the Acuity Central Workstation, refer to *Acuity Directions For Use*.

5 Maintenance

This section provides information to help operators of the monitor and the battery charger perform routine maintenance activities such as changing or recharging batteries, inspection, and cleaning.

Change the battery

1. Remove the depleted battery.
2. Insert a fully-charged battery. Use only batteries supplied by Welch Allyn.

WARNING Before installing a battery, carefully inspect the battery case. If there are any signs of damage, cracks, or leaks, discard the battery properly and do not use it.

Note The Acuity unit can be configured to allow you a short time (typically 30 seconds or more) to change the monitor battery while the monitor is connected to the network without causing an Acuity equipment alert. If the monitor is connected to the network and the battery is removed for longer than the allowable battery changing time, Acuity generates a DROPOUT equipment alert at the Acuity Central Station.

Recharge a battery

Eight-bay battery charger

1. On the monitor battery charger (008-0651-XX), choose an empty battery well where the LED is off.
2. Insert the depleted battery into the battery well.
3. Confirm that the charger displays a flashing green LED by the battery to indicate the battery is detected or is charging.
4. When the green LED is on continuously, the battery is fully charged. Remove the battery.

If the yellow LED is on continuously, the battery may have reached the end of its useful life. Refer to the table below for suggested responses.

Charger LED	Battery Charger Label—LEDs	Battery Status and Possible Response
Green LED on continuously		Battery is fully charged.
Green LED flashing		Battery is charging.
Green LED flashing very slowly		Battery is detected and waiting to be charged.
LED off		No battery is detected.
Yellow LED on continuously		Something is wrong with the battery or the charger. Remove the battery. • If the LED goes off, it is probably a battery problem. Insert a new battery into the same battery well. If the new battery charges correctly, then the battery has a problem; discard the battery. The battery reorder number is 008-0647-XX. If the same problem occurs with the new battery, the charger may need repair. Contact biomedical engineering. • If the LED does not go off when you remove the battery, it is probably a charger problem. Unplug the charger power cord, wait at least 5 seconds, then plug in the charger power cord again. Insert a new battery into the same battery well. If the new battery charges correctly, then the battery has a problem; discard the battery. If the same problem occurs with the new battery, the charger may need repair. Contact biomedical engineering.

The charger can accommodate up to eight batteries. The charger charges a maximum of four batteries at a time. After a battery begins recharging (as indicated by the green LED that flashes on one second, off one second), it is typically fully recharged within four hours at room temperature. After a battery is fully charged, the charger continues to maintain the full charge on the battery until the battery is removed. Leaving a fully-charged battery in the charger will not harm the battery.

Remove batteries from the battery charger if the battery charger will be disconnected from ac power for more than a few days. Do not block the cooling vents at the rear of the battery charger.

The monitor battery charger only charges four batteries at a time. A battery is not fully charged until the green LED is on continuously. Do not remove a battery until it is fully charged, or displays a battery fault.

WARNING The monitor battery is Lithium Ion. Do not incinerate, submerge, crush, disassemble, or autoclave. If a battery has been submerged in liquid, discard the battery properly; do not try to recharge or reuse the battery. Do not short the battery terminals. Do not try to connect the battery to any device except the monitor or the monitor battery charger. Do not expose to high temperature (above 60° C or 140° F). Use only the specified monitor battery charger.

Inspect the monitor, batteries, battery charger, and accessories

WARNING Be sure to unplug the monitor battery charger power cord from the electrical power outlet before inspecting the battery charger.

Before cleaning, thoroughly inspect the monitor and all accessories for any signs of damage, cracks, or improper mechanical function of the keys or connectors. While gently bending and flexing the cables, inspect for damage, cracks, cuts, abrasions, extreme wear, exposed wires, or bent connectors. Confirm that the connectors are securely seated. Remove damaged items from use and report damage or improper function to your service department. At least every 12 months, be sure to thoroughly inspect the battery charger case and power cord for damage or extreme wear.

Clean the monitor, batteries, and battery charger

WARNING Unplug the monitor battery charger power cord from the electrical power outlet before cleaning the battery charger. Exposing the battery charger to liquids while connected to electrical power could result in electrical shock or fire.

WARNING Do not autoclave the monitor, battery, or battery charger. Never immerse the monitor, battery, or battery charger in liquid.

Note The monitor, battery, and battery charger may be disinfected to comply with OSHA requirements for cleaning and decontaminating spills of blood and other body fluids. For more information, refer to the Federal OSHA Standard on bloodborne pathogens: 29 CFR 1910, 1030, 12/6/91.

1. Wipe the equipment with a nearly dry clean cloth moistened with one of the approved cleaning solutions listed in "Approved cleaning solutions" on page 46. Do not use any solution or solution with similar constituents listed in "Prohibited cleaning solutions" on page 46.
   a. Do not allow cleaning solution to accumulate anywhere on the device.
   b. Inspect to ensure no cleaning liquid is present in connector openings, latches, or crevices.
2. After cleaning, thoroughly remove residual cleaning solution by wiping all surfaces with a clean soft cloth dampened with water.
3. Thoroughly dry all surfaces with warm air.

Clean the accessories

WARNING Do not autoclave the accessories. Never immerse the accessories in liquid unless the accessory manufacturer explicitly instructs you to do so.

Clean accessories per manufacturer's instructions.

Approved cleaning solutions

Brand names	Generic
Coverage®	Warm water
Wex-cide®[a]	Liquid soap
Sani Cloth®[b]	Hydrogen peroxide solution
Cidex Plus®	
Betadine®	

a. Wex-cide (Wexford Labs, Inc. Kirkwood, MO) is a disinfectant that meets OSHA requirements, is EPA approved, and will not harm the outside of the monitor, battery, or battery charger. Wipe away disinfectant after the manufacturer's recommended period.
b. Sani-Cloth Wipes are proven effective in 5 minutes or less. Sani-Cloth Wipes are EPA-registered and meet CDC and OSHA guidelines. They are an adequate substitution for Theracide™ Disinfectants.

Prohibited cleaning solutions

Caution Use only cleaning solutions that are recommended by Welch Allyn for this equipment. Use of solutions that are not recommended or that have a high acid content or are otherwise inappropriate can cause damage to the equipment, including cracking and deterioration of the plastic case. Do not use these solutions or similar products. If your cleaning solution is not on the approved or prohibited cleaning solution lists, check the cleaning solution ingredients to ensure that nothing listed in the prohibited cleaning solutions is a constituent element. If you are unsure whether a cleaning solution should be used, defer to the approved cleaning solutions list.

Brand names	Generic
Freon™	Butyl alcohol
Vesphene®	Denatured alcohol
Enviroquat®	Acetone
Staphene®	Chlorine bleach solution
Misty®	70 percent isopropyl alcohol
Virex®	Trichloroethane
Formula 409®	Trichloroethylene
Fantastik®	Glutaraldehyde
Ovation®	
TBQ®	
Windex®	

Recycling monitor components

When the battery, monitor, or battery charger reaches the end of its life, recycle it locally according to national, state, and local regulations. You can also return the battery, monitor, or charger to Welch Allyn for recycling.

