IntelliVue MX40

Instructions for Use

PHILIPS

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(978) 687-1501

Printed in USA

Document number

453 564 242 441

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Printing History

New editions of this document will incorporate all material updated since the previous edition. Update packages may be issued between editions and contain replacement and additional pages to be merged by a revision date at the bottom of the page. Note that pages which are rearranged due to changes on a previous page are not considered revised.

The documentation printing date and part number indicate its current edition. The printing date changes when a new edition is printed. (Minor corrections and updates which are incorporated at reprint do not cause the date to change.) The document part number changes when extensive technical changes are incorporated.

First Edition June 2011

Document Conventions

In this guide:

Warnings

Warning

A Warning alerts you to a potential serious outcome, adverse event or safety hazard. Failure to observe a warning may result in death or serious injury to the user or patient.

Cautions

Caution

A Caution alerts you to where special care is necessary for the safe and effective use of the product. Failure to observe a caution may result in minor or moderate personal injury or damage to the product or other property, and possibly in a remote risk of more serious injury.

Notes

A Note contains additional information on the product's usage.

Contents

1. Introducing the IntelliVue MX40

This section introduces the IntelliVue MX40 wearable monitor.

MX40 Features

- Easy for clinicians to use and comfortable for patients to wear.
- 2.8" color, touch sensitive display.
- Smart, multi-measurement cable system available for use with reusable and single-patient use supplies.
- FAST SpO_2 (continuous, or manual measurement).
- EASI or standard ECG selectable in one device.
- 6-lead with two V-leads for diagnosing multiple cardiac abnormalities, including wide-QRS complex tachycardias and acute myocardial ischemia/infarction.
- Local measurement trend/alarm history.
- Local alarming for measurements (requires IntelliVue Information Center Release N or later).
- Integrated Smart-hopping radio.
- Integrated Short-Range Radio (SRR).
- Communication with IntelliVue Patient Monitors and Cableless Measurements via Short-Range Radio connection (MP5/MP5T/MP5SC, MP2 and X2 monitors only).
- Powered by three AA batteries or rechargeable lithium-ion battery pack.
- Audio feedback for out-of-range and lost device.
- Battery gauge on device and at Information Center.
- Alarm suspend and resume from standby at device and Information Center.
- Pouch with clear front that closes securely.

Note — Unlike a traditional bedside monitor which operates on AC power, the MX40 is powered by battery and provides time-limited screen display and local alarming.

MX40 Models

The MX40 is available in three models (ECG only, ECG and FAST SpO_2, or ECG and SpO_2 Ready (for future upgrade).

MX40 Compatibility

The MX40 is compatible for use with IntelliVue Information Center Release N. Limited compatibility is offered when used with IntelliVue Information Center Release L or M. See the "Operating with Release L or M" chapter for more information.

The MX40 is compatible for use with IntelliVue Patient Monitors Release G or later when wirelessly connected.

The MX40 is compatible for use with IntelliVue Cableless Measurements Release A.1.

The MX40 Patient Cable is compatible for use with IntelliVue Patient Monitor platforms MP2/X2, MP5/MP5T/MP5SC, MP20/30 with MMS or X2, MP40/50 with MMS or X2, MP60/70 with MMS or X2, MP80/90 with MMS or X2, and MX800/700/600 with MMS or X2.

2. Product Safety

This section consolidates the general safety warnings associated with the IntelliVue MX40. These warnings are repeated throughout the book in context where relevant.

Safety symbols and other markings on the MX40 are also described here.

General Safety

Warnings

- The IntelliVue MX40 should not be used for primary monitoring in applications where the momentary loss of the ECG is unacceptable at the Information Center.
- For continued safe use of this equipment, it is necessary that the listed instructions are followed. Instructions in this manual in no way supersede established medical procedures.
- Do not touch the patient, or table, or instruments, during defibrillation. The battery door must be closed during defibrillation. These steps protect the clinician from high defibrillator voltage.
- This device is not to be used in the vicinity of electrosurgical units because such use may interrupt or interfere with the transmission of signals from the MX40.
- This equipment is not suitable for use in the presence of a flammable anesthetic mixture with air, or with oxygen or nitrous oxide.
- This equipment is not suitable for use in an MRI environment.
- Do not use patient cables with detachable lead wires that have exposed male pins. Electrocution could result if these pins are plugged into AC power.
- Do not use patient cables or accessory cables and sensors if prior visual inspection reveals cable damage or the presence of liquid, lint or dust inside.
- The system is not completely immune from radio interference although it is designed to minimize interference. Sources of interference that may be a problem include failing fluorescent lights and construction equipment. See "Electromagnetic Compatibility p. 13-6". The product should not be used next to or stacked with other equipment. If you must stack the product, you must check that normal operation is possible in the necessary configuration before the product is used on patients.
- Do not rely exclusively on the audible alarm system for patient monitoring. Adjustment of alarm volume to a low level during patient monitoring may result in patient danger. Remember that the most reliable method of patient monitoring combines close personal surveillance with correct operation of monitoring equipment.

- If the MX40 enters a continuous "boot-up" cycle, or the main display does not appear or update, remove the device from service and contact your service personnel.
- Place the MX40 in a pouch or over clothing, or both, during patient use. The device should not touch the patient's skin during use.
- Patients should be instructed not to open the battery compartment while the MX40 is in use.
- Failure on the part of the responsible individual hospital or institution employing the use of this equipment to implement satisfactory maintenance as needed may cause undue equipment failure and possible health hazards.
- Because the coverage range of Access Points can sometimes overlap, including different floor levels, the IntelliVue Device Location feature is not intended for use when attempting to locate a patient.
- Short-range radio connections are subject to interruption due to interference from other radio sources in the vicinity, including microwaves, bluetooth devices, and DECT phones. Outside the frequency band and 5% above and below, i.e. the exclusion band according to IEC 60601-1-2, the short-range radio connection is immune up to 3V/m in the frequency range from 80MHz to 2.5 GHz. Depending on the strength and duration of the interference, the interruption may occur for an extended period. Any interruption of the signal due to interference, moving out of range, or for other reasons is indicated with a Tele Disconnected INOP message on the IntelliVue Patient Monitor.

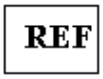
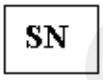
Caution

Philips recommends that when using a pouch to attach the MX40 to your patient that you consider your patient's condition and are careful about placement of the straps as the straps could present a strangulation hazard.

Safety Symbols & Other Marks

The table below describes the safety symbols and other markings present on the MX40 and the lithium-ion battery.

Label	Definition
FCC ID: **IC:**	**Federal Communications Commission (FCC) ID** **Canadian ID**
	**Federal Communications Commission (FCC)** **Grant of Equipment Authorization**
	**CE Mark (MX40)** Compliance to Council Directive 93/42/EEC (Medical Device Directive) Class 2 Radio Equipment Identifier (1999/5/EC)
	**CE Mark (Rechargeable Lithium-ion Battery)** Compliance to Council Directive 2004/108/EC (EMC Directive)
	**Non-Ionizing Radiation** Interference to electronic equipment may occur in the vicinity of devices marked with this symbol.
	**Disposal** Dispose of in accordance with the local country's requirements.
	**Follow operating instructions.**

Label	Definition
	**Prescription Device**
	**Canadian and American standards compliance** Complies with applicable Canadian and American safety standards.
	**Defibrillation Proof** Patient connections are protected against defibrillation (DEFIBRILLATION-PROOF) and are a TYPE CF APPLIED PART.
	**Product Number**
	**Serial Number** Used to identify the equipment during a call to the Philips Healthcare (Service).
	**MAC Address**
	**Date of Manufacture**
	**Battery Polarity**
	**IPX Waterproof Rating**
	**2D Barcode**
	**Underwriter's Laboratories Listed Component**

Label	Definition
Service #:	**Service Identification Number** Used to identify the equipment during a call to the Philips Healthcare (Service).
	**Attention!** See *Instructions for Use*.

3. Basic Operation

This section gives you an overview of the IntelliVue MX40 and its functions. It tells you how to perform tasks that are common to all measurements, such as turning a measurement on and off, adjusting wave size and information in preparation for use.

Familiarize yourself with all instructions including warnings and cautions before starting to monitor patients. Read and keep the Instructions for Use that come with any accessories as these contain additional important information.

Controls, Indicators and Connectors

This section describes the clinical controls of the IntelliVue MX40. These controls include buttons, display icons, visual and auditory indicators, ports, and safety labeling located on the front and back of the device.

MX40 Controls and Indicators

1. Patient Cable
2. Patient Information Area
3. Active Alarms Area
4. INOP Area
5. Measurement Area 1
6. Measurement Area 2
7. Waveform 1
8. Waveform 2
9. Radio/Network/Battery Status Area
10. Leads Off Status Area
11. Silence Alarms Button
12. SmartKeys Button
13. Main Screen Button
14. Multi-Function Button

Multi-Function Button

Button	Function
	Depending on configuration at the Information Center: • generates a Nurse Call; • Initiates a Delayed Recording; • Both, or; • None ***Note —*** the Multi-Function Button does not operate when paired with an IntelliVue Patient Monitor via the short-range radio connection.

Silence Alarm Button

Button	Function
	• Initiates a local silence/acknowledgment of all active alarms when enabled. • Silences the "Find Device" sound. ***Note —*** Alarms at the MX40 can be silenced from the Information Center.

SmartKeys Button

Button	Function
	Displays the SmartKey Menu on the touch screen.

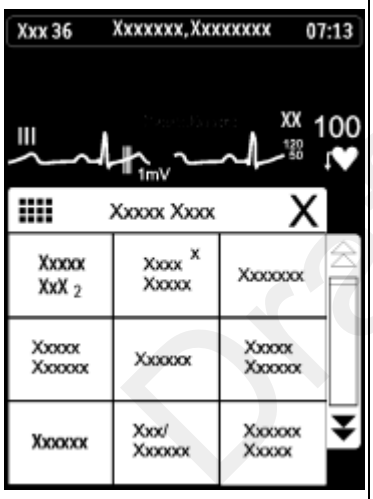
Main Screen Button

Button	Function
	• Activates the Touch Display if touched for two seconds. • Cycles through the display screens if touched repeatedly. • Resumes from Standby.

SmartKeys

The following table lists the SmartKeys available on the display of the MX40.

Note—gray text on a SmartKey signifies that the item is unavailable.

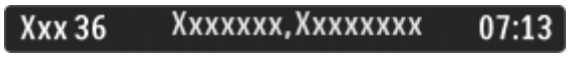
	SmartKey	Function
	Start SpO_2 ***Note —*** This SmartKey is unavailable when SpO_2 mode is continuous.	Starts a manual SpO_2 measurement.
	Delay Record	Starts a delayed recording at the Information Center.
	Alarms	Review of up to 50 previous alarm conditions. Pause Alarms for configured time period (if enabled at the Information Center).
	Mode: Telemetry / Mode: Monitor	Toggles between modes. In Telemetry Mode, display and audio are off; in Monitor Mode, display and audio are always on.

	SmartKey	Function
	Standby	Puts the device into standby locally and at the Information Center. Displays purchased/enabled product options.
	Add/Remove	Displays available monitors and IntelliVue Cableless Measurements to assign to via the short-range radio.
	Print Reports	Prints the pre-configured report as designated at the Information Center.
	Vitals Trends (Optional)	View up to 24 hours of tabular trend data.
	Screen Setup	Determines time period that the display remains active after user interaction.
	Lock/Unlock	Locks/Unlocks the display.
	Op Mode	Selects either Monitoring, Demo, Config or Service modes.

Alarms Area

- The Alarm Area of the MX40 displays physiological alarms and technical alarms.
- A multiple alarm indicator (down arrow) is displayed when multiple alarm conditions are present.
- A check mark in front of the alarm text signifies that the alarm has been acknowledged by touching the Silence Alarms button.
- Alarm Indicators display in the Patient Information Area in place of the time clock when alarm/INOP conditions are present but have not been acknowledged.
- Touching the Alarms Area displays a list of all active alarms.
- The alarms paused icon communicates whether the alarm system is on/off.
- Local Alarm Audio is off when the alarm volume symbol is present.

Patient Information Area



Touching the Patient Information Area displays the following information:

- Bed Label
- Patient Name (up to 15 characters will display)
- Paced Status (see Paced Status below)
- Time
- Gender/Type (Male/Female and Adult/Pediatric)
- MRN (Lifetime ID, Encounter ID)
  Note — If you use an alternative ID, it will display at the Information Center and on printed reports. It will not display at the MX40.

Paced Status

1. Pacing algorithm is on.
2. Pacing algorithm is off.

Display Lock

The Lock symbol appears in the lower left of the display when the MX40 is in a locked state after five minutes of non-use. Locking the display provides additional protection against accidental patient access. The display is unlocked using the SmartKeys menu.

Status Area

The status area of the MX40 displays short-range radio connection (optional) and system wireless connection status. You can also view battery strength for the type of battery used in the device, AA or rechargeable Li-on.

Operating and Navigating

The principle method of operating your MX40 is via the Touch Display. Almost every element on the is interactive. Display elements include measurement numerics, information fields, alarm fields, waveforms, SmartKeys and menus.

Power-On Self Test

Once battery power is supplied, the MX40 performs a power-on self test to check operational status prior to start-up. Should a failure be detected, an INOP tone will sound and if possible, the appropriate INOP message for the failure will be communicated to the Information Center and displayed locally.

A successful power-on self test will then transition the MX40 to the start-up screen. Selectable background colors can be configured and display on the screen for assistance with device identification. This can be helpful when devices are in a pooled use setting.

If the MX40 enters a continuous "boot-up" cycle or the main display does not appear or update, ensure that you are using a freshly charged lithium-ion battery or new disposable batteries. If the batteries are fresh and the device reboots or does not update, remove the device from service and contact your service personnel.

You must visually check that a waveform is present on the display. You can access further status information is by touching the status area on the display.

Navigating

Touching the Navigation Bar on the right of the display will scroll through additional display items. Solid downward arrows indicate there are additional elements that are not currently displayed. The arrows briefly illuminate when touched. Your selection from the menu also illuminates when touched.

Selecting Display Elements

Touch a display element to get to the actions linked to that element. For example, touch the Patient Information element to call up the Patient Info window, or touch the HR numeric to call up the Setup ECG menu. Touch the ECG waveform to call up the wave selection menu.

Locking the Display

To provide additional protection against accidental patient access to the MX40, the display can be locked using the **Lock SmartKey**. When **Lock** is selected, the **SmartKey** menu automatically changes to the **Main Screen**. When **Unlock** is selected, you must close the **SmartKey** menu to return to the **Main Screen**.

The display automatically locks when there is no interaction for five minutes.

Function	Display Locked/Active	Display Locked/Inactive	Display Unlocked/Active	Display Unlocked/Inactive
Display Touch	No	No	Yes	No
Main Screen Button	No	Yes	Yes	Yes
SmartKeys Button	Yes	No	Yes	No
Silence Button	No	No	Yes	No

Measurement Area

The measurement area of the MX40 display is optimized to show available parameter numerics, waveforms, and alarm limits. Each element is a touch object and when you select it, further controls and menus become available.

Measurement Area Display Configurations

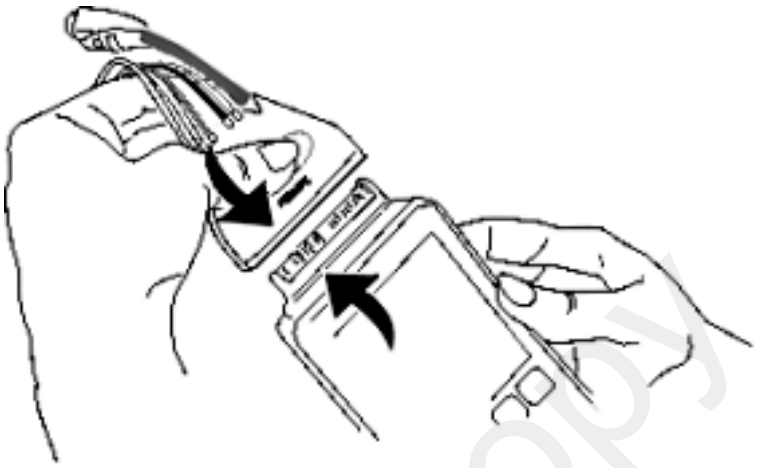
The display of your MX40 is configured/can operate in one of four available orientations:

- Portrait - One Waveform and four Numerics
- Portrait - Two Waveforms and two Numerics
- Landscape - Two Waveforms and three Numerics

- Portrait - Viewable Chest Diagram and two Numerics

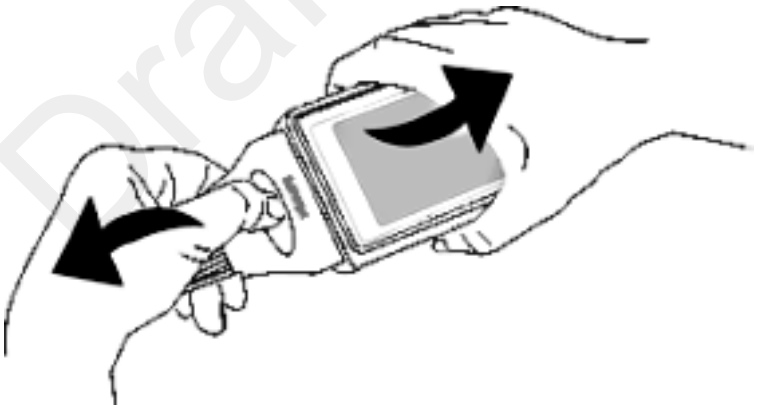
Connecting/Disconnecting the Patient Cable

The patient cable is connected to the MX40 as shown in the illustration below.



When connecting to the MX40, there is a slight clicking sound that signifies the the cable is securely connected.

Disconnect the patient cable as shown below.



Caution

Never disconnect the patient cable by pulling on the leadwires, as this may damage wires over time.

Understanding Settings

Each aspect of how the MX40 works and looks is defined by a setting. There are a number of different categories of settings, including:

- Screen Settings - to define the selection and appearance of elements on each individual display screen.
- Measurement Settings - to define setting unique to each measurement, e.g. high and low alarm limits.
- Monitor Settings -including settings that affect more than one measurement or display screen, for example alarm volume and alarm pause time.

You must be aware that, although many settings can be changed during use, permanent changes to settings can only be done in Configuration Mode. All settings are restored to their default setting when the patient is discharged or the MX40 is powered off.

Changing Measurement Settings

Each measurement has a setup menu in which you can adjust all of its settings. You enter the setup menu by selecting the measurement numeric.

ECG Settings at the MX40

Setting	Description
Alarm Limits	Heart Rate alarm limits can be viewed locally at the MX40. Limits set at the Information Center (Release N or later) are reflected at the MX40 when connected on the network.
Primary (used for arrhythmia analysis only)	I,II, III, aVR, aVL, aVF, V1-V9, MCL, V3R, V4R, V5R. Available waveforms are based on lead set type. Lead II is the default.
Secondary (used for arrhythmia analysis only)	I,II, III, aVR, aVL, aVF, V1-V9, MCL, V3R, V4R, V5R. Available waveforms are based on lead set type. Lead V is the default.
Paced Mode	Yes, No
Adjust Size	Set ECG gain to x1/2, x1, x2, x4
Arrhythmia	Initiate an Arrhythmia Relearn; View Arrhythmia Alarm Limits; Turn Arrhythmia Annotation On/Off.
Lead Placement	Set EASI, Standard

Setting	Description
ECG	Set ECG On/Off
New Lead Setup	When IntelliVue Patient Monitor lead sets are in use, selects 3-wire, or 5-wire.
Va Lead	Shows position of Va, Vb or C1, C2 electrodes. Choices are V1-V9, v3R, V4R, V5R.
Vb Lead	Shows position of Va, Vb or C1, C2 electrodes. Choices are V1-V9, v3R, V4R, V5R.
Change Numeric	Selects parameter numeric to display in place of current HR numeric.

Waveform Settings at the MX40

Setting	Description
Wave 1	Primary, Secondary, I, II, III, aVR, aVL, aVF, V1-V9, MCL, V3R, V4R, V5R. Available waveforms are based on patient cable type. Lead II is the default. If Primary or Secondary are selected, then the waveform displayed is the waveform configured as primary or secondary for arrhythmia analysis.
Wave 2	Primary, Secondary, I,II, III, aVR, aVL, aVF, V1-V9, MCL, V3R, V4R, V5R, Pleth (if SpO_2 is available). Available waveforms are based on patient cable type. Lead V is the default.Iif Primary or Secondary are selected, then the waveform displayed is the waveform configured as primary or secondary for arrhythmia analysis.

Primary or secondary waveform configuration changes made at the Information Center change the MX40.

Battery Information

Battery Safety Information

Warnings

- The battery compartment door must be closed during defibrillation.
- Use the Philips Rechargeable Lithium-ion Battery or 3 Duracell Alkaline batteries, size AA, MN 1500, 1.5V, to ensure specified performance and correct battery gauge reporting. Outdated, mismatched, or poor-quality batteries can give unacceptable performance (e.g., insufficient Battery-Low warning time). If you are using disposable batteries, the use of fresh high-quality alkaline batteries is strongly recommended.
- Certain failure conditions, such as short circuits, can cause a battery to overheat during use. High temperatures can cause burns to the patient and/or user. If the MX40 becomes hot to the touch, remove it from the patient and place it aside until it cools. Then remove the batteries and discard them. Have the MX40 checked by your service provider to identify the cause of overheating.
- If you receive a BATTERY LOW or REPLACE BATTERY alarm, the batteries must be promptly replaced. If these conditions are not corrected, they will result in a device shutdown and cessation of monitoring.
- Disposable batteries should be removed from the MX40 at the end of the battery's useful life to prevent leakage.

  If battery leakage should occur, use caution in removing the battery. The leaked substance may cause eye or skin irritation. Avoid contact with skin. Clean the battery compartment according to the instructions in the Maintenance section. Wash hands.
- To eliminate the risk of electrical shock or burn, do not carry loose batteries on your person, e.g. in clothing pockets.

Caution

Use of AA Lithium batteries or batteries with terminal voltage >1.6V may cause damage to the device.

Lithium-ion Rechargeable Battery Care

Care of the rechargeable battery begins when you receive a new battery for use and continues throughout the life of the battery. The table below lists battery care activities and when they should be performed.

Activity	When to Perform
Perform a visual inspection.	Before inserting a battery in the MX40.
Charge the battery.	Upon receipt, after use, or if a low battery state is indicated. To optimize performance, a fully (or almost fully) discharged battery should be charged as soon as possible.
Clean the battery	At each patient discharge, or in cases when the battery is exposed to contaminants.
Charge stored batteries to at least 40% of their capacity every six months.	When not in use for an extended period of time.
Decommission the battery	When any of the following INOPs are displayed on the MX40: **TELE SERVICE BATTERY** **TELE CHECK BATT TEMP** **TELE REMOVE BATT**

Rechargeable batteries are charged using the IntelliVue CL Charging Station. For information on charging station use, see Charging Li-ion Rechargeable Batteries p. 12-7 .

Lithium-ion Rechargeable Battery Handling Precautions

Lithium-ion batteries store a large amount of energy in a small package. Use caution when handling the batteries; misuse or abuse could cause bodily injury and/or equipment damage.

- Do not short circuit - take care that the terminals do not contact metal (e.g. coins) or other conductive materials during transport and storage.
- Do not crush, drop or puncture - mechanical abuse can lead to internal damage and internal short circuits that may not be visible externally.
- Do not apply reverse polarity.
- Do not incinerate batteries or expose them to temperatures above 60°C (140°F).

If a battery has been dropped or banged against a hard surface, whether damage is visible externally or not:

- discontinue use.
- dispose of the battery in accordance with the disposal instructions.

Lithium-ion Rechargeable Battery Storage

When storing rechargeable batteries, make sure that the battery terminals do not come into contact with metallic objects or other conductive materials.

If batteries are stored for an extended period of time, they should be stored in a cool, dry place, ideally at 15°C (60°F), with a state of charge of 20% to 40%. Storing batteries in a cool place slows the aging process.

The batteries should not be stored at a temperature outside the range of -20°C (-4°F) to 50°C (122°F).

Stored batteries should be should be charged to at least 40% of their capacity every 6 months.". They should be charged to full capacity prior to use.

Note — Storing batteries at temperatures above 38°C (100°F) for extended periods of time could significantly reduce the batteries' life expectancy.

Inserting/Removing Batteries

Warning

Arrhythmia relearning is initiated whenever the MX40 is powered down for one minute or longer. Be sure to check your patient's arrhythmia annotation for accuracy whenever relearn has occurred.

Caution

Remove the batteries before storing the MX40 for an extended period of time.

The battery compartment is located on the back of the MX40, accessible by opening the compartment door from the bottom. It accommodates three AA 1.5V Alkaline batteries or the Philips Rechargeable Lithium-ion battery. Only these batteries should be used.

Note— Lithium-ion batteries should be fully charged prior to first use.

Important— Do not use other rechargeable batteries. Use of this type of battery will adversely affect:

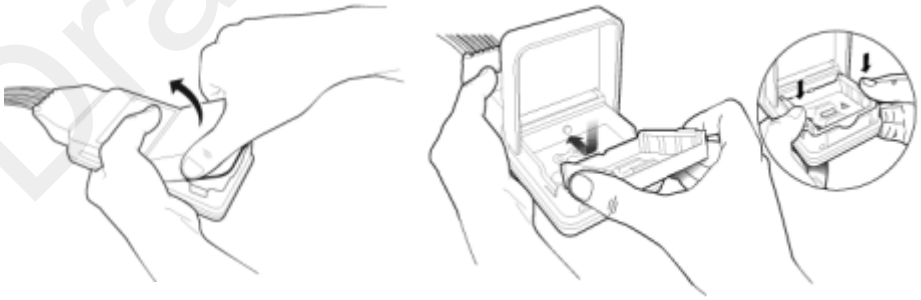
- Battery gauge performance
- Battery low warnings
- Battery life performance

Inserting Batteries

➢ *Insert batteries into the MX40 using the following procedure.*

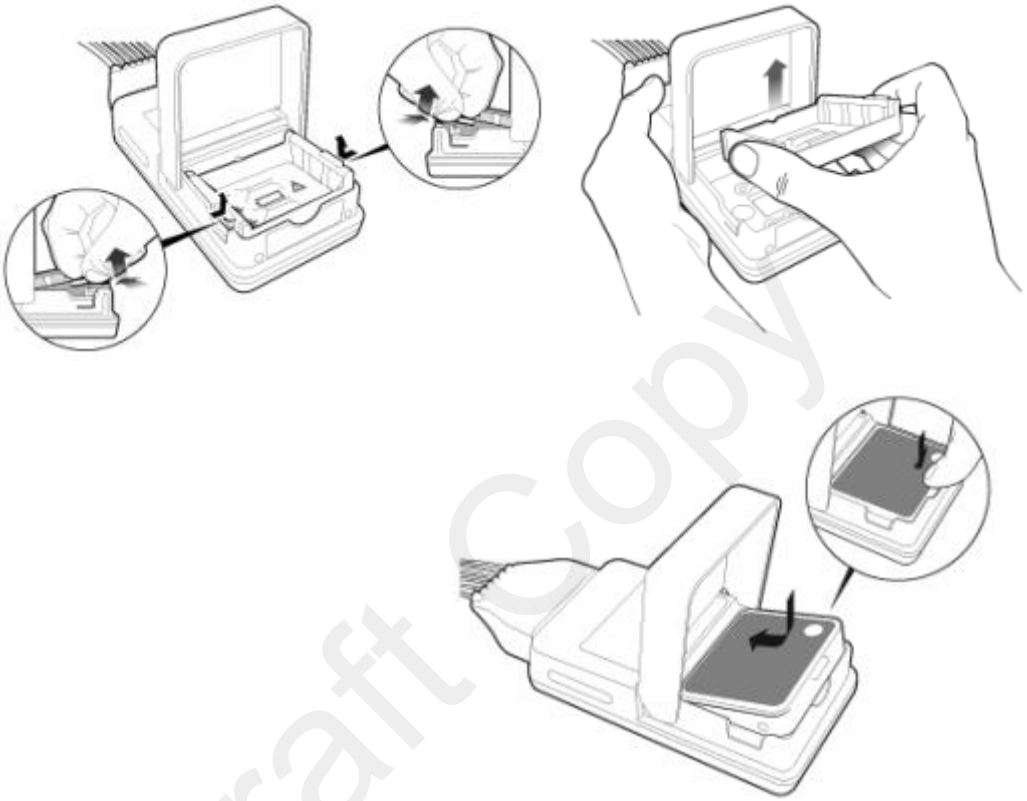
1. Open the battery compartment by lifting up on both bottom sides of the compartment door.
2. Insert the AA battery tray if not already present.
3. Insert three AA 1.5V Alkaline batteries, matching the polarity with the +/- indications inside the compartment.

   Note—all batteries are inserted with the + polarity in the same direction.