Within the European Union

Do not dispose of this product as "unsorted municipal waste." Prepare it for reuse or separate collection as specified by Directive 2002/96/EC, as amended, of the European Parliament and the Council of the European Union on Waste Electronic and Electrical Equipment (WEEE).

If the monitor or battery (Li++) is contaminated, this directive does not apply. For more specific information, see www.welchallyn.com/weee, or contact Welch Allyn Customer Service.

Li++

Recycle monitor batteries (Li++) according to the Directive 91/157/EEC (Batteries and accumulators containing certain dangerous substances) and Directive 93/86/EEC (Labelling of batteries and accumulators containing certain dangerous substances).

Change the network name

This procedure allows you to change the network name assigned to the monitor (as long as the current network name is one of the pre-set names available in the monitor Network Name Menu).

WARNING Changing the monitor network name will cause the monitor to re-start and seek to connect with the FlexNet network corresponding to the new name. Do not attempt to change the network name unless you are a qualified biomedical service engineer or technician (or a Welch Allyn employee), and only change the network name in a non-clinical environment.

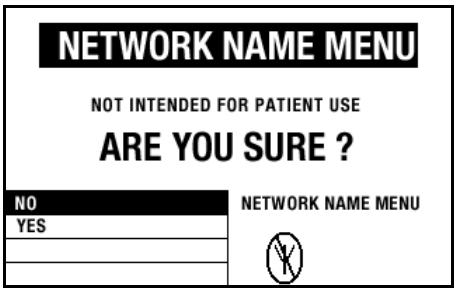
To change the network name:

1. Press ▼ to access the Main Menu, then repeatedly press ▼ until **SERVICE MENU** is highlighted.
2. Press ✓ to display the Service Menu screen.
3. Press and hold ▲ and ▼, then press ✓ to display the Network Name Menu.

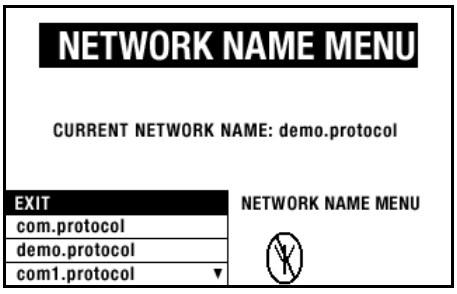
   If the current monitor network name is one of the following pre-set names:

com.protocol	demo.protocol
com1.protocol	com2.protocol
com3.protocol	com4.protocol
com5.protocol	com6.protocol
com7.protocol	com8.protocol

   then the monitor displays the following screen

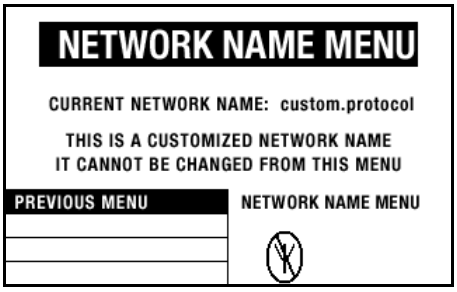


To change the network name, make sure **YES** is highlighted, then press ✓ to display the following screen:



Press ▲ or ▼ to highlight the desired network name, then press ✓. The monitor automatically turns itself off, then turns on and seeks to connect to a FlexNet network with the new network name.

If the current network name is a custom name, the monitor displays the following screen:



You cannot change the network name using the Network Name Menu. Press ✓ to return to the Service Menu. Contact Welch Allyn Technical Support for assistance.

6 Reference

Operating settings

The following table lists all of the monitor settings and the default settings.

Parameter	Set at Monitor	Set at Acuity		Previous Setting Retained at Monitor at Power-Up	Monitor Default Setting
		For Each Patient [a]	For Entire Acuity Unit[b]		
Patient Mode Adult (age 13 years and older) Pediatric (age greater than 28 days of age or more than 44 weeks gestation up to 12 years)	No	Yes	No	Yes	Adult
ECG screen mode (Single, Dual, 5 Sec, or Full Screen)	Yes	No	Yes	Yes	Single
ECG 1 Lead Selection	Yes	Yes	Yes	Yes	II
ECG 2 Lead Selection	Yes	Yes	Yes	Yes	V (or III if no V lead)
ECG Size (Scale)	Yes	No	No	Yes	1 mV/cm
Language	No	No	Yes	Yes	English
Mains Filter (off, 50, or 60 Hz)	No	No	Yes	Yes	60
Vital Signs Alarm Volume (high, low, or off) With Acuity Connection Without Acuity Connection	 No No	 No No	 Yes Yes	 No Yes	 off high
Equipment Alert Volume (high, low, or off) With Acuity Connection Without Acuity Connection	 No No	 No No	 Yes Yes	 No Yes	 off low
HR/PR Alarm Limits (Lower, Upper)	Yes	Yes	Yes	Yes	Adult: 50, 120 bpm Ped: 50, 150 bpm
SpO_2 Alarm Limits[c] (Lower, Upper)	Yes	Yes	Yes	Yes	Adult: 90, 100% Ped: 90, 100%
Regulatory settings (U.S., Europe, Japan)	No	No	Yes	Yes	U.S.
Pacer Detection Enable	No	Yes	No	Yes	On
Menu Lockout	No	No	Yes	No	Off
Display Backlight Timeout	No	No	Yes	Yes	120 seconds

a. Set by clinician at Acuity Central Station.

b. Set by Acuity System Administrator during system installation.

c. SpO_2 alarm limit range depends on the software version of the Acuity System to which the monitor is connected. (See "Heart rate and arrhythmia analysis option" on page 55 and "Pulse oximetry (SpO_2) specifications - Nellcor" on page 57.)

Specifications

Monitor radio specifications (5 GHz)

Characteristic	Specification
FlexNet™ Network	5 GHz orthogonal frequency division multiplexing (OFDM) wireless local area network (WLAN) and 10/100/1000 base-T Ethernet network
Modulation	OFDM
Output power	40 mW maximum; country-dependent
IEEE standards	802.11a, 802.11e, 802.11h, 802.1X
Monitors per access point	20 (max.)

Caution Some countries restrict the use of 5-GHz bandwidths. The 802.11a radio in the Micropaq monitor uses only the channels indicated by the access point with which the radio associates. The hospital IT department must therefore configure all associated access points to operate within approved domains.

Channel restrictions in the 5-GHz band, by country, are as follows:

Restrictions for use in the 5 GHz bands[a]		
Allowed frequency bands[b]	**Allowed channel numbers[c]**	**Countries**
5.15 to 5.25 GHz	36, 40, 44, 48	Austria
5.15 to 5.35 GHz	36, 40, 44, 48, 52, 56, 60, 64	Cyprus, Czech Republic, France, Hungary, Slovakia
5.15 to 5.35 GHz and 5.470 to 5.725 GHz	36, 40, 44, 48, 52, 56, 60, 64, 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140	Belgium, Bulgaria, Denmark, Estonia, Finland, Germany, Greece, Iceland, Ireland, Italy[d], Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovenia, Spain, Sweden, Switzerland, U.K.

a. This device may be not be operated outdoors when using the bands 5150 to 5350 MHz (Channels 36, 40, 44, 48, 52, 56, 50, 64).

b. This device must be used with Access Points that have employed and activated a radar detection feature required for European Community operation in the 5GHz bands. This device will operate under the control of the Access Point in order to avoid operating on a channel occupied by any radar system in the area. The presence of nearby radar operation may result in temporary interruption in communications of this device. The Access Point's radar detection feature will automatically restart operation on a channel free of radar. You may consult with the local technical support staff responsible for the wireless network to ensure the Access Point device(s) are properly configured for European Community operation.

c. To remain in conformance with European spectrum usage laws for Wireless LAN operation, the above 5 GHz channel limitations apply. The user should check the current channel of operation. If operation is occurring outside of the allowable frequencies as listed above, the user must cease operating the device at that location and consult the local technical support staff responsible for the wireless network.

d. In Italy the end-user must apply for a license from the national spectrum authority to operate this device outdoors.

Monitor radio specifications (2.4 GHz)

Characteristic	Specification
FlexNet Network	2.4 GHz Wireless Local Area Network (WLAN) and 10/100 Base-T Ethernet network
Frequency[a]	2.402 to 2.480 GHz
Modulation	Frequency Hopping Spread Spectrum (FHSS)
Output Power	100 mW
IEEE 802.11 compliant	Yes
Monitors per Access Point	15 (maximum) in most countries. In countries where available frequencies are limited, this number is reduced.

a. When used within certain countries, authorization for use is restricted as follows:
France: The equipment is internally restricted to the 2.448-2.482 GHz frequency range.
Spain: The equipment is internally restricted to the 2.447-2.473 GHz frequency range.
Japan: The equipment is internally restricted to the 2.473-2.495 GHz frequency range.
Italy: Operation requires a user license.
Note: The frequency ranges specified above are subject to geographic-specific regulatory authorities.

ECG specifications

The ECG channel meets all the requirements for Cardiac Monitors Heart Rate Meters and Alarms specified ANSI/AAMI EC13-1992, except for Impulse response at the monitor (section 3.2.9.8 part (c)), and Standardizing Voltage at the monitor and at Acuity (section 3.2.9.9). The channel also meets the American National Standard, Safe Current Limits for Electromedical Apparatus (ANSI/AAMI ES1-1993).

Characteristic	Specification
Connector	Hypertronics D01 latching connector
Selectable Leads	
5-Lead Cable	Monitored: II, III, V; Derived: I, aV_R, aV_L, aV_F
3-Lead Application (using 3-lead ECG cable, or 5-lead ECG cable with detachable lead wires; only RA, LA, LL electrodes connected)	Monitored: II
Lead Fault Indicator	Displayed chest icon with flashing indicator for each electrode
ECG Size (sensitivity)	0.2, 0.5, 1, 2, 4, and 8 mV/cm
Display Sweep Speed	25 mm/sec
Bandwidth	
Local display	0.5 to 94 Hz independent of patient mode
To Acuity Central Station	0.05 to 94 Hz independent of patient mode
Sample Rate	364 Hz (182 Hz with turning point decimation to Acuity Central Station)
Input Protection	Electrosurgery and defibrillator protected when used with ECG cables specified in the Welch Allyn *Products and Accessories* booklet (810-0409-XX).
Electrosurgery interference suppression	Included on all vectors.
Lead Fail Sense Current	70 nA dc typical for active leads. 140-280 nA dc typical for reference electrode, depending on number of electrodes attached.
Tall T-wave Rejection	Meets AAMI (USA) EC13-1992, section 3.1.2.1.c, up through 1.2 mV

Characteristic	Specification
Common Mode Rejection	
FILTER function OFF	<1 mV p-p RTI for 10V rms, 50/60 Hz into unbalanced input
FILTER function ON	<30 µV p-p RTI for 10V rms, 50/60 Hz into unbalanced input
Input Impedance	>2.5 M¾ differential @ 60 Hz
Input Range (ac)	10 mV peak to peak (local display) 10 mV peak to peak (Acuity Central Station)
Input Range (dc)	Up to ±500 mV
System Noise	ð30 µV peak-to-peak, RTI
QRS Detector	Adult or Pediatric Amplitude Range: 0.22 to 5.0 mV (RTI) Adult Width Range (Duration): 70 to 120 msec Pediatric Width Range (Duration): 40 to 120 msec
Heart Rate Range	25 to 350 beats per minute (measurement) 25 to 300 beats per minute (display)
Alarm Limits	25 to 245 beats per minute (lower) 30 to 250 beats per minute (upper)
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 EC13-1992 clause 4.1.2.1 (f), including 3.1.2.1 parts f. and g. waveforms.) Includes 1 second readout update interval.
HR Display Update Interval at monitor	1 second
HR Accuracy	±3 beats per minute or 3%, whichever is greater
Heart Rate Response to ineffectively paced QRS pattern	Indicates rate of 30 to 46 during AAMI EC13-1992 part 3.1.4.1 part (f) and (g) tests. NOTE: AAMI Test 4.1.4 part f and g: Accuracy is affected (i.e., rate increases) 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 of previous average interval + 1/4 of 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 Pulse Display	Pacer indicator shown on screen if PACER display 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 ±3 mV to ±700 mV @ 0.1 ms width, ±2 mV to ±700 mV @ 0.2 to 2 ms pulse width in electrically quiet environment. Thresholds automatically adjust to reject repetitive ambient noise. Operates even while pacer indication is disabled. 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 up to 25%, 2mV maximum, whether ventricular only, or A-V sequential pulses (150 and 250 ms separation), 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)

Heart rate and arrhythmia analysis option

Method for calculating heart rate	
Monitor	Determined by monitor (displayed at monitor) 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.
Acuity System with Arrhythmia Option	Determined by Acuity Arrhythmia Option software (displayed at Acuity Central Station) The beat-to-beat heart rate (HR) value is calculated as follows: HR = 60000/actual RR (bpm). Actual RR = time between last detected QRS complex and previously detected QRS complex (ms). Average HR is calculated on the basis of the mean RR interval in the last 6 seconds or 8 RR intervals (whichever is shorter).
Arrhythmia analysis option when connected to Acuity	
ST Analysis	ST Analysis can be performed for any or all of seven leads, depending on the operator selection. The operator can select a measurement offset. ST segment shifts are recorded in continuous trend data every second. The operator can inspect trend data to see the duration and elevation or depression for each episode for any time period recorded. The operator can also inspect a summary of ST segment shift data within tabular trends.
Heart Rate	Heart rate information is available in the trend data which can be viewed on the display or printed. The operator can inspect the trend data to see the lowest, highest, and median (averaged) heart rates. Trend data also includes the total beats per range of time.
Definition of Pause Arrhythmia Event	A pause is defined as the R-R interval which is greater than or equal to two times the average R-R.

Pulse oximetry (SpO_2) specifications - Masimo

SpO2 complies with EN ISO 9919:2005.