4 If using the rechargeable lithium-ion battery, remove the AA battery tray if present.

5 Insert the battery pack so that the raised tab is aligned with the cutout in the base of the battery compartment. Close the battery compartment door.



6 Watch for the start-up screen on the front of the MX40 to illuminate briefly.

Removing the Batteries

Batteries should be removed when the MX40 is not in use or is being stored.

To remove the batteries, open the battery compartment door and push from the opening at the bottom of the compartment to pop the batteries out. Device settings (patient cable type, SpO_2 mode, volume, etc.) are retained when the batteries are removed.

If you remove good AA batteries to turn off the MX40, keep them together as a set for later re-use so that all batteries will have the same level of power remaining.

Important— Do not "store" disposable AA batteries by leaving them in the incorrect polarity position in the MX40.

Be careful not to short circuit the batteries. Batteries can get hot when shorted. Short circuits are caused when a piece of metal touches both the positive and negative terminals simultaneously. More than a momentary short circuit will generally reduce the battery life. In case of a short circuit, discard the batteries, or just the shorted one if the batteries are new.

Disposal of Batteries

When disposing of batteries, follow local laws for proper disposal. Dispose of batteries in approved containers. If local regulations require you to recycle batteries, recycle batteries in accordance with those regulations.

Battery Charge Status

The battery charge indicator displays in the Status Area and communicates the remaining battery charge time when using both AA batteries or the rechargeable lithium-ion battery.

When the MX40 is initially powered-on, it takes approximately 25 seconds for the indicator to populate. During this time, the indicator displays a ? in the battery icon.

In order to guarantee overall device performance, certain functionality is disabled when the battery charge reaches critical levels. See the tables below for additional information about battery status.

Lithium-ion Rechargeable Battery Charge Status

Approximate Battery Life Remaining	Approximate Time Remaining (ECG only)	Approximate Time Remaining (ECG & Spo_2 Continuous)	Functionality Disabled	Battery Indicator LCD Segments
100%	> 25 hours	> 9 hours	None	5 Green
75%	< 19 hours	< 7 hours	None	4 Green
50%	< 13 hours	< 5 hours	None	3 Green
25%	< 6 hours	< 2 hours	None	2 Green
10%	< 3 hours	< 1 hours	None	1 Green

Approximate Battery Life Remaining	Approximate Time Remaining (ECG only)	Approximate Time Remaining (ECG & Spo_2 Continuous)	Functionality Disabled	Battery Indicator LCD Segments
Low battery level to replace/charge battery level	< 30 minutes	< 30 minutes	SpO_2 and short-range radio are disabled. Display is at half brightness	1 Red Red Battery Icon Audio
Replace/charge battery level	< 10 minutes	< 10 minutes	Device shutdown	1 Red Red Battery Icon

AA Battery Charge Status

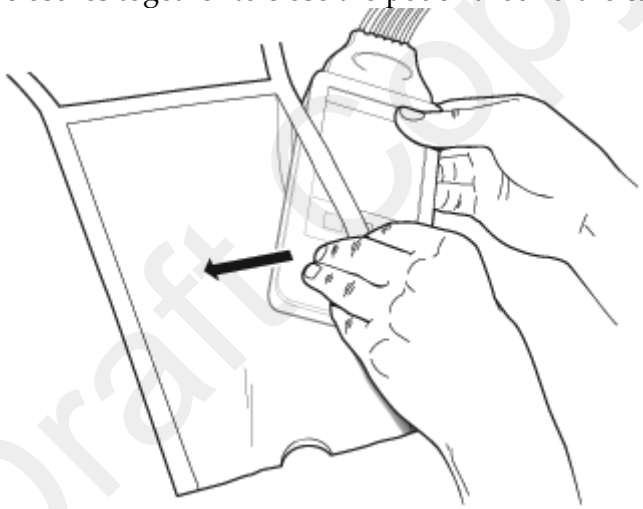
Approximate Battery Life Remaining	Approximate Time Remaining (ECG only)	Approximate Time Remaining (ECG & Spo_2 Continuous)	Functionality Disabled	Battery Indicator LCD Segments
100%	> 24 hours	> 9 hours	None	5 Green
75%	< 18 hours	< 7 hours	None	4 Green
50%	< 12 hours	< 5 hours	None	3 Green
25%	< 6 hours	< 2 hours	None	2 Green
10%	< 2 hours	< 1 hours	None	1 Green
Low battery level to replace/charge battery level	< 30 minutes	< 30 minutes	SpO_2 and short-range radio are disabled. Display is at half brightness.	1 Red Red Battery Icon Audio
Replace/charge battery level	< 10 minutes	< 10 minutes	Device shutdown	1 Red Red Battery Icon

Pouch Use

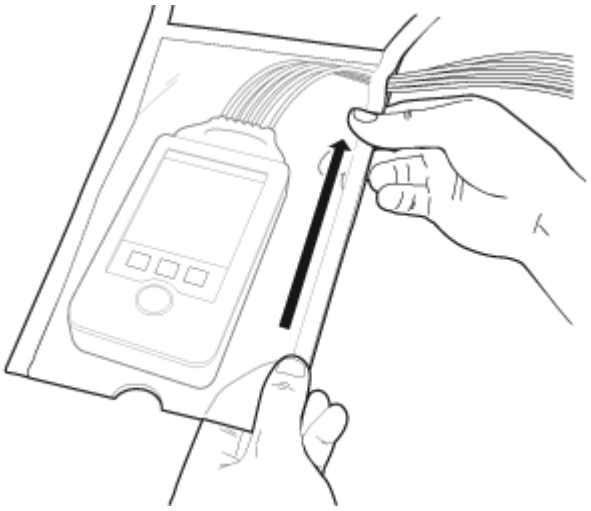
The MX40 is not intended for direct contact with the patient's skin. During normal use, the MX40 should be worn over clothing, in a pocket or, preferably, in a pouch. The Waterproof Carry Pouch with clear front is an appropriate means for holding the MX40. See Appendix A, "Accessories" for ordering information.

Securing the Pouch

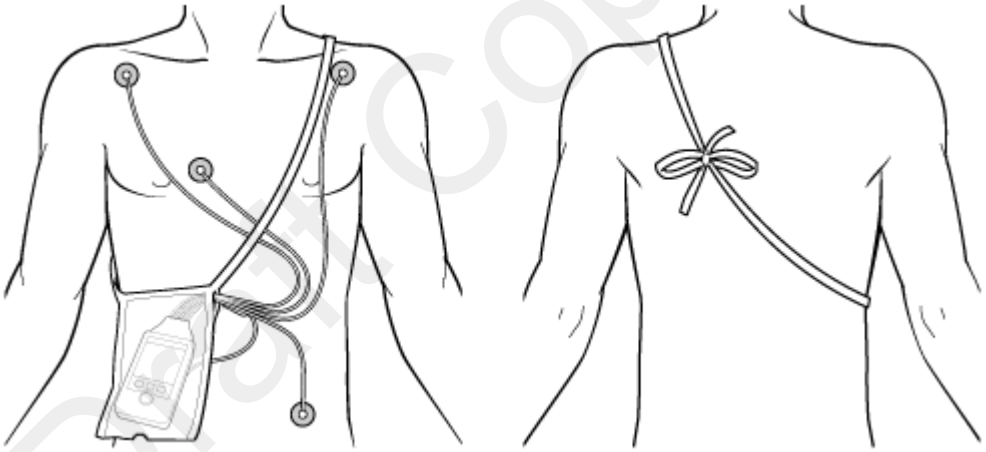
1. See the *Carry Pouch, Waterproof, Instructions for Use*, P/N 453564267571, for more information.
2. Insert the MX40 into the pouch with lead wires and SpO_2 sensor cable, if used, exiting from the side opening of the pouch. Pinch the velcro enclosures together to close the pouch around the cables.



3 Seal the pouch.



4 Secure the pouch on the patient with the ties around the patient's shoulder and under the arm.



5 Check that the patient is comfortable wearing the pouch with the MX40.

Warning

To avoid the risk of strangulation, do not tie a pouch solely around the patient's neck.

Showering

Warning

When the patient is showering, signal quality and leads off detection may be compromised due to significant movement. Appropriate clinical precautions must be taken.

Caution

Because the touchscreen display is sensitive to water impact, the display should be locked when showering.

The MX40 can be used to monitor a patient in the shower, but only when placed inside a Philips carrying pouch and secured on the patient as described above. The combination of the MX40 and pouch will withstand showering for up to 10 minutes.

Drying the MX40 after Showering

After showering, perform the following steps to continue monitoring:

1. Remove the battery.
2. Pat dry the patient cable connections at the electrodes.
3. Wipe the lead wires with care.
4. If wet, dry the outside of the MX40 with a non-lint producing cloth.
5. If wet, wipe dry the inside of the battery compartment. Dry the batteries.
6. If wet, disconnect the patient cable and shake out any water. Dry the connector pin area with a cotton swab.
7. Re-insert the battery.

Caution

The MX40 should not be used for monitoring if the battery compartment is wet. Remove the batteries and wipe the compartment dry before continued monitoring use.

Accidental Liquid Exposure

If the MX40 is accidentally immersed in liquid, no damage to the device and no electrical safety issues for the patient will result. Remove the device, dry it off, and follow the procedure for cleaning/sterilization under "Cleaning and Sterilization" as needed.

Telemetry Mode Use

To minimize patient disruption, the MX40 operates in Telemetry Mode when connected to the Information Center. In Telemetry Mode, the local volume is set to zero and the display is off. You can activate the display at any time by touching the Main Screen button for two seconds. All active alarms can be viewed when the display is on. Regardless of the display status, all measurement data is being sent to the Information Center. Telemetry Mode is only available when connected to the Information Center.

Monitoring Mode Use

You may find the use of Monitoring Mode helpful when spending extended time directly with your patient, e.g. during transport, showering, dressing change. The display is always on for easy viewing and should an alarm condition occur, it will be announced locally at the MX40 and at the Information Center if networked connected. If the MX40 is not network connected, the alarm is only announced locally.

➢ *To use Monitor Mode:*

1 Press the SmartKeys Button.

2 Press the Mode: Telemetry / Mode: Monitor SmartKey and choose Mode: Monitor.

Briefing the Patient

Warning

Patients should be instructed not to interact with the with display of the device and to not open the battery compartment while the MX40 is in use.

Note — Pausing alarms at the Information Center activates the MX40 display. Patients should be notified that this is normal operation and not cause for any concern.

If the Multi-Function button has been configured to generate a Nurse Call alarm, recording at the Information Center, or both, instruct the patient to use the button when needed.

If desired, you can turn off patient use of the Multi-Function button at the Information Center. For more information see Patient Configurable Settings in Telemetry Setup p. 9-7.

4. Alarms

The section provides alarm information that applies to all measurements. Measurement-specific alarm information is discussed in the sections on individual measurements.

Alarms Overview

The MX40 has two different types of alarms: physiological alarms and INOPs. For MX40 devices operating with IntelliVue Information Center Release L and M, physiological alarms are not available locally on the MX40. INOPs are displayed as described here.

For MX40 devices operating with IntelliVue Information Center Release N, physiological alarms are available locally on the MX40 when network connected to the Information Center, and as configured by the Information Center. Changes to physiological alarm settings can only be made at the Information Center.

Physiological Alarms

Physiological alarms are red and yellow alarms. A red alarm indicates a high priority patient alarm such as a potentially life threatening situation (for example, asystole). A yellow alarm indicates a lower priority patient alarm (for example, a low SpO_2 alarm limit violation). Additionally there are short yellow alarms, most of which are specific to arrhythmia-related patient conditions (for example, ventricular bigeminy).

INOPs

INOPs are technical alarms, they indicate that the monitor cannot measure or detect alarm conditions reliably. If an INOP interrupts monitoring and alarm detection (for example, LEADS OFF), the monitor places a question mark in place of the measurement numeric and an audible indicator tone will be sounded. INOPs without this audible indicator indicate that there may be a problem with the reliability of the data, but that monitoring is not interrupted.

Most INOPs are light blue, however there are a small number of INOPs which are always yellow or red to indicate a severity corresponding to red and yellow alarms. The following INOPs can also be configured as red or yellow INOPs to provide a severity indication:

- ECG LEADS OFF
- REPLACE BATTERY (when using disposable batteries)
- TELE BATT EMPTY (when using the rechargeable battery pack)

All monitors in a unit should have the same severity configured for these INOPs.

The MX40 is designed to achieve visual alarm notification at a distance of up to one meter, which is consistent with its intended use model as a wearable monitor.

Alarms are indicated after the alarm delay time. This is made up of the system delay time plus the trigger delay time for the individual measurement. For more information see ECG Performance Disclosure/Specifications p. 13-22 .

If more than one alarm is active, the highest priority alarm is shown. A downward facing arrow symbol next to the alarm message informs you that more than one message is active. The monitor sounds an audible indicator for the highest priority alarm.

Visual Alarm Indicators

Warning

The MX40 display is inactive for a majority of the time because it is operating in Telemetry Mode. You must activate the screen to view any alarms locally. The alarm message text is displayed, however, the alarm volume setting is at zero.

Alarm Message

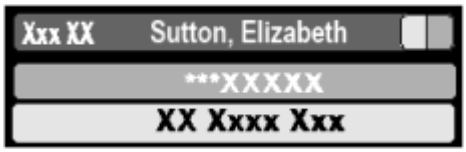
An alarm message text appears in the alarm status area at the top of the screen indicating the source of the alarm. If more than one alarm is present,there is a downward facing arrow symbol at the right side. The background color of the alarm message matches the alarm priority: red for red alarms, yellow for yellow alarms, light blue for standard INOPs, red for red INOPs and yellow for yellow INOPs. The asterisk symbols (*) beside the alarm message match the alarm priority: *** for red alarms, ** for yellow alarms, * for short yellow alarms. Standard INOPs do not have a symbol, red and yellow INOPs have exclamation marks beside the alarm message: !!! for red INOPs and !! for yellow INOPs.

Alarm limit violation messages are displayed in text form, for example **** SpO_2 LOW**.

Alarm Indicator

An Alarm Indicator on the MX40 main display communicates alarm/INOP conditions that have not been acknowledged. The alarm indicator is divided into two sections and appears in the upper right hand corner normally occupied by the time display. The right section flashes for a physiological alarm, except for short yellow alarms where the indicator will light for approximately six seconds. The color is yellow or red corresponding to the highest priority alarm currently present.

An unacknowledged physiological alarm and INOP appears as (portrait view):



An acknowledged physiological alarm and INOP with an additional unacknowledged physiological alarm appears as (landscape view):

The left section lights continuously for a standard INOP and flashes for INOPs configured as red or yellow alarms as follows:

INOP Color	On	Off
Yellow	1.0 seconds	1.0 seconds
Red	0.25 seconds	0.25 seconds

If only patient alarms are present, and no INOPs, the patient alarms will use both left and right sections to flash (for red and yellow alarms) or light for approximately six seconds (for short yellow alarms). If only INOPs are present, and no patient alarms, red and yellow INOPs will use both left and right sections to flash, but standard INOPs will always light continuously in the left section only.

Once all alarm/INOP conditions are acknowledged, the time display reappears.

Flashing Numeric

The numeric of the measurement in alarm flashes.

Audible Alarm Indicators when in Monitoring Mode

The audible alarm indicators configured for your monitor depend on which alarm standard applies in your hospital. Audible alarm indicator patterns are repeated until you acknowledge the alarm by switching it off or pausing it, or until the alarm condition ceases (if audible alarm indication is set to non-latching).

Warning

- Do not rely exclusively on the audible alarm system for patient monitoring. Adjustment of alarm volume to a low level or off during patient monitoring may result in patient danger. Remember that the most reliable method of patient monitoring combines close personal surveillance with correct operation of monitoring equipment.
- No audible alarm indicators are available when the MX40's volume setting is zero or when operating in Telemetry Mode. Audible alarm indicators become active as soon as the MX40 is no longer connected to the Information Center.

Traditional Audible Alarms (HP/Agilent/Philips/Carenet)

- Red alarms and red INOPs: A high pitched sound is repeated once a second.
- Two-star yellow alarms and yellow INOPs: A lower pitched sound is repeated every two seconds.
- One-star yellow alarms (short yellow alarms): The audible indicator is the same as for yellow alarms, but of shorter duration.
- Standard INOPs: an INOP tone is repeated every two seconds.

ISO/IEC Standard Audible Alarms

- Red alarms and red INOPs: A high pitched tone is repeated five times, followed by a pause.
- Two-star yellow alarms and yellow INOPs: A lower pitched tone is repeated three times, followed by a pause.
- One-star yellow alarms (short yellow alarms): The audible indicator is the same as for yellow alarms, but of shorter duration.
- Standard INOPs: a lower pitched tone is repeated twice, followed by a pause.

Acknowledging Alarms

To acknowledge all active alarms and INOPs, touch the Silence Alarm button. This switches off the audible alarm indicators, if present, and alarm messages.

A check mark beside the alarm message indicates that the alarm has been acknowledged .

If the condition that triggered the alarm is still present after the alarm has been acknowledged, the alarm message stays on the screen with a check mark symbol beside it, except for NBP alarms and alarms from other intermittent measurements. When such an alarm is acknowledged the alarm message disappears.

If the alarm condition is no longer present, all alarm indicators stop and the alarm is reset.

Switching off the alarms for the measurement in alarm, or switching off the measurement itself, also stops alarm indication.

Pausing or Switching Off Alarms

If you want to temporarily prevent alarms from sounding, for example while you are moving a patient, you can pause alarms, if configured. Depending on your MX40 configuration, alarms are paused for one, two or three minutes.

To Pause All Alarms

Select the **Alarms** SmartKey and select **Pause Alarms**. A timer on the display shows the remaining pause time.

To Switch Individual Measurement Alarms On or Off

1 Select the measurement numeric to enter its setup menu.

2 Select **Alarms** to switch between on and off

The alarms off symbol is shown beside the measurement numeric.

While Alarms are Paused

- In the alarm field, the monitor displays the message ALARMS PAUSED 1:28 or ALARMS OFF, together with the alarms paused symbol or the alarms off symbol.

- No alarms are sounded and no alarm messages are shown.
- INOP messages are shown but no INOP tones are sounded.

  The only exceptions are the INOPs CUFF NOT DEFLATED, NBP CUFF OVERPRESS and INOPs relating to empty, missing and malfunctioning batteries.

  These INOPs switch the alarms on, and the INOP tones are sounded, even if alarms are paused or off. You need to remove the INOP condition first before you can switch the alarm tones off again.

Restarting Paused Alarms

To manually switch on alarm indication again after a pause, select **Pause Alarms**.

Alarm Limits

The alarm limits you set determine the conditions that trigger yellow and red limit alarms. For some measurements (for example, SpO_2), where the value ranges from 100 to 0, setting the high alarm limit to 100 switches the high alarm off, or setting the low alarm limit to 0 switches it off. In these cases, the alarms off symbol is not displayed.

Warning

Be aware that the monitors in your care area may each have different alarm settings, to suit different patients. Always check that the alarm settings are appropriate for your patient before you start monitoring.

Viewing Individual Alarm Limits

You can see the alarm limits set for each measurement next to the measurement numeric on the main screen.

Changing Alarm Limits

- ***To change individual measurement alarm limits using the measurement's Setup Menu:***

  1 In the measurement's setup menu, select the alarm limit you want to change. This calls up a list of available values for the alarm limit.

  2 Select a value from the list to adjust the alarm limit.

Reviewing Alarms

You can see which alarms and INOPs are currently active in the respective alarms and INOPs fields at the top of the screen.

To see the currently active alarms and INOPs listed in one place, touch the Alarms area.

All alarms and INOPs are erased from the Alarm Messages window when you discharge a patient, or if you change to Demonstration Mode.

Review Alarms Window

The Review Alarms window contains a list of the 50 most recent alarms and INOPs with date and time information.

The Review Alarms window also shows when alarms are paused or silenced.

Note — Alarms that occur during an alarm suspend period will appear in the Review Alarm window, however, they are not communicated to the Information Center.

Latching Alarms

The alarm latching setting for your MX40 defines how the alarm indicators behave when you do not acknowledge them. When alarms are set to non-latching, their indicators end when the alarm condition ends. Switching alarm latching on means that visual and/or audible alarm indications are still displayed or announced by the monitor after the alarm condition ends. The indication lasts until you acknowledge the alarm by touching the Alarm Silence button.

Alarm Latching Behavior

Red & Yellow Measurement Alarms		Non-latching Alarms	Visual and Audible Latching
Alarm has not been acknowledged.	Alarm condition still present.	Alarm tone on. Alarm message. Flashing numerics.	Alarm tone on. Alarm message. Flashing numerics.
	Alarm condition no longer present.	All audible and visual alarm indicators automatically stop.	Alarm tone on. Alarm message . Flashing numerics.
Alarm has been acknowledged.	Alarm condition still present.	Alarm tone off. Alarm message with check mark. Flashing numerics. Audible alarm reminder (if configured)	Alarm tone off. Alarm message with check mark. Flashing numerics. Audible alarm reminder (if configured)
	Alarm condition no longer present.	Audible and visual alarm indicators automatically stop.	Audible and visual alarm indicators automatically stop.

Alarm Behavior at Power On

If the MX40 is powered off for longer than one minute and then powered on again (or after a loss of power lasting longer than one minute, or when a patient is discharged), the device restores the alarm settings from the monitor's configured default settings.

If power is lost for less than one minute, the alarm on/off condition prior to the power loss is restored.

Physiologic Alarms

Physiologic alarms indicate a life-threatening situation or a less urgent situation such as heart rate beyond limits.

Warning

- Do not rely exclusively on the audible alarm system for patient monitoring. Adjustment of alarm volume to a low level during patient monitoring may result in patient danger. Remember that the most reliable method of patient monitoring combines close personal surveillance with correct operation of monitoring equipment.
- ST and QT related alarm messages appear at the Information Center only.

Arrhythmia alarm chaining and customizing arrhythmia alarm settings are described in the ECG and Arrhythmia Monitoring chapter. There are two levels of arrhythmia analysis available: Basic and Enhanced. Enhanced analysis includes Basic alarms.

The MX40 provides physiological alarms based on the settings at the Information Center, Release N or later. Alarming is not active on the MX40 until it is configured via an active association with the Information Center.

In the following table, Red (***) alarms are listed alphabetically, followed by the Yellow (**) alarms, and the Yellow (*) alarms.

Alarm Text	Priority	Condition	Source
*** ASYSTOLE	Red	Asystole. No QRS for 4 consecutive seconds	ST/AR Basic & Enhanced Arrhythmia
*** BRADY yyy < xxx	Red	Extreme Bradycardia. Heart Rate (yyy) less than Extreme Brady limit (xxx)	ST/AR Basic & Enhanced Arrhythmia
*** DESAT	Red	Very Low SpO_2 Saturation. SpO_2 value below Desaturation limit ***Note—*** Desat limit is set 10 points below low limit.	SpO_2

Alarm Text	Priority	Condition	Source
*** TACHY yyy > xxx	Red	Extreme Tachycardia. Heart Rate (yyy) greater than Extreme Tachy limit	ST/AR Basic & Enhanced Arrhythmia
*** V-FIB/TACH	Red	Ventricular Fibrillation. Fibrillatory wave (sinusoidal wave between 2-10 Hz) for 4 consecutive seconds	ST/AR Basic & Enhanced Arrhythmia
*** V-TACH	Red	Ventricular Tachycardia. Consecutive PVCs greater than or equal to V-Tach Run limit and Heart Rate greater than V-Tach limit (xxx)	ST/AR Basic & Enhanced Arrhythmia
*/**AFIB	Yellow	Atrial fibrillation waveform detected	ST/AR Enhanced Arrhythmia
**NBP High	Yellow	High limit has been exceeded for high pressure limit	NBP
**NBP Low	Yellow	Low limit has been exceeded for low pressure limit	NBP
** SpO_2T yyy > xxx	Yellow	High SpO_2. SpO_2 value (yyy) greater than high SpO_2 limit (xxx).	SpO_2
** SpO_2T yyy < xxxx	Yellow	Low SpO_2. SpO_2 value (yyy) less than low SpO_2 limit (xxx).	SpO_2
* HR yyy > xxx	Yellow	Heart Rate (yyy) greater than the upper Heart rate limit (xxx).	ST/AR Basic & Enhanced Arrhythmia
* HR yyy < xxx	Yellow	Heart Rate (yyy) lower than the lower Heart Rate limit (xxx).	ST/AR Basic & Enhanced Arrhythmia
* IRREGULAR HR	Yellow	Consistently irregular rhythm (irregular R-R intervals).	ST/AR Enhanced Arrhythmia
* MISSED BEAT	Yellow	No beat detected for 1.75 x average R-R interval for Heart Rate greater than 120, or no beat for 1 second with Heart Rate greater than 120 (non-paced patient only).	ST/AR Enhanced Arrhythmia

Alarm Text	Priority	Condition	Source
* MULTIFORM PVCs	Yellow	The occurrence of two differently shaped Vs, each occurring at least twice within the last 300 beats as well as each occurring at least once within the last 60 beats.	ST/AR Enhanced Arrhythmia
* NON-SUSTAIN VT	Yellow	A run of Vs having a ventricular Heart Rate greater than V-Tach limit but lasting for less than the V-Tach Run limit.	ST/AR Enhanced Arrhythmia
*Nurse Call	Yellow	The patient has pressed the Multi-Function Button on the MX40.	
* PACER NOT CAPT	Yellow	No QRS for 1.75 x the average R-R interval with Pace Pulse (paced patient only).	ST/AR Basic & Enhanced Arrhythmia
* PACER NOT PACE	Yellow	No QRS and Pace Pulse for 1.75 x the average R-R interval (paced patient only).	ST/AR Basic & Enhanced Arrhythmia
* PAIR PVCs	Yellow	Two consecutive PVCs between non-PVCs.	ST/AR Enhanced Arrhythmia
* PAUSE	Yellow	No QRS detected for x seconds. Choices of >1.5 to 2.5 seconds.	ST/AR Enhanced Arrhythmia
* PVCs >xxx/MIN	Yellow	PVCs within one minute exceed by the PVCs/min limit (xxx).	ST/AR Basic & Enhanced Arrhythmia
* R-ON-T PVCs	Yellow	For Heart Rate less than 100, a PVC with R-R interval less than 1/3 the average interval followed by a compensatory pause of 1.25 x average R-R interval, or 2 such Vs without a compensatory pause occurring within 5 minutes of each other. (When Heart Rate is greater than 100, 1/3 R-R interval is too short for detection.)	ST/AR Enhanced Arrhythmia
* RUN PVCs	Yellow	Run of PVCs greater than or equal to 2.	ST/AR Enhanced Arrhythmia

Alarm Text	Priority	Condition	Source
* SVT	Yellow	Run of SVPBs greater than or equal to SVT Run limit and with SVT Heart Rate greater than the SVT Heart Rate limit.	ST/AR Enhanced Arrhythmia
* VENT BIGEMINY	Yellow	A dominant rhythm of N, V, N, V (where N= supraventricular beat, V=ventricular beat).	ST/AR Enhanced Arrhythmia
* VENT RHYTHM	Yellow	A dominant rhythm of adjacent Vs greater than Vent Rhythm limit and ventricular Heart Rate less than V-Tach limit.	ST/AR Enhanced Arrhythmia
* VENT TRIGEMINY	Yellow	A dominant rhythm of N, N, V, N, N, V (where N=supraventricular beat, V=ventricular beat).	ST/AR Enhanced Arrhythmia

Technical Alarms (INOPs)

Technical Alarms, or INOPs (inoperative conditions), are sourced at the MX40, the ST/AR algorithm running at the Information Center, or the IntelliVue Patient Monitor. They identify inoperative conditions (that is conditions where the system is not operating properly and therefore cannot measure or detect alarm conditions reliably). There are four levels of Technical Alarms:

- **Severe** - Monitoring and alarm generation are disabled. Visual alarm indicator on the MX40. Audible tone at the Information Center. Must be acknowledged by a clinician.
- **Hard** - Monitoring and alarm generation are disabled. Visual alarm indicator on the MX40. Audible tone at the Information Center. If the hard INOP is "latched", the sound will be silenced, but the message will remain on the display until resolution of the offending condition.
- **Soft** - Monitoring and alarms remain active. Visual alarm indicator on the MX40 and at the Information Center. No audible tones are generated at the Information Center
- **Red/Yellow** - Replace Battery and ECG Leads Off INOPs may be configured to display as either Red or Yellow Technical Alarms. ***Note -*** The ECG Leads Off INOP will initially display as a cyan technical alarm until a valid ECG signal is obtained.

In the following table, technical alarms are listed alphabetically.

Alarm Text	Priority	Condition	What to do
BATTERY LOW T **Source - MX40**	Soft	• There is less than 15 minutes of monitoring time remaining (AA batteries).	• Replace batteries promptly to avoid shutdown and cessation of monitoring.
		• Lithium-ion battery level is ≤ 10% or has ≤30 minutes remaining time.	• Insert a charged lithium-ion battery pack.