Characteristic	Specification
Saturation (% SpO_2)	
Range	1% to 100%
Resolution	1%
Alarm Limits[a]	
With Acuity 6.0 or higher	50% to 99% (lower); 51% to 100% (upper)
With Acuity 5.4X or lower	80% to 99% (lower); 81% to 100% (upper)
Probe Accuracy (Adults, Pediatrics)	
No Motion	70% to 100% ±2 counts 0% to 69% unspecified
During Motion[b]	70% to 100% ±3 counts 0% to 69% unspecified
Pulse Rate	
Range	26 to 239 beats per minute
Resolution	1 beat per minute
Alarm Limits	25 to 245 beats per minute (lower) 30 to 250 beats per minute (upper)
Pulse Rate Accuracy	
No Motion	±3 beats per minute
During Motion[2]	±5 beats per minute
Display Update Interval at monitor	1 second
Alarm Hold-Off Time Period	10 seconds; resets if the sensor reports levels within limits before 10 seconds elapses
Circuitry	Microprocessor controlled Automatic self-test of oximeter when powered on Automatic setting of default parameters Automatic alarm messages
Electrosurgery interference suppression	Yes
Sensor Compatibility	Compatible only with Masimo sensors listed in the Micropaq monitor section of the Welch Allyn *Products and Accessories* booklet (810-0409-XX). For probe/sensor compliance to EN ISO 9919:2005, see the Masimo directions for use.
Sensor LEDs	
RED Wavelength	660 nm (nominal)
INFRARED Wavelength	905 nm (nominal)
Sensor Energies (Radiant Power)	0.13 mW to 0.79 mW at 50 mA pulsed

a. SpO_2 alarm limit range depends on the software version of the Acuity System to which the monitor is connected.

b. Motion is defined as rubbing and tapping motions at 2 to 4 Hz at an amplitude of 1 to 2 cm and a nonrepetitive motion between 1 to 5 Hz at an amplitude of 2 to 3 cm in induced hypoxia studies in the range of 70-100% SpO_2 against a laboratory co-oximeter and ECG monitor. This variation equals ±1 standard deviation which encompasses 68% of the population.

WARNING Interfering Substances: Carboxyhemoglobin may erroneously increase readings. The level of increase is approximately equal to the amount of carboxyhemoglobin present. Dyes, or any substances containing dyes, that change usual arterial pigmentation may cause erroneous readings.

WARNING Although the SpO_2 alarm limit range can be adjusted down to 50% saturation (with Acuity 6.0 software or higher), the SpO_2 performance and accuracy is not specified below 70%.

Pulse oximetry (SpO_2) specifications - Nellcor

SpO2 complies with EN ISO 9919:2005.

Characteristic	Specification
Saturation (% SpO_2)	
Range	1% to 100%
Resolution	1%
Alarm Limits[a]	
With Acuity 6.0 or higher	50% to 99% (lower); 51% to 100% (upper)
With Acuity 5.4X or lower	80% to 99% (lower); 81% to 100% (upper)
Probe Accuracy[b] (Adults, Pediatrics)	70% to 100% (0% to 69% unspecified) OxiMax Max-A, Max-AL ±2 counts OxiCliq N ±2.5 counts D-YS ±3 counts DS-100A ±3.5 counts
Pulse Rate	
Range	26 to 239 beats per minute
Resolution	1 beat per minute
Alarm Limits	25 to 245 beats per minute (lower) 30 to 250 beats per minute (upper)
Pulse Rate Accuracy	±3 beats per minute
Display Update Interval at the monitor	1 second
Alarm Hold-Off Time Period	10 seconds; resets if the sensor reports levels within limits before 10 seconds elapses
Circuitry	Microprocessor controlled Automatic self-test of oximeter when powered on Automatic setting of default parameters Automatic alarm messages
Electrosurgery interference suppression	Yes
Sensor Compatibility	Compatible only with Nellcor sensors listed in the Micropaq monitor section of the Welch Allyn *Products and Accessories* booklet (810-0409-XX). For probe/sensor compliance to EN ISO 9919:2005, see the Nellcor directions for use.
Sensor LED Wavelengths	Within 500 to 1,000 nm
Sensor Energies (Radiant Power)	Does not exceed 15 mW

a. SpO_2 alarm limit range depends on the software version of the Acuity System to which the monitor is connected.

b. Although some of the listed Nellcor sensors can be used with neonates with other pulse oximetry devices, the monitor is only intended for use with adult and pediatric patients, not with neonates.

WARNING Interfering Substances: Carboxyhemoglobin may erroneously increase readings. The level of increase is approximately equal to the amount of carboxyhemoglobin present. Dyes, or any substances containing dyes, that change usual arterial pigmentation may cause erroneous readings.

WARNING Although the SpO_2 alarm limit range can be adjusted down to 50% saturation (with Acuity 6.0 software or higher), the SpO_2 performance and accuracy is not specified below 70%.

Patient alarm and equipment alert specifications

Characteristic	Specification
Visual Alarm Indicator at the monitor	
Flashing GREEN LED	Normal operation
Flashing RED LED	Patient alarm
Continuously ON RED LED	Patient alarms are silenced
Flashing YELLOW LED	An equipment alert or not connected to the network
Continuously ON YELLOW LED	Equipment alert suspended for 90 seconds at Acuity or low battery alert acknowledged (dismissed)
Audio Tone Locations	Monitor Acuity Central Station (when connected)
Audio Tone Frequency	2900 Hz
Life-Threatening Arrhythmia Alarm Tone Pattern	1 second on, 1 second off
Patient Alarm Tone Pattern	1second on, 2 seconds off
Equipment Alert Tone Pattern	1second on, 4 seconds off
Audio Tone Volume	The monitor audio tone volume is configured by the Acuity System to High, Low, or Off. The monitor can be configured with separate audio tone volume settings for when it is connected to an Acuity System and when it is not.
Limits	Setable on all parameters
Alarm Control	Automatic preset or manual settings
Alarm Priority	Highest priority: 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."
Alarm Holdoff Time Period[a]	HR = 3 seconds % SpO_2, PR = 10 seconds
Acuity-Configurable Audio Alarm Delay at the monitor	When a monitor is connected to an Acuity System, the audio alarms at the 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.
Patient Alarm Tone Silence from the monitor or Suspend from Acuity	The monitor LED is continuously ON RED and the audio tone is silenced for 90 seconds (non-adjustable). If original alarm was silenced from the monitor, new patient alarms or equipment alerts break the silence at the monitor, but only life-threatening arrhythmia alarms break the silence at Acuity. If original alarm suspended at Acuity, only life-threatening arrhythmia alarms break the silence at the monitor and Acuity.
Equipment Alert Acknowledge from the monitor	The LED returns to the pre-alert state (except Low Battery remains continuously ON YELLOW) and the auditory tone is dismissed.
Equipment Alert Suspend from Acuity	The LED is continuously ON YELLOW and the audio tone is silenced for 90 seconds (non-adjustable).
Patient Alarm Tone Reset from the monitor or Resume from Acuity	For a patient alarm tone that has been silenced, resets the tone.
Patient Out of Range; Transmitter Failure	An equipment alert is generated whenever the monitor fails to communicate to an Acuity System after a connection has been successfully established. In addition, the “No Acuity” icon is displayed on the monitor display.