Alarm Text	Priority	Condition	What to do
CANNOT ANALYZE ECG **Source - MX40 and Information Center**	Hard	Arrhythmia algorithm cannot reliably analyze the ECG data on any monitored leads.	Assess the lead selections, initiate relearn, and validate analyzed rhythm. Check other INOPs for possible source of problem.
CHECK ECG SETTINGS **Source - MX40**	Hard	Synchronization of ECG settings between the monitor and the Information Center has failed.	Check that the ECG settings from the ECG source are appropriate. ***Note —*** When transitioning between networked and non-networked monitoring, this INOP will display. Pressing the Silence button on the monitor will dismiss the INOP.
CHECK PAIRING **Source - MX40**	Yellow Technical Alarm	• There is a problem with device pairing. • When the MX40 is wirelessly paired with an X2 patient monitor (no label) docked with a larger networked MP series monitor, and the network connection is lost.	• Check that the bedside monitor is correctly paired. • Select the correct device to be paired.
cl NBP Batt Low **Source - Cableless Measurement Device**	Hard	CL NBP Pod weak battery condition.	Charge battery.
cl NBP Batt Empty **Source - Cableless Measurement Device**	Severe	CL NBP Pod empty battery condition.	Charge battery. Monitoring is not possible.

Alarm Text	Priority	Condition	What to do
cl NBP DISCONNECT **Source - Cableless Measurement Device**	Hard	CL NBP Pod is not connected with the MX40.	• Resolve interference condition. • Reduce range between CL NBP Pod and MX40.
cl SpO_2 Batt Low **Source - Cableless Measurement Device**	Hard	CL SpO_2 Pod weak battery condition.	Charge battery.
cl SpO_2 Batt Empty **Source - Cableless Measurement Device**	Severe	CL SpO_2 Pod empty battery condition.	Charge battery. Monitoring is not possible.
cl SpO_2 DISCONNECT **Source - Cableless Measurement Device**	Hard	CL SpO_2 Pod is not connected with the MX40.	• Resolve interference condition. • Reduce range between CL SpO_2 Pod and MX40.
ECG/ARRH ALARM OFF **Source - MX40**	Soft	ECG is turned off.	Turn on ECG.
ECG LEADS OFF Note This INOP may also be configured to display as a Red or Yellow Technical Alarm. **Source - MX40**	Red or Yellow or Hard Technical Alarm	• Multiple leads are off.	Re-attach ECG leads to patient..
<electrode> LEAD OFF **Source - MX40**	Hard	Single lead is off. If primary lead is MCL, lead will be identified as V/C in INOP text.	Re-attach ECG leads to patient.

Alarm Text	Priority	Condition	What to do
LEADSET UNPLUGGED **Source - MX40**	Hard	Leadset has been unplugged from the MX40.	Re-attach the ECG leadset.
LOCAL AUDIO OFF **Source - MX40**	Soft	There is no alarm audio notification when operating in Telemetry Mode. ***Note —*** This is normal operation in Telemetry Mode.	Change to Monitor Mode.
MONIT. DISCONNECT **Source - MX40**	Hard	The paired MX40/bedside monitor is out of short-range radio range or there is excessive radio interference.	• Reduce the distance between the devices. • Identify and remove interference source.
NO ALARM DISPLAY **Source - MX40**	Soft	When operating with Information Center Release L Or M, there is no local alarming at the MX40, networked or non-networked.	Condition is not present when operating with Information Center Release N or later (unless specifically configured to operate in this way).
NO CENTRAL MONITOR (appears at MX40 only) **Source - Patient Monitor**	Hard	• The MX40 is out of range of the network. • Patient Sector at the Information Center is in Standby.	• Return the MX40 to the coverage area. • Select Resume at the Information Center.

Alarm Text	Priority	Condition	What to do
NO SIGNAL (appears at the Information Center only) **Source - Information Center**	Hard, Latched	• The MX40 is outside the coverage area, or • No batteries in the MX40, or • The MX40 has failed.	• Make sure that the MX40 is within the coverage area and has good batteries. • Replace the MX40 if Power On Self Test fails. • Put bed in Standby.
REPLACE BATTERY T **Source - MX40** ***Note —*** This INOP may also be configured to display as a Red or Yellow Technical Alarm.	Red or Yellow or Hard Technical Alarm, Latched	• Dead battery. No monitoring is occurring. • When operating wirelessly, the patient monitor is no longer providing power to the MX40, and battery capacity is now depleted.	Replace batteries.
SOME ECG ALARMS OFF **Source - Information Center**	Soft	Some yellow arrhythmia alarms have been turned off for this patient.	For information only.
%SpO_2T EQUIP MALF **Source - MX40**	Hard	Malfunction in the SpO_2 equipment	Contact Service.
%SpO_2T ERRATIC **Source - MX40**	Hard	Erratic SpO_2 measurements, often due to a faulty sensor or invalid SpO_2 measurements, or incorrect transducer position	Repeat measurement, reposition sensor on patient, or finally, replace sensor.
%SpO_2T EXTD UPDATE Numeric is replaced by a -?-. **Source - MX40**	Soft	The update period of displayed values is extended due to an NBP measurement on the same limb or an excessively noisy signal.	If NBP is not active, check the sensor placement. Reposition the sensor on patient, or replace sensor.

Alarm Text	Priority	Condition	What to do
%SpO_2T INTERFERENCE **Source - MX40**	Hard	Level of ambient light or level of electrical interference are so high that the SpO_2 sensor cannot measure SpO_2 and pulse rate.	Reduce ambient light to sensor or electrical noise sources.
%SpO_2T LOW PERF **Source - Monitor**	Soft	Accuracy may be reduced due to low perfusion. Data displayed with ?.	Increase perfusion. Change sensor site. Avoid site distal to BP cuff or intra-arterial line. Warm the site.
%SpO_2T NO SENSOR ***Note —*** Silencing this technical alarm turns off the SpO_2 measurement on the MX40 only (not at the Information Center). **Source - MX40**	Hard	No sensor attached to SpO_2 device	Attach SpO_2 sensor.
%SpO_2T NOISY SIGN **Source - MX40**	Hard	Excessive patient movements or electrical interference are causing irregular pulse patterns	Reduce movement or electrical noise sources.
%SpO_2T NON-PULSAT ***Note —*** When paired directly with an IntelliVue MP5 Patient Monitor, the INOP will display as SpO_2T SENSOR OFF. **Source - MX40**	Hard	• Pulse is too weak or not detectable • Sensor has fallen off at patient	• Check connection to patient. • Change sensor site. Avoid site distal to BP cuff or intra-arterial line.
%SpO_2T SEARCHING	Soft	The patient signal is analyzed, but a valid numeric is not available yet.	Wait for the measurement to complete.
%SpO_2T SENSOR MALF **Source - MX40**	Hard	Malfunction of the SpO_2 sensor/adapter cable	Replace sensor.
TELE BATTERY LOW **Source - MX40**	Soft	Lithium-ion battery level is $\leq$ 20% or has $\leq$30 remaining time.	Insert a charged lithium-ion battery pack.

Alarm Text	Priority	Condition	What to do
TELE BATT EMPTY ***Note —*** This INOP may also be configured to display as a Red or Yellow Technical Alarm. **Source - MX40**	Hard, Latched	Lithium-ion battery level is critically low. A 10-minute countdown begins. The MX40 will shutdown if the condition is not cleared. ***Note —*** For Information Center Release L or M, this INOP will appear as "REPLACE BATTERY T".	Insert a charged lithium-ion battery pack.
TELE BATTERY TEMP **Source - MX40**	Hard	The temperature of the lithium-ion battery is above 55° C or below -5° C. ***Note —*** For Information Center Release L or M, this INOP will appear as "REPLACE BATTERY T"	Replace the lithium-ion battery.
TELE CHECK BATT **Source - MX40**	Soft	Lithium-ion battery has ≤ 25 charge cycles remaining before reaching the charge cycle maximum limit.	Be aware that the Lithium-ion battery pack will soon need replacement.
TELE INCOMPATIBLE **Source - Monitor**	Hard	MX40s and bedside monitors equipped with short-range radio capability are not supported with this revision of the Information Center	Contact Service. The Information Center needs to be upgraded to support this functionality.
TELE MALFUNCTION **Source - MX40**	Hard	MX40 malfunction or self-test failure.	Contact Service to replace the MX40.
TRANSMITTER OFF **Source - MX40**	Hard	RF Auto Shutoff after 10 minutes of all leads off and no SpO_2 sensor connected.	• Reattach ECG leads to patient. • Reattach SpO_2 sensor.

Alarm Text	Priority	Condition	What to do
TELE REMOVE BATT **Source - Monitor**	Hard, Latched	The temperature of the lithium-ion battery is >60° C and the battery must be removed. ***Note —*** For Information Center Release L or M, this INOP will appear as "REPLACE BATTERY T".	Replace the lithium-ion battery.
TELE SERVICE BATT **Source - Monitor**	Hard	The lithium-ion battery has exceeded the maximum charge cycle limit.	Replace the lithium-ion battery.
TELE WEAK SIGNAL **Source - MX40**	Soft	• Patient is at outer range of the radio coverage area. • The MX40 is receiving a weak signal with high data loss from the AP. • Condition exists for multiple devices in a specific area	• Return patient to the coverage area. • If patient is in close proximity to AP, replace the MX40. Contact service. • The AP covering the specific area is suspect. Contact Service.

5. ECG and Arrhythmia Monitoring

This section covers the specifics of ECG measurement and the ST/AR Arrhythmia, ST, and QT algorithms used for arrhythmia monitoring.

ECG Safety Information

Warnings

- Always confirm MX40 and Information Center observations with clinical observation of the patient before administering interventions.
- To avoid patient injury, assure that the patient cable is not positioned where leads could become entangled around the patient, or cause choking, strangulation, or inhibit circulation in extremities.
- Every lead must be secured to an electrode on the patient. Conductive parts of electrodes must not contact earth or other conductive parts.
- EASI derived 12-lead ECGs and their measurements are approximations to conventional 12-lead ECGs. As the 12-lead ECG derived with EASI is not exactly identical to the 12-lead conventional ECG obtained from an electrocardiograph, it should not be used for diagnostic interpretations.
- EASI lead placement is supported for adult patients only.
- Ensure that the patient cable is properly connected to the MX40.
- Do not mix and match electrodes of different types. In particular, do not use electrodes of dissimilar metals. This helps ensure optimal signal quality.
- Non-manufacturer supplied accessories and supplies can corrupt the performance of the equipment. Use only AAMI EC-12 compliant electrodes with this device. Use of electrodes that are non-compliant may provide erroneous results.
- During complete heart block or pacemaker failure (to pace or capture), tall P-waves (greater than 1/5 of the average R-wave height) can be erroneously counted by the arrhythmia algorithm, resulting in missed detection of cardiac arrest.

Caution

- To protect the MX40 from damage during defibrillation, to ensure accurate ECG information, and to provide protection against signal noise and other interference, use only ECG electrodes and cables specified by Philips.
- Philips recommends that you change the lead label only to reflect the physical placement of electrodes. This will ensure a match between the monitored lead and the label, and prevent any possible confusion.

Note— When switching from EASI to standard monitoring, there is a momentary loss of data.

For Paced Patients

Warnings

- The output power of the MX40 and other sources of radio frequency energy, when used in the proximity of a pacemaker, can be sufficient to interfere with pacemaker performance. Due to the shielding effects of the body, internal pacemakers are somewhat less vulnerable than external pacemakers. However, caution should be exercised when monitoring any paced patient.

  In order to minimize the possibility of interference, position electrodes, electrode wires, and the MX40 as far away from the pacemaker as possible.

  Consult the pacemaker manufacturer for information on the RF susceptibility of their products and the use of their products with the IntelliVue Telemetry System. See the *IntelliVue Information Center Instructions for Use* for additional information on monitoring paced patients.
- When an external pacemaker is being used on a patient, arrhythmia monitoring is severely compromised due to the high energy level in the pacer pulse. This may result in the arrhythmia algorithm's failure to detect pacemaker non-capture or asystole.
- Pacemakers that create fusion beats (pace pulse on top of the QRS complex) cannot be detected by the monitor's QRS detector.
- For paced patients who exhibit only intrinsic rhythm, the monitor can erroneously count pace pulses as QRS complexes when the algorithm first encounters them, resulting in missed detection of cardiac arrest. The risk of missing cardiac arrest can be reduced by monitoring these patients with the low heart rate limit at or slightly above the basic/demand pacemaker rate. A low heart rate alarm notifies you when the patient begins pacing. Proper detection and classification of the paced rhythm can then be determined.

Note— During defibrillation, monitoring may be temporarily interrupted or distorted. It may take several seconds for the ECG trace to reappear on the screen. After defibrillation, the device will continue to monitor as before; the device settings will not be affected.

Measuring ECG

The electrocardiogram (ECG) measures the electrical activity of the heart and displays it on the MX40 and the Information Center as a waveform and a numeric.

In order to compare measured ECG signals, the electrodes (or patient cables) are placed in standardized positions, forming "leads". To obtain ECG signals optimized for use in diagnosis and patient management in different care environments, different leadsets in varying lead placements are used. Both standard lead and EASI lead placements can be used with the MX40.

The Heart Rate calculation resides in the arrhythmia algorithm on the MX40 and at the Information Center. Arrhythmia analysis is always turned on for telemetry patients. Arrhythmia analysis is either Basic or Enhanced, depending on the product configuration.

Connecting and Positioning ECG Electrodes

Correct lead placement is always important for accurate diagnosis. Especially in the precordial leads, which are close the heart, QRS morphology can be greatly altered if an electrode is moved away from its correct location. Each electrode is color-coded. Use the placement diagrams available on the display of the MX40 and in this section for guidance. Additional lead placement information is available in the *Online Help* at the IntelliVue Information Center.

When placing electrodes on the patient, choose a flat, non-muscular site where the signal will not be impacted by either movement or bones.

Philips recommends that electrodes be changed every 24 hours.

In addition to correct positioning of the electrodes, optimal skin preparation prior to electrode placement will help ensure a clear signal for diagnosis.

1 Prepare the patient's skin. Good electrode-to-skin contact is important for a good ECG signal, as the skin is a poor conductor of electricity.

- Select sites with intact skin, without impairment of any kind.
- Clip or shave hair from the site as necessary.
- Wash site with soap and water, leaving no soap residue.

  Note— Philips does not recommend using ether or pure alcohol, because they dry the skin and increase the resistance.
- Dry thoroughly.
- Use ECG skin preparation paper (abrasive) to remove dead skin cells and to improve the conductivity of the electrode site.

2 Check electrodes for moist gel, and attach to the clips. If you are not using pre-gelled electrodes, apply electrode gel to the electrodes before placement.

Note— Gel must be moist to provide a good signal.

3 Place the electrodes on the patient according to the lead placement you have chosen (see the electrode placement diagrams following). Place the edge down, then "roll down" the rest of the pad. Press firmly around the adhesive edge toward the center.

4 Attach the patient cable to the MX40. An ECG waveform and numeric appear on the monitor display.

Selecting the Primary and Secondary ECG Leads

The MX40 uses the primary and secondary lead selected at the Information Center to compute HR and to analyze and detect cardiac arrhythmias. They are also available for recordings and for display on the Information Center.

The secondary lead is used if your device is configured for multi-lead (instead of single-lead) arrhythmia analysis.

You should choose a lead as primary or secondary lead at the Information Center that has the following characteristics:

- the QRS complex should be either completely above or below the baseline and it should not be biphasic
- the QRS complex should be tall and narrow
- the P-waves and T-waves should be less than 0.2 mV

Checking Paced Status

It is important to set the paced status correctly when you start monitoring ECG.

When Paced is set to Yes:

- Pacer Algorithm is switched on. This means that pacemaker pulses are not counted as extra QRS complexes.
- The pacer spikes are shown in white.
- The paced symbol is displayed.

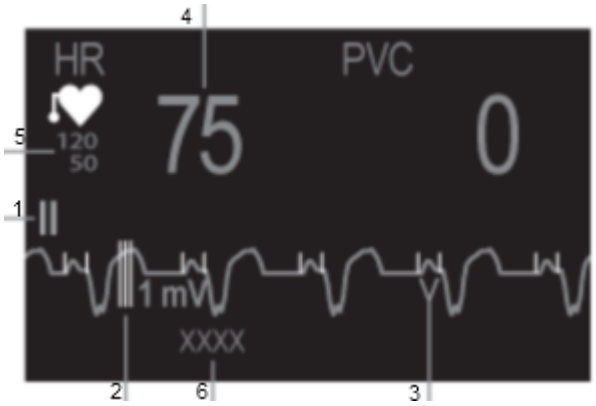
When Paced is set to No and your patient has a pacemaker, pace pulses may be counted as regular QRS complexes, which could prevent an asystole event from being detected.

Warning

- Pace pulse rejection must be switched on for paced patients by setting Paced to Yes. Switching pace pulse rejection off for paced patients may result in pace pulses being counted as regular QRS complexes, which could prevent an asystole event from being detected. At admission/discharge, always check that paced status is correct for the patient.
- Some pace pulses can be difficult to reject. When this happens, the pulses are counted as a QRS complex, and could result in an incorrect HR and failure to detect cardiac arrest or some arrhythmias. Make sure that pace pulses are detected correctly by checking the pace pulse markers on the display. Keep pacemaker patients under close observation.

Understanding the ECG Display

Your display may be configured to look slightly different.



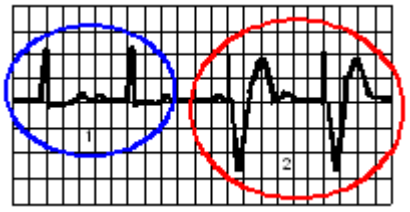
1. Lead label of the displayed wave
2. 1 mV calibration bar
3. Pacer spikes
4. Current heart rate
5. Current heart rate alarm limits
6. EASI lead placement label (located here when active)

ECG HR numeric: This is the heart rate derived from the monitored ECG.

Pacer Spikes: The pacer spikes are shown in white.

Monitoring Paced Patients

An ECG optimized for monitoring a paced patient should look like this:



1. Normal Beats
2. Pace Pulses/Beats

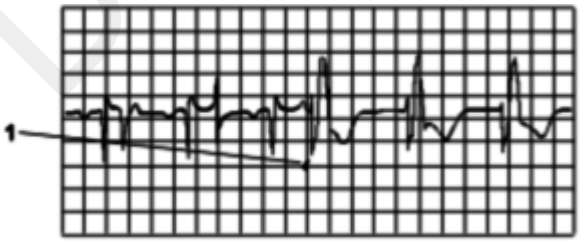
You should choose a lead as primary or secondary lead that has these characteristics:

- the normal QRS complex should be either completely above or below the baseline and it should not be biphasic. For paced patients, the QRS complexes should be at least twice the height of pace pulses.
- the QRS complex should be tall and narrow
- the P-waves and the T-waves should be less than 0.2 mV.

Avoiding Pace Pulse Repolarization Tails

Some unipolar pacemakers display pace pulses with repolarization tails. These tails may be counted as QRSs in the event of cardiac arrest or other arrhythmias.

If you note a visible repolarization tail, choose a lead that decreases the size of the repolarization tail.



1. Repolarization tail (note width)

Changing the Size of the ECG Wave

If any of the displayed ECG waves is too small or clipped, you can change the size of the ECG waves on the screen.

Changing the adjustment factor only changes the visual appearance of the ECG wave on the MX40. It does not affect the ECG signal analyzed by the algorithm.

Comparing the wave size to the 1 mV calibration bar on the ECG wave segment can help you to get an idea of the true ECG signal strength.

To change the size of the ECG waves on the screen by a fixed adjustment factor:

1 In the Setup ECG menu, select Adjust Size.

2 Select the required adjustment factor from the line of pop-up keys.

- Size X1/2 to halve the wave size
- Size X1 to display the wave without zoom
- Size X2 to double the wave size
- Size X4 to multiply the wave size by four

Selecting Positions of Va and Vb Chest Leads

The two chest leads for the 6-lead placement can be positioned at any two of the V1 to V9 and V3R, V4R and V5R positions. Select the positions you have used in the Patient Window at the Information Center, so that the chest leads will be correctly labeled.

Choosing EASI or Standard Lead Placement

Choose either standard lead placement or EASI lead placement:

1 In the **Setup ECG** menu, select **Lead Placement** to toggle between Standard or EASI.

2 Select **Standard** or **EASI**.

Note — When changing lead placement, the patient cable must be attached to the MX40.

EASI is shown beside the 1 mV calibration bar on the ECG wave on the display, and EASI is marked on any recorder strips and printouts.

See the sections on Lead Placement for electrode placement diagrams.

ECG Configuration

The MX40 supports 3-, 5-, and 6-wire patient cables. The 5-wire patient cable can be used for either standard or EASI electrode configurations. The MX40 detects the patient cable type attached and automatically determines the ECG measurement and transmitted leads.

Note—The labels and colors of the ECG electrodes differ according to the standards that apply for your hospital. The electrode placement references and illustrations in this chapter use the AAMI labels and colors. See the table below for additional label and color information.

Electrode Labels			Electrode Colors	
AAMI	**EASI**	**IEC**	**AAMI**	**IEC**
RA	I	R	White	Red
LA	S	L	Black	Yellow
LL	A	F	Red	Green
RL	N	N	Green	Black
V/Va	E	C/Ca	Brown	White
Vb		Cb	Brown/White	White/Blue

ECG Leads Monitored

Depending on the patient cable connected to the MX40, a different set of viewable leads are available at the MX40 and the Information Center. The MX40 can source up to four raw ECG waves to the Information Center.

If you are using ...	these leads can be selected at the MX40 and the Information Center
3-wire	I, II, III Sourced (raw) waves are received as: Channel 1 = I, II, or III Default is II.
5-wire (Standard mode)	I, II, III, aVR, aVL, aVF, MCL and V Sourced (raw) waves are received as: Channel 1 = II Channel 2 = III Channel 3 = MCL Defaults are II, V, III.
5-wire (EASI mode)	I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6 In EASI mode, the sourced (raw) waves are received as: Channel 1 = Vector 1 (A-I) Channel 2 = Vector 2 (A-S) Channel 3 = Vector 3 (E-S) Defaults are II, V2, III, V5. Arrhythmia monitoring is performed only on the primary and secondary leads selected at the Information Center, although you can view and perform ST analysis on all 12 EASI derived leads.

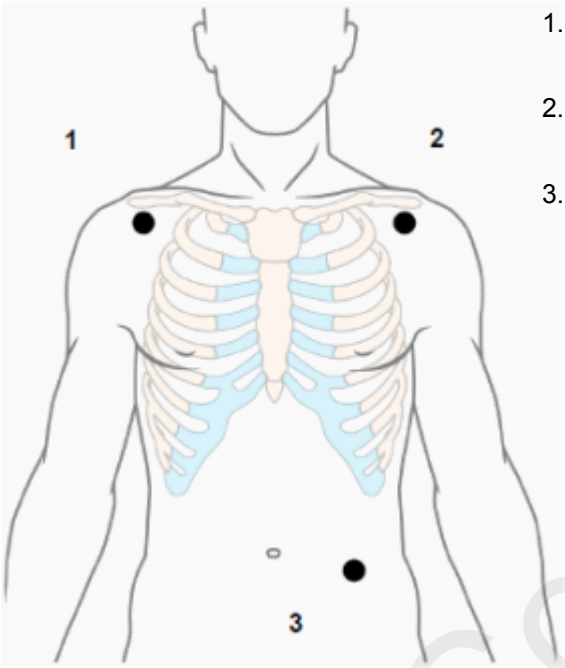
If you are using ...	these leads can be selected at the MX40 and the Information Center
6-wire	I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6, V7, V8, V9, V3R, V4R, V5R. Sourced (raw) waves are received as: Channel 1 = II Channel 2 = III Channel 3 = Va Channel 4 = Vb Defaults are II, Va = V2, III,Vb = V5. The two chest leads, Va and Vb, can be placed on the patient in any of the V lead positions (V1 through V9, V3R, V4R, V5R). Lead assignment is available at the Information Center. When unassigned, the chest leads use the defaults. ***Note—*** The lead label assigned to Vb cannot be selected for Va even though Vb does not appear to be used. When display of the pleth wave is enabled at the Information Center, the second chest lead (Vb) is not available for monitoring.

Reconstructed Leads

Reconstruction of leads from the sourced wave is defined by the calculations in the following table. EASI reconstructed leads are a linear combination of all three raw EASI leads

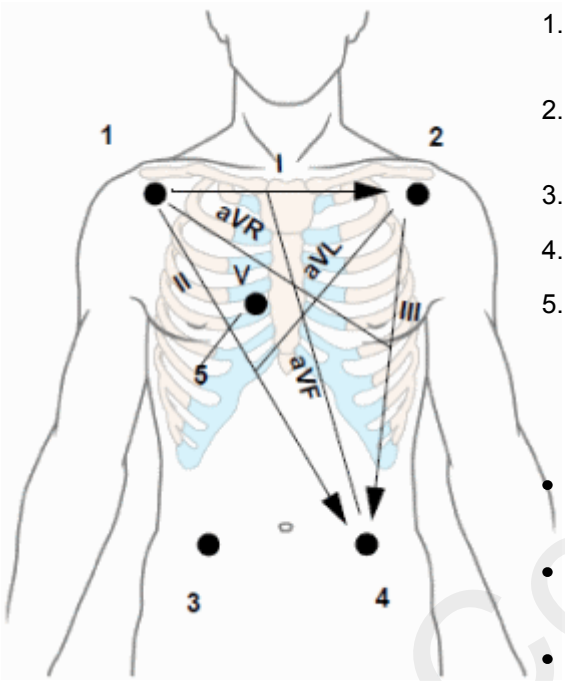
ECG Lead			Clinical Calculations in terms of electrodes
3-wire	**5-wire Standard**	**6-wire**	
I	I	I	LA-RA
II (default)	II (default)	II (default)	LL-RA
III	III (default)	III (default)	LL-LA
-	MCL		V-LA, where V=C
-	aVR	aVR	RA-(LA+LL)/2
-	aVL	aVL	LA-(RA+LL)/2
-	aVF	aVF	LL-(LA+RA)/2
-	V (default)		V-(RA+LA+LL)/3, where V=C
		Va	Va-(RA+LA+LL)/3, where Va=V2 (default) position
		Vb	Vb-(RA+LA+LL)/3, where Vb =V5 (default) position

3-Wire Placement



1. RA - directly below the clavicle and near the right shoulder
2. LA -directly below the clavicle and near the left shoulder
3. LL - on the left lower abdomen

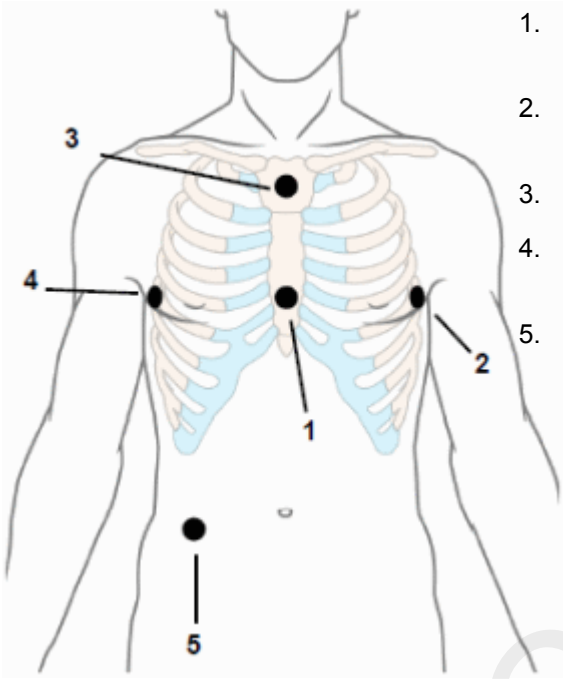
5-Wire Placement (Standard Mode)



1. RA directly below the clavicle and near the right shoulder
2. LA directly below the clavicle and near the left shoulder
3. RL on the left lower abdomen
4. LL on the right lower abdomen
5. V on the chest, the position depends on your required lead selection. The typical position is V1, although this may vary according based on your hospital's protocol.

- V1 on the fourth intercostal space at the right sternal border
- V2 on the fourth intercostal space at the left sternal border
- V3 midway between the V2 and V4 electrode positions
- V4 on the fifth intercostal space at the left midclavicular line
- V5 on the left anterior axillary line, horizontal with the V4 electrode position
- V6 on the left midaxillary line, horizontal with the V4 electrode position

5-Wire Placement (EASI Mode)



1. E (V) on the lower sternum at the level of the fifth intercostal space
2. A (LL) on the left midaxillary line at the same level as the E electrode
3. S (LA) on the upper sternum
4. I (RA) on the right midaxillary line at the same level as the E electrode
5. N (Reference) can be anywhere, usually below the sixth rib on the right hip

Make sure that the S and E electrodes line up vertically on the sternum, and that the I, E and A electrodes align horizontally.