Characteristic	Specification
Transmitter Battery Failure	An equipment alert is generated before the monitor battery becomes exhausted.

a. To help minimize false alarms, the monitor briefly delays or "holds off" triggering both audible and visual alarms for limit violations for these vital signs. After the alarm hold-off period begins, if the monitor detects that the patient's vital sign has returned to acceptable limits, the monitor cancels the alarm hold-off. The next time a vital sign limit is violated, the monitor starts a new hold-off period.

Display specifications

Characteristic	Specification
Type	Monochrome passive matrix; LCD module
Resolution	320 x 200 pixels
Active Viewing Area	2.26 x 1.41 in. (57.5 x 35.9 mm)
Pixel Pitch	0.0071 in. (0.18 mm)
Pixel Size	0.0065 in. (0.165 mm)
Viewing Angle	6 o'clock position
Display Color	black on white

Environmental specifications (with battery installed)

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
Drop	1 meter onto vinyl tile over concrete per EN60601-1
Shock	50 g
Vibration, Random	$0.02g^2$/Hz from 10 to 500 Hz, ramping down to $0.002g^2$/Hz at 2000 Hz. Operating 1 hour per axis, 3 hours per test. Designed to meet RTCA DO-160D, Category C.
Degree of Protection Against Ingress	IPX1 Rating, Drip Proof per EN60529: 1991
Electromagnetic Compatibility (EMC)	EN60601-1-2: 2001

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

Physical specifications

Protection classifications, all configurations	
Characteristic	**Specification**
Type of Protection against Electric Shock—Monitor Type: CF	Battery operation only Battery must be recharged in separate battery charger. IEC EN 60601-1, 2nd Edition
Degree of Protection Against Electric Shock, for Parts Applied to Patients	See monitor labels. CF defibrillator protected. IEC EN 60601-1, 2nd Edition
Recovery time following defibrillator discharge	Less than or equal to 10 seconds
Method of Disinfection	Not suitable for autoclaving (see cleaning instructions on "Inspect the monitor, batteries, battery charger, and accessories" on page 45).
Flammable Anesthetics	Not suitable for use with flammable anesthetics.
Height	7.80 in (19.8 cm)
Width	3.50 in (8.9 cm)
Depth	1.96 in (4.9 cm)
Weight (including battery) Model 406 Model 408	 17.0 oz (0.48 kg) 18.6 oz (0.53 kg)

Battery specifications

Characteristic	Specifications
Reorder Number Lithium Ion Battery 2EA Active A	008-0647-XX
Battery Type	Rechargeable, Lithium Ion
Battery Capacity	2 cells, 7.4 V (nominal), 8.4 V (charging), 1800 mA-hr
Battery Weight	4.5 oz (0.13 kg)
Battery Charger	External device
Battery Fuse Rating	5 A, 125 V (not user-accessible) Note: Internal electronic overload circuitry is used as the primary method of protection.
Operating Times on Battery[a]	Model 406: 25 hrs Model 408: 10 hrs
Battery Recharge Time	4 hours at 25° C (typical)
Battery Lifetime	300 charge/discharge cycles to 70% of original capacity (typical)

a. Battery operating times based on these conditions: new fully-charged battery operating at 25° C, the monitor connected to Acuity, eight patient alarms per hour, minimal motion artifact.

Note The following factors may reduce battery operating time:

- Amount of time not connected to Acuity.
- Frequency and duration of alarms and alerts.
- Amount of operator activity using monitor keys (activates display).
- Age of battery.
- Amount of motion artifact during SpO_2 monitoring.

WARNING The monitor battery is Lithium Ion. Do not incinerate, submerge, crush, disassemble, or autoclave. If a battery has been submerged in liquid, discard the battery properly; do not try to recharge or reuse the battery. Do not short the battery terminals. Do not try to connect the battery to any device except the monitor or the battery charger. Do not expose to high temperature (above 60° C or 140° F). Use only the specified monitor battery charger.

Eight-bay battery charger specifications

Characteristic	Specification
Reorder Number Universal Battery Charger Active C	008-0651-XX
Functional Specifications	
Capacity	Eight charging bays; able to charge four (Lithium Ion) batteries simultaneously.
Protection Classifications[a]	
Duty Cycle	Continuous
Type of Protection Against Electric Shock	Class I, (Protectively Earthed) with Double Insulation
Degree of Protection Against Harmful Ingress of Water	For ordinary, indoor locations only.
Method of Disinfection	Not suitable for autoclaving. (See cleaning instructions on "Inspect the monitor, batteries, battery charger, and accessories" on page 45.)
Flammable Anesthetics	Not suitable for use with flammable anesthetics.
Environmental Specifications	
Operating Temperature	0° to 40° 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	30 g
Vibration	$0.01g^2$/Hz from 5 to 500 Hz, 30 minutes per axis
Electromagnetic Compatibility (EMC)	EN60601-1-2: 2001
Physical Specifications	
Length	15.0 in (38.1 cm)
Width	9.0 in (22.9 cm)
Height	3.6 in (9.1 cm) including feet
Weight	3.5 lb (1.6 kg)
Electrical Specifications	
Rated Input	100 V-240 V AC 600 mA, 50/60 ± 3 Hz, Electrical Class I
Rated Fuses	T1.25 A/250V, Time-Delay 5x20mm
Rated Output per charging bay (Continuous)	8.4 V ± 100 mV dc @1 A max.
Charge Time	4 hours typical for fully discharged battery. Automatic charge termination when charge is completed, or fault detected.
Output Over-Current	Electronic overload protection
Additional Features	Detachable power cord
LED Indicators	
LED OFF	No battery detected.
Flashing GREEN LED 1 sec ON, 3 sec OFF 1 sec ON, 1 sec OFF	 Battery detected, waiting to be charged Battery is charged
Continuously ON GREEN LED	Battery is charged.
Continuously ON YELLOW LED	Battery or charging bay fault.

a. Per EN 60601-1 unless otherwise stated.

7 Compliance

General

The 802.11a Wireless PC Card must be installed and used in strict accordance with the manufacturer's instructions as described in the user documentation that comes with the product.

This product contains encryption. It is unlawful to export out of the U.S. without obtaining a U.S. Export License.

Federal Communications Commission (FCC)

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with the instructions, it may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by tuning the equipment off and on, the user is encouraged to try and correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the distance between the equipment and the receiver
- Connect the equipment to outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

The user may find the following booklet prepared by the Federal Communications Commission helpful:

The Interference Handbook

This booklet is available from the U.S. Government Printing Office, Washington, D.C. 20402. Stock No. 004-000-0034504.

Welch Allyn is not responsible for any radio or television interference caused by unauthorized modification of the devices included with this Welch Allyn product, or the

substitution or attachment of connecting cables and equipment other than specified by Welch Allyn.

The correction of interference caused by such unauthorized modification, substitution or attachment will be the responsibility of the user.

Industry Canada (IC) emissions

This device complies with RSS 210 of Industry Canada.

Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of this device.

L'utilisation de ce dispositif est autorisée seulement aux conditions suivantes: (1) il ne doit pas produire de brouillage et (2) l' utilisateur du dispositif doit étre prêt à accepter tout brouillage radioélectrique reçu, même si ce brouillage est susceptible de compromettre le fonctionnement du dispositif.

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conform à la norme NMB-003 du Canada.