6-Wire Placement

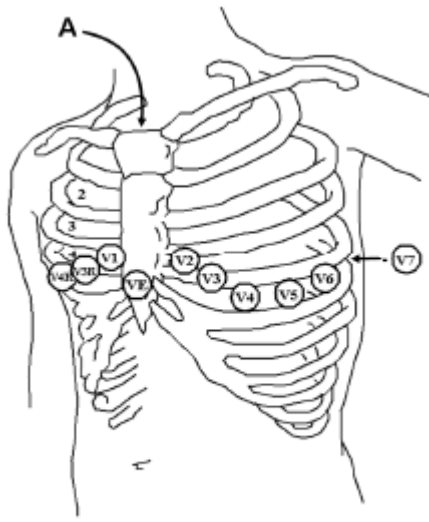
6-lead placement uses the same positions from as the 5-lead standard placement described above , along with two precordial leads - referred to as Va and Vb.

The default position of Va - the brown lead - is at the V2 position.

The default position for Vb - the brown/white lead - is at the V5 position.

The lead placement for the Va and Vb lead labels must be appropriate. If your unit uses other precordial leads for Va and Vb, they may be assigned in Unit Settings at the Information Center as defaults for your whole unit, or you may need to assign the new positions on a per-patient basis in the Patient Window at the Information Center.

Chest Electrode Placement



A - Angle of Lewis

V1 on the fourth intercostal space at the right sternal border

V2 on the fourth intercostal space at the left sternal border

V3 midway between the V2 and V4 electrode positions

V4 on the fifth intercostal space at the left midclavicular line

V5 on the left anterior axillary line, horizontal with the V4 electrode position

V6 on the left midaxillary line, horizontal with the V4 electrode position

V3R-V6R on the right side of the chest in positions corresponding to those on the left

VE over the xiphoid process

V7 on posterior chest at the left posterior axillary line in the fifth intercostal space

V7R on posterior chest at the right posterior axillary line in the fifth intercostal space

For accurate chest electrode placement and measurement, it is important to locate the fourth intercostal space.

➢ *To locate the fourth intercostal space:*

1 Locate the second intercostal space by first palpating the Angle of Lewis (the little bony protuberance where the body of the sternum joins the manubrium). This rise in the sternum is where the second rib is attached, and the space below this is the second intercostal space.

2 Palpate and count down the chest until you locate the fourth intercostal space.

Monitoring during Leads Off

ECG Fallback and Extended monitoring states are supported for the MX40 when the primary and/or secondary leads are in a "Leads Off" INOP condition. Both of these states are entered into after 10 seconds of "Leads Off" in an attempt to maintain monitoring and arrhythmia analysis.

ECG Fallback

ECG Fallback occurs when the primary lead is in "Leads Off" for 10 seconds and a secondary lead is available.

Multilead Analysis

If there is a "Leads Off" technical alarm in the primary lead for > 10 seconds, the active secondary lead becomes the primary lead. The arrhythmia algorithm switches the leads on the display, but relearn does not occur. When the "Leads Off" condition is corrected, the leads are switched back to their original state.

Single Lead Analysis

For single lead analysis, if there are two leads available, the secondary lead is made the primary lead until the "Leads Off" condition is corrected. The arrhythmia algorithm performs a relearn using the available lead.

Fallback for EASI

If one of the derived EASI leads is in a technical alarm condition, a flat line is displayed. After 10 seconds, the directly acquired EASI AS, EA, or AI lead, depending on which is available, is displayed. Arrhythmia relearn is performed with transition to or from EASI Fallback monitoring using the available lead(s).

Relearning

Whenever there is a "Leads Off" condition for more than 60 seconds, the arrhythmia algorithm performs a Relearn using the available leads.

Warning

Since Relearn happens automatically, if learning takes place during ventricular rhythm, the ectopics can be incorrectly learned as the normal QRS complex. This can result in missed detection of subsequent events of V-Tach and V-Fib. For this reason, you should:

1 Respond promptly to any technical alarm.

2 Ensure that the arrhythmia algorithm is labeling beats correctly.

ST/AR Arrhythmia Monitoring

ST/AR Arrhythmia Algorithm

Indications for Use

The ST/AR Arrhythmia Algorithm is indicated for use in instances where the clinician decides to monitor cardiac arrhythmias of adult and pediatric patients and/or the ST segment of adult patients to gain information for treatment, monitor the adequacy of treatment, or to exclude causes of symptoms.

How the ST/AR Algorithm Works

ST/AR multi-lead analysis is performed on the user-selected primary and secondary leads. If only one lead is available for multilead, ST/AR analysis is performed on the single available lead.

Arrhythmia analysis consists of several steps:

1 The ECG signal is pre-processed to filter out baseline wander, muscle artifact, and signal irregularities. In addition, if the Patient Paced status = Yes, pace pulses are detected then rejected from the processing to avoid seeing them as QRS beats.

2 Beat detection to locate the QRS complexes for further analysis.

3 Feature measurement such as R-wave height, width, and timing.

4 Beats classification. Templates are created and are matched to incoming beats, and the appropriate beat label is determined.

5 Rhythm and alarm detection. Beat labels are used to produce the values and events needed to generate rhythms and alarms.

Working in parallel with beat detection and classification, a separate detector examines continuously for ventricular fibrillation, asystole, and noise.

The quality of the ECG signal is important for accurate arrhythmia analysis. The section below provides guidelines for optimizing signals for arrhythmia analysis.

For additional information on the ST/AR Algorithm, refer to the Arrhythmia Monitoring ST/AR Algorithm Application Note, #453564115631.

Aberrantly-Conducted Beats

As P-waves are not analyzed, it is difficult and sometimes impossible for the monitor to distinguish between an aberrantly-conducted supraventricular beat and a ventricular beat. If the aberrant beat resembles a ventricular beat, it is classified as ventricular. You should always select a lead where the aberrantly-conducted beats have an R-wave that is as narrow as possible to minimize incorrect calls. Ventricular beats should look different from these 'normal beats'. Instead of trying to select two leads with a narrow R-wave, it may be easier to just select one lead and use single lead arrhythmia monitoring. Extra vigilance is required by the clinician for this type of patient.

Intermittent Bundle Branch Block

Bundle branch and the other fascicular blocks create a challenge for the arrhythmia algorithm. If the QRS during the block changes considerably from the learned normal, the blocked beat may be incorrectly classified as ventricular, causing false PVC alarms. You should always select a lead where the bundle branch block beats have an R-wave that is as narrow as possible to minimize incorrect calls. Ventricular beats should look different from these 'normal beats'. Instead of trying to select two leads with a narrow R-wave, it may be easier to just select one lead and use single lead arrhythmia monitoring. Extra vigilance is required by the clinician for this type of patient.

ECG and Arrhythmia Alarm Overview

The ECG and arrhythmia alarms available depend on which measurements are switched on, and the arrhythmia option enabled for your MX40.

Basic arrhythmia alarms are available when Arrhythmia is switched on

Enhanced arrhythmia alarms are available when the Enhanced Arrhythmia option has been enabled for your device. To check your enabled settings, view the **Standby** screen.

Alarms with Basic Arrhythmia Option	Additional Alarms with Enhanced Arrhythmia Option
***Asystole	**Afib
***Ventricular Fibrillation/Tachycardia	**Supraventricular Tach
***Extreme Bradycardia	**Missed Beat
***Extreme Tachycardia	**Pause

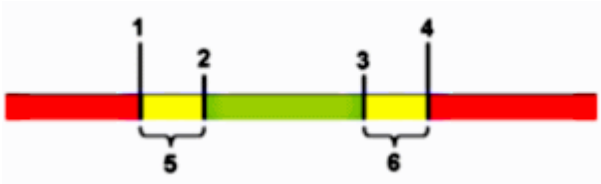
Alarms with Basic Arrhythmia Option	Additional Alarms with Enhanced Arrhythmia Option
***Ventricular Tachycardia	**Irregular HR
**High heart rate	**Ventricular Rhythm
**Low heart rate	**Run PVCs High
**Pacer Not Capture (if Pacing set to Yes)	**Pair PVCs
**Pacer Not Pacing (If Pacing set to Yes)	**R-on-T PVCs
**PVCs/min HIGH (PVC > limit/min)	**Ventricular bigeminy
	**Ventricular trigeminy
	**Non-sustain VT
	**Multiform PVCs

Using ECG Alarms

ECG alarms can be switched on and off and the high and low alarm limits changed just like other measurement alarms, as described in the Alarms chapter. Special alarm features which apply only to ECG are described here.

Extreme Alarm Limits for Heart Rate

The extreme rate alarms, Extreme Tachy and Extreme Brady, are set at the Information Center by adding a set value (the D value) to the high and low alarm limits.



1. Extreme Brady Limit
2. Low Limit
3. High Limit
4. Extreme Tachy Limit
5. Extreme Brady (D value)
6. Extreme Tachy (D value)

You need to know which value has been configured for your monitor. Changing the high and low alarm limits automatically changes the extreme alarm limits within the allowed range.

Arrhythmia Alarm Settings

Some arrhythmia alarms can be turned off at the Information Center. They are:

Non-Sustain, Vent Rhythm, Run PVCs, Pair PVCs, R-On-T PVCs, V.Bigeminy, V.Trigeminy, Multif.PVCs, Pause, SVT, Irregular HR, Missed Beat, PVCs/min and **Afib**.

It is also possible to turn all yellow arrhythmia alarms off at the Information Center.

Alarms that have been turned off at the Information Center will appear as off in the Arrhythmia menu of the MX40, but they are not accessible, nor can you change limits locally.

Yellow Arrhythmia Alarms

Yellow arrhythmia alarms are short yellow alarms specific to arrhythmia-related patient conditions. Depending on your monitor and Information Center configuration, they may be shown with one or two stars. The heart rate alarms (High HR and Low HR) can be configured as short yellow or standard yellow alarms. When they are standard yellow alarms they exist independently of the other arrhythmia alarms and no timeout periods apply.

Warning

When arrhythmia analysis is on, all yellow ECG and arrhythmia alarms are short yellow alarms (one-star). This means that the alarm tones (if volume is on) are active for six seconds only, after which the blinking numeric and the alarm message remain for up to three minutes. The only exception to this are the HR High and Low alarms which can be configured as standard yellow alarms. Red alarms behave as usual.

Viewing Arrhythmia Waves

➢ *To review arrhythmia beat labels:*

1 Go to the **Setup ECG** menu.

2 Select **Arrhythmia**.

3 Change **Annotate Arrhy** from **Off** to **On**. Beat labels will be annotated above the ECG wave and Delayed will appear beside it.

➢ ***To return to the normal ECG primary lead display:***

1 Select **Annotate Arrhy**.

2 Change to **Off**.

3 Exit from the **Setup ECG** menu.

Arrhythmia Beat Labels

Arrhythmia beat labels tell you how the monitor is classifying beats.

N = Normal

V = Ventricular Ectopic

S = Supra-ventricular Premature

P = Paced

' = Pacer spike

" = Biventricular Pacer Spike

L = Learning patient's ECG

A = Artifact (noisy episode)

? = Insufficient information to classify beats

Learning

The arrhythmia system's goal is to learn the patient's normal complexes so it can differentiate abnormal beats. This "learning" process uses the 15 first valid beats (for example, free from noise) encountered during the learning phase.

While the system is learning the complex, the delayed arrhythmia wave displays the beat label "L".

Learning Phase

A learning phase involves the system learning the patient's dominant complexes. During a learning phase:

- Alarm timeout periods are cleared.
- Stored arrhythmia templates are cleared.

- Asystole, Vfib, and HR alarms (when there are enough beats to compute the HR) are active.
- All other alarms are not active.

Single Lead Analysis

If single lead analysis is selected, the arrhythmia system begins alearning whenever:

- ECG monitoring is initiated.
- The Relearn key is activated (see Initiating Arrhythmia Relearning Manually p. 5-31).
- The ECG Lead or Lead Label is changed manually, or when Fallback occurs (see ECG Fallback p. 5-23).
- A Leads Off INOP condition (that has been active for >60 seconds) ends.

Multilead Analysis

If multilead analysis is selected, the arrhythmia system begins a learning on *both* leads whenever:

- ECG monitoring is initiated.
- The Relearn key is activated (see Initiating Arrhythmia Relearning Manually p. 5-31).
- There has been a Leads Off INOP condition (that has been active for >60 seconds) for both leads, and the condition ends in either lead.

Multilead Analysis With Changes in One Lead

Since the arrhythmia system uses more than one lead for analysis, if there is a change in one lead, the system does a relearn only on the affected lead. This happens whenever:

- An ECG lead or label is changed.
- A Leads Off INOP condition (that has been active for >60 seconds) ends.

Note— During this learning phase the system will continue monitoring using the operative lead. Therefore, the delayed arrhythmia wave is not labeled"L". In addition:

- Alarm timeout periods are maintained.
- Stored arrhythmia templates are maintained for the operative lead.
- All alarms turned on are active.

EASI ECG Monitoring

Whenever there is an INOP condition, the arrhythmia algorithm performs a Relearn, using the available lead.

Warning

Since Relearn happens automatically, if learning takes place during ventricular rhythm, the ectopics may be incorrectly learned as the normal QRS complex. This may result in missed detection of subsequent events of V-Tach and V-Fib. For this reason, you should:

1 Respond to the INOP message (for example, re-connect the electrode(s).

2 Ensure that the arrhythmia algorithm is labeling beats correctly.

Initiating Arrhythmia Relearning Manually

To initiate relearning manually, in the **Setup ECG** menu, select **Relearn Arrhy**.

- While the monitor is learning, if annotate arrhythmia is On, the delayed arrhythmia wave displays the beat label **L.**
- Next, the monitor determines the dominant rhythm. The beats are labeled **N.**

After relearning is complete, you should check the delayed arrhythmia wave to ensure that the algorithm is labeling the beats correctly.

If beats are still not classified correctly, check that the ECG is optimized for arrhythmia monitoring. You may need to select a different lead or change the electrodes or electrode positions if there is excessive noise, unstable voltage, low amplitude, or large P- or T-waves.

ST/AR ST Analysis Algorithm

Intended Use

The intended use of the ST/AR ST Analysis algorithm is to monitor an adult patient's ECG for ST segment elevation or depression and produce events/alarms for all possible ECG leads. The ST Analysis algorithm is capable of monitoring paced and non-paced adult patients.

Note—The ST Analysis algorithm does not analyze ventricularly paced or ventricular ectopic beats.

Warning

This device provides ST level change information; the clinical significance of the ST level change information needs to be determined by a physician.

The ST/AR ST algorithm at the Information Center monitors ST segment elevation or depression for each available telemetry ECG lead and produces events/alarms simultaneously. ST values update with every measurement period and enunciate, depending upon the severity of the change, events and alarms as they are detected.