European Union

Czech	Welch Allyn tímto prohlašuje, ze tento *RLAN device* je ve shodě se základními po_adavky a dalšími příslušnými ustanoveními směrnice 1999/5/ES.
Danish	Undertegnede Welch Allyn erklærer herved, at følgende udstyr RLAN device overholder de væsentlige krav og øvrige relevante krav i direktiv 1999/5/EF
Dutch	Bij deze verklaart Welch Allyn dat deze RLAN device voldoet aan de essentiële eisen en aan de overige relevante bepalingen van Richtlijn 1999/5/EC.
English	Hereby, Welch Allyn, declares that this RLAN device is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.
Estonian	Käesolevaga kinnitab Welch Allyn seadme RLAN device vastavust direktiivi 1999/5/EÜ põhinõuetele ja nimetatud direktiivist tulenevatele teistele asjakohastele sätetele.
Finnish	Welch Allyn vakuuttaa täten että RLAN device tyyppinen laite on direktiivin 1999/5/EY oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.
French	Par la présente, Welch Allyn déclare que ce RLAN device est conforme aux exigences essentielles et aux autres dispositions de la directive 1999/5/CE qui lui sont applicables
German	Hiermit erklärt Welch Allyn die Übereinstimmung des Gerätes RLAN device mit den grundlegenden Anforderungen und den anderen relevanten Festlegungen der Richtlinie 1999/5/EG. (Wien)
Greek	ΜΕ ΤΗΝ ΠΑΡΟΥΣΑ Welch Allyn ΔΗΛΩΝΕΙ ΟΤΙ RLAN device ΣΥΜΜΟΡΦΩΝΕΤΑΙ ΠΡΟΣ ΤΙΣ ΟΥΣΙΩΔΕΙΣ ΑΠΑΙΤΗΣΕΙΣ ΚΑΙ ΤΙΣ ΛΟΙΠΕΣ ΣΧΕΤΙΚΕΣ ΔΙΑΤΑΞΕΙΣ ΤΗΣ ΟΔΗΓΙΑΣ 1999/5/ΕΚ
Hungarian	Alulírott, Welch Allyn nyilatkozom, hogy a RLAN device megfelel a vonatkozó alapvetõ követelményeknek és az 1999/5/EC irányelv egyéb elõírásainak.
Italian	Con la presente Welch Allyn dichiara che questo RLAN device è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 1999/5/CE.
Latvian	Ar šo Welch Allyn deklarē, ka *RLAN device* atbilst Direktīvas 1999/5/EK būtiskajām prasībām un citiem ar to saistītajiem noteikumiem.
Lithuanian	Šiuo Welch Allyn deklaruoja, kad šis RLAN device atitinka esminius reikalavimus ir kitas 1999/5/EB Direktyvos nuostatas.
Malti	Hawnhekk, Welch Allyn, jiddikjara li dan RLAN device jikkonforma mal-htigijiet essenzjali u ma provvedimenti ohrajn relevanti li hemm fid-Dirrettiva 1999/5/EC
Portuguese	Welch Allyn declara que este RLAN device está conforme com os requisitos essenciais e outras disposições da Directiva 1999/5/CE.
Slovak	Welch Allyn týmto vyhlasuje, ze RLAN device spĺňa základné po_iadavky a všetky príslušné ustanovenia Smernice 1999/5/ES.
Slovene	Šiuo Welch Allyn deklaruoja, kad šis RLAN device atitinka esminius reikalavimus ir kitas 1999/5/EB Direktyvos nuostatas.

Spanish	Por medio de la presente Welch Allyn declara que el RLAN device cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 1999/5/CE
Swedish	Härmed intygar Welch Allyn att denna RLAN device står I överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 1999/5/EG.

Electromagnetic compatibility

Special precautions concerning electromagnetic compatibility (EMC) must be taken for all medical electrical equipment. This device complies with IEC EN 60601-1-2:2001.

- All medical electrical equipment must be installed and put into service in accordance with the EMC information provided in this document and the *Micropaq Monitor Directions For Use*.
- Portable and mobile RF communications equipment can affect the behavior of medical electrical equipment.

The monitors and battery charger comply with all applicable and required standards for electromagnetic interference.

- It does not normally affect nearby equipment and devices.
- It is not normally affected by nearby equipment and devices.
- It is safe to operate the monitor in the presence of high-frequency surgical equipment.
- However, it is good practice to avoid using the monitor in extremely close proximity to other equipment.

Monitor

Monitor - Guidance and Manufacturer's Declaration—Electromagnetic Emissions		
The Model 4XX Series Monitor is intended for use in the electromagnetic environment specified below. The customer or the user of the monitor should assure that it is used in such an environment.		
Emissions test	**Compliance**	**Electromagnetic Environment—Guidance**
RF emissions CISPR 11	Group 2	The Model 4XX Series Monitor must emit electromagnetic energy in order to perform its intended function. Nearby electronic equipment may be affected.[a]
RF emissions CISPR 11	Class B	The Model 4XX Series Monitor is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	No connection to mains (battery-operated)	
Voltage fluctuations/flicker emissions IEC 61000-3-3	No connection to mains (battery-operated)	

a. The Model 4XX Series Monitor contains a 5-GHz orthogonal frequency-division multiplexing transmitter or a 2.4-GHz frequency-hopping spread-spectrum transmitter for the purpose of wireless communication. The radio is operated according to the requirements of various agencies, including FCC 47 CFR 15.247 and R&TTE Directive (1995/5/EC). The transmitter is excluded from the EMC requirements of 60601-1-2:2001, but should be considered when addressing possible interference issues between this and other devices.

Monitor - Guidance and Manufacturer's Declaration—Electromagnetic Immunity

The Model 4XX Series Monitor is intended for use in the electromagnetic environment specified below. The customer or the user of the monitor should assure that it is used in such an environment.

Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment—Guidance
Electrostatic discharge (ESD) IEC 61000-4-2	±6 kV contact ±8 kV air	±6 kV contact ±8 kV air	Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/ burst IEC 61000-4-4	±2 kV for power supply lines ±1 kV for input/output lines	No connection to mains (battery-operated). No other cables requiring EFT/Burst testing.	Since there is no connection to the mains, there is no requirement for mains quality.
Surge IEC 61000-4-5	±1 kV differential mode ±2 kV common mode	No connection to mains (battery-operated).	
Voltage dips, short interruptions, and voltage variations on power-supply input lines IEC 61000-4-11	<5% U_t (>95% dip in U_t) for 0.5 cycle 40% U_t (60% dip in U_t) for 5 cycles 70% U_t (30% dip in U_t) for 25 cycles <5% U_t (>95% dip in U_t) for 5 sec	No connection to mains (battery-operated).	
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.

Note U_t is the AC mains voltage prior to application of the test level.

Monitor - Guidance and Manufacturer's Declaration—Electromagnetic Immunity

The Model 4XX Series Monitor is intended for use in the electromagnetic environment specified below. The customer or the user of the monitor should assure that it is used in such an environment.

Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment—Guidance
			Portable and mobile RF communications equipment should be used no closer to any part of the Model 4XX Series Monitor, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended Separation Distance**
Conducted RF IEC 61000-4-6	3 V_{rms} 150 kHz to 80 MHz 2Hz AM	3 V_{rms}	$d = 1.2\ \sqrt{P}$
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2.5 GHz 2Hz AM	3 V/m	$d = 1.2\ \sqrt{P}$ 80 MHz to 800 MHz $d = 2.3\ \sqrt{P}$ 800 MHz to 2.5 GHz where **P** is the maximum output power rating of the transmitter in watts according to the transmitter manufacturer and **d** is the recommended separation distance in meters. Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey[a], should be less than the compliance level in each frequency range[b]. Interference may occur in the vicinity of equipment marked with the following symbol: 

Note 1 At 80 MHz and 800 MHz, the higher frequency range applies.

Note 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

a Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the Model 4XX Series Monitor is used exceeds the applicable RF compliance level above, the Model 4XX Series Monitor should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the monitor.

b Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

Recommended Separation Distances Between Portable and Mobile RF Communications Equipment and the Model 4XX Series Monitor

The Model 4XX Series Monitor is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the monitor can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the monitor as recommended below, according to the maximum output power of the communications equipment.

Rated Maximum Output Power of Transmitter (W)	**Separation Distance (m) According to Frequency of Transmitter**		
	150 kHz to 80 MHz $d = 1.2\sqrt{P}$	**80 MHz to 800 MHz** $d = 1.2\sqrt{P}$	**800 MHz to 2.5 GHz** $d = 2.3\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

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

NOTE 1 At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

Battery charger for the monitor

Monitor Battery Charger Only- Guidance and Manufacturer's Declaration—Electromagnetic Emissions		
The Battery Charger for the Model 4XX Series Monitor is intended for use in the electromagnetic environment specified below. The customer or the user of the battery charger should assure that it is used in such an environment.		
Emissions test	**Compliance**	**Electromagnetic Environment—Guidance**
RF emissions CISPR 11	Group 1	The Battery Charger uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class B	The Battery Charger is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/ flicker emissions IEC 61000-3-3	Complies	

Monitor Battery Charger Only- Guidance and Manufacturer's Declaration—Electromagnetic Immunity

The Battery Charger for the Model 4XX Series Monitor is intended for use in the electromagnetic environment specified below. The customer or the user of the monitor should assure that it is used in such an environment.

Immunity Test	IEC 60601 Test level	Compliance Level	Electromagnetic Environment—Guidance
Electrostatic discharge (ESD) IEC 61000-4-2	±6 kV contact ±8 kV air	±6 kV contact ±8 kV air	Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	±2 kV for power supply lines ±1 kV for input/output lines	±2 kV for power supply lines ±1 kV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1 kV differential mode ±2 kV common mode	±1 kV differential mode ±2 kV common mode	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions, and voltage variations on power-supply input lines IEC 61000-4-11	<5% U_t (>95% dip in U_t) for 0.5 cycle 40% U_t (60% dip in U_t) for 5 cycles 70% U_t (30% dip in U_t) for 25 cycles <5% U_t (>95% dip in U_t) for 5 sec	<5% U_t (>95% dip in U_t) for 0.5 cycle 40% U_t (60% dip in U_t) for 5 cycles 70% U_t (30% dip in U_t) for 25 cycles <5% U_t (>95% dip in U_t) for 5 sec	Mains power quality should be that of a typical commercial or hospital environment. If the user of the Battery Charger requires continued operation during a power mains interruption, it is recommended that the Battery Charger be powered from an uninterruptible power supply or battery.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.

Note U_t is the AC mains voltage prior to application of the test level.

Monitor Battery Charger Only- Guidance and Manufacturer's Declaration—Electromagnetic Immunity

The Battery Charger for the Model 4XX Series Monitor is intended for use in the electromagnetic environment specified below. The customer or the user of the battery charger should assure that it is used in such an environment.

Immunity test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment—Guidance
			Portable and mobile RF communications equipment should be used no closer to any part of the Battery Charger, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.
			Recommended Separation Distance
Conducted RF IEC 61000-4-6	3 V_{rms} 150 kHz to 80 MHz 2Hz AM	3 V_{rms}	$d = 1.2\ \sqrt{P}$
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2.5 GHz 2Hz AM	3 V/m	$d = 1.2\ \sqrt{P}$ 80 MHz to 800 MHz $d = 2.3\ \sqrt{P}$ 800 MHz to 2.5 GHz where **P** is the maximum output power rating of the transmitter in watts according to the transmitter manufacturer and **d** is the recommended separation distance in meters. Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey[a], should be less than the compliance level in each frequency range[b]. Interference may occur in the vicinity of equipment marked with the following symbol: 

Note 1 At 80 MHz and 800 MHz, the higher frequency range applies.

Note 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

a Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the Battery Charger is used exceeds the applicable RF compliance level above, the Battery Charger should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the Battery Charger.

b Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

Recommended Separation Distances between Portable and Mobile RF Communications Equipment and the Battery Charger for the Model 4XX Series Monitor

The Battery Charger for the Model 4XX Series Monitor is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the Battery Charger can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the Battery Charger as recommended below, according to the maximum output power of the communications equipment.

Rated Maximum Output Power of Transmitter (W)	**Separation Distance (m) According to Frequency of Transmitter**		
	150 kHz to 80 MHz $d = 1.2\ \sqrt{P}$	**80 MHz to 800 MHz** $d = 1.2\ \sqrt{P}$	**800 MHz to 2.5 GHz** $d = 2.3\ \sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

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

Note 1	At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.
Note 2	These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

Index

1-Waveform display, 15
2-Waveform display, 15
5-Second waveform display, 15

A

Accessories, 16
  Inspection and cleaning, 45
  Use only recommended, 6, 16
Access points, 8
Acuity, 8
  Acuity Central Station, 1, 8
  Alarm holdoff at Acuity, 58
  Default settings for Micropaq, 51
  Download default settings, 21
  DROPOUT equipment alert, 30
  Messages displayed on Micropaq, 16
  Micropaq operating settings, 16
  Monitoring at Acuity, 41
  Silence Micropaq alarms, 36
ACUITY CONNECTION LOST, 40
Acuity Menu
  END TELE, 13
  NEW PATIENT, 13
  NEW ROOM, 13
  TRANSFER, 13
Adjust alarm limits at Micropaq, 37
Alarm/Alert Silence Key, 11
Alarm holdoff with Acuity, 58
Alarms
  Adjust alarm limits at Micropaq, 37
  Alarm holdoffs (delays), 35
  Alarms off symbol, 12
  Download defaults from Acuity, 21
  Priority, 58
  Respond to patient alarms, 36
  Silence Alarms Key, 11
  Specifications, 58
Alerts, 35
  Messages, 40
  Micropaq, 38
  Silence Alerts Key, 11
Anemia and SpO2, 27
Anesthetics
  Warning, 4
Arterial occlusion and SpO2, 27
Artifact interference and waveform display, 22
Audible indicator, 10
Autoclave, caution about use, 6, 45

B

Battery
  Changing, 43
  Low battery icon, 12
  Recharge, 43
  Recycling, 47
  Specifications, 60
Battery charger
  Specifications, 61
  Use, 43
Battery life
  Sleep mode, 12
BATTERY TOO LOW, 40
Beeps, 10
Bell symbol, 12
Blank display during sleep, 12

C

Cardiac arrest and SpO2, 27
Cautions, general, 6
Change network name, 48
Change the battery, 43
Change waveform display, 15
Charge a battery, 43
Charger
  Recharge a battery, 43
  Specifications, 61
Cleaning, 45
Connect a new patient, 19, 21
Connect to the network, 19
Customize alarms, 21

D

Default

Acuity and settings, 16, 51
Operating settings, 16, 51
DEFECTIVE SPO2 SENSOR, 40
Defibrillation
During SpO2 monitoring, 26
Warning, 4
Delays for alarms, 35
Demo Mode
Accessing, 17
Display values, alarm limits, 18
Toggling between modes, 18
Demonstration Mode, 17
Disconnection symbol, 12
Discontinue monitoring a patient, 30
Display
Alert messages, 40
Artifact interference, 22
Blank during sleep mode, 12
Indicator symbols, 12
Pacemaker signals, 12
Sleep mode, 12
Specifications, 59
Waveform display options, 15
DROPOUT alert at Acuity, 30, 43

E

ECG
Alarm holdoff (delay), 35
Electrode application, 21
Electrode lead off, 23
Lead selection, 13
Scale selection, 13
Size (scale) selection, 13
Electrode application, 21
Electrosurgery warning, 4
END TELE, 13, 30
Environmental specifications, 59
Equipment alert
Description, 38
Messages, 40
Errors
Error message, 6
Error number, 6
Ethernet, 1
EXCESSIVE ECG OFFSET, 40

F

FCC
Warning, RF, 5
Federal Communications Commission
see FCC
FlexNet, 1, 8
Access points, 8
Automatic reconnection, 8
Defined, 8
Operation out of range, 8
Full Screen waveform display, 15

G

General cautions, 6
General Warnings, 4
Green LED, 10

H

Hazards
General cautions, 6
General warnings, 4
Holdoffs (delays) for alarms, 35
Hyperbaric chamber
Warning, do not use, 4, 21
Hypotension and SpO2, 27
Hypothermia and SpO2, 27

I

In-Service
see Demo Mode
Inspection, 45
Intended Use, 1

K

Keys
Alarm/Alert Silence, 11
Scroll Up/Down, 10
Select, 11
KEY STUCK, 40

L

Lead off indication, 23
Lead selection, 13
LEDs defined, 10
List of patients, 20
List of rooms, 21
Lithium ion battery, 43
Lockout menu, 14, 51
Low battery icon, 12
LOW BATTERY message, 40

M

Magnetic Resonance Imaging
see MRI

Main Menu
EXIT, 13
Menu Lock option, 14, 51
Restricting access, 14
Maintenance
Inspection and cleaning, 45
Operator maintenance, 43
Masimo
SET technology, 7
Menu Lock option, 14, 51
Messages for alerts, 40
Messages from Acuity, 16
Micropaq
Acuity messages, 16
Adjust alarm limits, 37
Alarms, 36
Audible indicators, 10
Automatic reconnection, 8
Battery recharging, 43
Communication with network, 8
Connect to the network, 19
Default operating settings, 16
Default settings, 51
Demo Mode, 17
Equipment alert, 38
Features, 7
NEW PATIENT, 34
Operating settings, 16
Out of range operation, 8
Reassign to new patient, 34
Specifications, 52
Monitor
Audible indicators, 10
Features, 7
Out of range, 29
Recycling, 47
Specifications, 52
Monitoring
At Acuity, 41
Connect a new patient, 19
Reconnect a recently monitored patient, 31
Stop monitoring a patient, 30
Motion interference and SpO2, 27
MRI
Warning, do not use monitor, 4, 21

N

Nellcor
OxiMax technology, 7
Neonatal
Not intended for use, 4
Network
Access points, 8
Automatic reconnection, 8
Connect the monitor, 19
Disconnection symbol, 12
Ethernet, 1
FlexNet, 8
Name change, 48
Operation out of range, 8
NEW PATIENT, 13, 34
NEW ROOM, 13, 32
NIBP
While monitoring SpO2, 27
NO ECG CABLE DETECTED, 40
NO SPO2 SENSOR DETECTED, 40

O

Operation
Default settings, 16
Settings, 16
Operator maintenance, 43
Out of range, 8
Monitor a patient out of range, 29
OxiMax technology, Nellcor, 7

P

Pacemaker
Signal detection, display, 12
Warning, rate meters, 4
Warning, wireless radio, 6
Pacer
see Pacemaker
Pacer detection, 51
Patient
Alarms, 36
Reassign to a new room, 32
Reconnect a recently monitored patient, 31
TRANSFER, 33
Patient alarms
Download defaults from Acuity, 21
Patient list, 20
Patient preparation for ECG, 21
Physical specifications, 60
Power specifications, 60
Prepare the patient, 21
Pulse oximetry
see SpO2

R

Radio Frequency
see RF
Reassign Micropaq to new patient, 34
Reassign to a new room, 32
Recharge a battery, 43

Reconnect a recently monitored patient, 31
Reconnection to network, 8
Recycling
  Batteries, 47
  Monitor, 47
Red LED, 10
Replace the battery, 43
Respond to equipment alert, 38
Respond to patient alarms, 36
RF warning, exposure, 5
Room selection, 21
Routine maintenance, 43

S

Scroll Up/Down Keys, 10
Select
  Patient, 20
  Room, 21
  Select Patient at Central, 20
  Select Room at Central, 21
Select Key, 11
Select Room at Central, 32, 33
Set patient alarms, 37
SET technology, Masimo, 7
Settings, operating, 51
Shock and SpO2, 27
Silence Alarm/Alert Key, 11
Silence alarms, 36
Simulation
  see Demo Mode
Site preparation for ECG, 21
Sleep mode, display, 12
Snapshot Key, 10
Specifications, 52
  Alarms, 58
  Battery, 60
  Battery charger, 61
  Display, 59
  Environmental, 59
  Physical, 60
  SpO2, 56
SpO2
  Alarm holdoff (delay), 35
  Anemia, 27
  Arterial occlusion, 27
  Cardiac arrest or shock, 27
  Hypotension, 27
  Hypothermia, 27
  Light interference, 27
  Monitoring, 26
  Monitoring and defibrillation, 26
  Motion interference, 27
  Specifications, 56
  Vasoconstriction, 27
  Warnings, 26
  While monitoring NIBP, 27
Stop monitoring a patient, 30
Symbols, display, 12
System error, 40

T

Training
  see Demo Mode
TRANSFER, 13, 33
Transfer a patient to new room, 33

U

Unassigned rooms, 21
UNRECOGNIZED SPO2 SENSOR, 40

V

Vasoconstriction and SpO2, 27
Venous pulsations and SpO2, 26
VERY LOW BATTERY message, 40
Volume of audible indicators, 10

W

Warnings
  General, 4
  SpO2, 26
Warranty service, 6
Waveform display options, 15
Wireless
  Warnings about limitations, 4
Wireless Local Area Network
  see WLAN
WLAN, 1, 8

Y

Yellow LED, 10