The ST/AR ST algorithm is approved for use only with non-paced and atrially-paced adult telemetry-monitored patients. With EASI monitoring, ST analysis is performed on up to 12 leads, and an additional value of ST index is calculated and displayed. Assessment of EASI-derived 12-lead ST measurement is recommended for adult patients that meet the following parameters:

- Ages: 33-82 years
- Heights: 147 to 185 cm (58 to 73 in)
- Weights: 53 to 118 kg (117 to 261 lbs)
- Height to Weight Ratios: 1.41 to 2.99 cm/kg (0.25 to 0.54 in/lb)

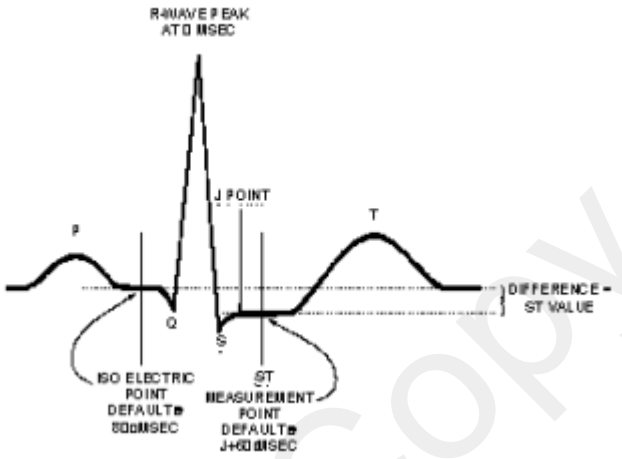
All ST analysis and ST alarms for telemetry patients are performed by the Information Center.

For additional information on ST monitoring, refer to the following documentation:

- *ST/AR Algorithm - ST Segment Monitoring* Application Note, #452296220161
- *IntelliVue Information Center Instructions for Use* and *Online Help*

The Measurement

The ST measurement for each beat complex is the vertical *difference* between two measurement points. The **isoelectric point** provides the baseline for the measurement and the **ST point** provides the other measurement point. It is positioned with reference to the J-point.



Algorithm Processing

ST analysis analyzes ECG signals to classify the heart beats. Only beats classified as normal or Supraventricular (atrially paced) are used to calculate ST elevations and depressions.

The ST/AR ST Analysis algorithm processing includes special ST filtering, beat selection and statistical analysis, calculation of ST segment elevations and depressions, and lead reconstruction and wave generation.

When ST analysis is being performed on two leads, the averaged derived and reconstructed ST waves and associated ST segment values are given for up to six leads, depending on the type of patient cable:

- 3-wire: one lead
- 5-wire: up to two leads if monitoring a chest and a limb lead
- 5-wire: up to six leads if monitoring two limb leads
- 5-wire: up to 12 leads if monitoring using EASI
- 6-wire: up to 8 leads if monitoring two limb leads and two chest leads

Note—No ST analysis is done on a patient if an electrode falls off.

Displayed ST Data

ST data displays as values in the Patient Sector and Patient Window at the Information Center. A positive value indicates ST segment elevation; a negative value indicates ST segment depression. You can view ST data in ST Review, Trend Review, and Event Review windows.

Note — ST data and alarms are not displayed at the MX40.

EASI ST Analysis

The Information Center generated ST values presented in the patient sector and Patient Window for EASI derived leads is STindx (ST Index). STindx is a summation of three ST segment measurements, using the leads that can indicate ST segment changes in the different locations of the heart:

- anterior lead V2
- lateral lead V5
- inferior lead aVF

Turning ST Monitoring On/Off

The ST Setup Window at the Information Center allows you to turn ST monitoring on or off for all available ECG leads.

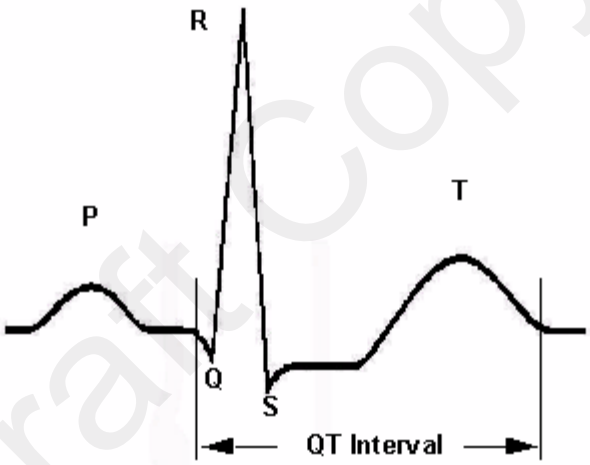
You would turn ST monitoring off if:

- You are unable to get any lead that is not noisy.
- Arrhythmias such as atrial fib/flutter cause irregular baseline.
- The patient is continuously ventricularly paced.
- The patient has left bundle branch block.

QT Interval Monitoring

Of special concern for QT monitoring is the administration of QT prolonging drugs to patients identified with risk factors for Torsade de Pointe. Females, older patients and patients with bradycardia, impaired left ventricular function (ischemia, left ventricular hypertrophy), hypokalemia and hypomagnesemia are in this increased risk category.

QT interval monitoring can assist in the detection of prolonged QT interval syndrome.The QT interval in an ECG lead is the time interval from the onset of the earliest deflection in the QRS complex to the end of the T wave. For patients being monitored by the MX40, the Information Center measures the QT interval once every minute during startup, during the learning phase and on lead mode change. After that the Information Center updates the QT values every five minutes.



The QT interval has an inverse relationship to heart rate. Faster heart rates shorten the QT interval and slower heart rates prolong the QT interval. To correct the QT interval for heart rate the Information Center uses the Bazett correction formula by default. Your system, however, may be set up to use the Fridericia correction formula as an alternative. The heart rate corrected QT interval is abbreviated as QTc.

Note — QT Data is not displayed at the MX40.

Intended Use

The intended use of the ST/AR QT/QTc analysis is for use by the physician in the risk assessment process indicated for pediatric and adult patients with and without symptoms of arrhythmia. QT measurement is intended to be used by qualified health professionals in hospital or clinical environments. Composite QT (single or multi-lead derived) measures the interval only and is not intended to produce any interpretation or diagnosis of those measurements. Additional information regarding QT monitoring can be found in the *QT/QTc Interval Monitoring Application Note*, #4522962215621

Warning

The device provides QT and QTc interval change information; the clinical significance of the QT and QTc interval change information should be determined by a clinician.

How the QT Analysis Algorithm Works

The Information Center measures the QT values once every minute during startup. Subsequently, the Information Center updates the QT values every five minutes. Normal or atrial paced beats and beats with a similar morphology are averaged to form a representative waveform for further processing. Normal beats followed by a premature QRS will be excluded from the measurements to prevent the premature beat from obscuring the end of the T-wave. If the algorithm cannot form a representative waveform, for example because the morphology of the beats is too varied, the Information Center generates a Cannot Analyze QT INOP when it detects two consecutive invalid 5 minute values. This is also the case if normal beats have been falsely labeled so that the algorithm does not have enough valid beats to make QT measurements. No QT value is calculated if the QT-HR is >150 bpm (Adult) or >180 bpm (Pedi/Neo).

Because of the different algorithm approaches, a QT/QTc measurement from a diagnostic 12-lead program may differ from the realtime measurement.

For QT interval monitoring to be effective, basic or enhanced arrhythmia monitoring must be on.

Adjusting QT Settings

For patients being monitored by the MX40, you can adjust QT settings in the QT Setup window at the Information Center.

Turn QT analysis on by clicking in the **QT Analysis On** check box. QT analysis is on when a checkmark displays in the check box. When the QT measurement is on, a QT status message is displayed in the QT Setup window, along with the current values for QT, QTc, dQTc and QT-HR. The lead labels indicating the leads used to calculate the baseline and current values also appear.

Note—Turning QT analysis off does not clear the baseline value. This allows you to turn QT analysis off during prolonged arrhythmias, such as bigeminy, without losing the baseline.

Limitations for QT Monitoring

Some conditions may make it difficult to achieve reliable QT monitoring. When this occurs the CANNOT ANALYZE QT INOP message displays at the Information Center, along with a QT STATUS message. Some conditions that may make reliable QT monitoring difficult include:

- **T-Wave Detection Limitations.**

  Flat T-wave, atrial Fibrillation or atrial Flutter and prominent U-waves can make QT monitoring difficult. For these cases you should select **All** as the QT Lead on the QT window. The Information Center will use the lead or leads that have a T-wave with sufficient amplitude and can be detected. Alternatively select a single lead with a good T- wave amplitude and no visible flutter activity and without a predominant U-wave or P-wave.

- **QRS Changes**

  QRS changes such as widened QRS can affect QT monitoring. If a long QTc is observed verify that is not caused by QRS widening.

- **Rhythm and Rate Limitations**

  Rhythm and rate limitations such as high heart rate (> 150 beats/min for adults patients or > 180 beats/min for pediatric or neonatal patients), paced rhythm and bigeminy rhythm can make reliable QT monitoring difficult. If rhythm is sustained you may want to consider turning QT interval monitoring off.

6. Monitoring Pulse Rate

This section provides an introduction to the Pulse measurement and its application.

Pulse Rate Measurement

The pulse rate measurement counts the arterial pulsations that result from the mechanical activity of the heart in beats per minute (bpm). The pulse rate is derived from the SpO_2 measurement. Displayed results can range from 30 to 300 bpm. There is no alarm function for pulse rate.

The pulse numeric is displayed at the Information Center only when SpO_2 is being measured continuously. Manual measurements are displayed at the MX40 with a time stamp. There are no alarms associated with the pulse measurement. Pulse is turned on in the **Telemetry Setup** window at the Information Center.

Displaying the Pulse Rate Measurement at the MX40

➢ *To display the pulse rate measurement at the MX40:*

1. If not already selected, press the Main Screen button and select the 1 waveform with 4 numerics display.
2. If pulse is not already displayed, touch a numeric.
3. Select **Change Numeric**.
4. Select **Pulse**.

7. SpO_2 Monitoring

This section provides an introduction to the SpO_2 measurement and its application.

SpO_2 Safety Information

Warnings

- Always confirm monitor observations with clinical observation of the patient before administering interventions.
- Prolonged, continuous monitoring can increase the risk of changes in skin characteristics, such as irritation, reddening, blistering or pressure necrosis, particularly on patients with impaired perfusion and varying or immature skin morphology. Specific attention must be given to sensor site inspection for changes in skin quality, proper optical path alignment and attachment. Check the application site at regular intervals and change the site if any compromise in skin quality should occur. More frequent checking can be required due to an individual patient's condition.
- Injected dyes such as methylene blue or intravascular dyshemoglobins such as methemoglobin and carboxyhemoglobin can lead to inaccurate (over-estimated) measurements.
- Interference leading to inaccurate measurements can be caused by:
  - High levels of ambient light (Hint: cover application site with opaque material)
  - Electromagnetic interference
  - Excessive patient movement and vibration.
- This equipment is not suitable for use in the presence of a flammable anesthetic mixture or oxygen concentrations greater than 25% (or partial pressures greater than 27,5 kPa /206.27 mmHg).
- Disposable SpO_2 sensors can be damaged and lead to patient harm if they become wet. Wet sensors must be replaced immediately.
- To avoid venous pulsation, obstructed circulation, pressure marks, pressure necrosis, artifacts and inaccurate measurements, make sure that the sensor is not too tight. If the sensor is too tight, because the application site is too large or becomes too large due to edema, excessive pressure may be applied. This can result in venous congestion distal from the application site, leading to interstitial edema, hypoxia and tissue malnutrition.
- Inspect the sensor application site every 2 to 3 hours to ensure skin integrity, correct optical alignment, and circulation distal to the sensor site. Move the sensor application site every four hours, or more often if circulation or skin integrity is compromised.

- At elevated ambient temperatures, be careful with measurement sites that are not well perfused, because this can cause severe burns after prolonged application. All listed sensors operate without risk of exceeding 41° C on the skin if the initial skin temperature does not exceed 37° C.
- Avoid placing the sensor on extremities with an arterial catheter or intravascular venous infusion line.
- Sensors connected to the MX40 but not applied to the patient, can produce an error measurement. To avoid misdiagnosis, ensure the sensor is properly applied to the patient.

Cautions

- If you measure SpO_2 on a limb that has a inflated NBP cuff, a non-pulsatile SpO_2 INOP (SpO_2T NO PULSE) can occur. If the monitor is configured to suppress this alarm, there may be a delay of up to 60 seconds in indicating critical patient status, such as sudden pulse loss or hypoxia.
- Do not use OxiCliq disposable sensors in a high humidity environment, such as an incubator, or in the presence of fluids, which may contaminate sensor and electrical connections causing unreliable or intermittent measurements. Do not use disposable sensors on patients who have allergic reactions to the adhesive.
- Do not use more than one extension cable (M1941A). See Appendix A, Accessories, for information on which sensors cannot be used with an extension cable.
- Position the sensor cable away from power cables to avoid electrical interference.

SpO_2 Information for the User

The pulse oximeter is calibrated to indicate functional oxygen saturation (fractional oxyhemoglobin), and displayed results can range from 0 to 100%.

A 10 second averaging filter is used in the calculation of the result. Displayed results are typically updated every second, but the update period can be automatically delayed by up to 30 seconds in the presence of noise.

Physiological SpO_2 alarm signals will be generated. For adult patients, the SpO_2 low limit can be set between 50 and 99% inclusive, in 1% increments, and the SpO_2 high alarm limit can be set between 51 and 100% inclusive, in 1% increments. For pediatric patients, the SpO_2 low limit can be set between 30 and 99% inclusive, in 1% increments, and the high alarm limit can be set between 31 and 100% inclusive, in 1% increments. The maximum delay between the physiological alarm condition and alarm signal generation is 25 seconds.

Pulse rate is also derived from the pulsatile SpO_2 measurement, and displayed results can range from 30 to 300 bpm. There is no alarm function for pulse rate.

The pleth wave is auto-scaled to maximum display size. It decreases only when the signal quality becomes marginal. Pleth wave size is NOT directly proportional to the pulse volume.

Pulse Oximetry Measurement

The MX40 supports an SpO_2 sensor connection using Fourier Artifact Suppression Technology (FAST). The FAST algorithm overcomes many of the issues associated with traditional pulse oximetry such as sensitivity to patient movement and intense ambient light. The algorithm offers improved motion artifact rejection as well as performance improvements for patients with low perfusion. SpO_2 can be measured continuously, where a value is sent to the Information Center every second, or as a single, individual Manual measurement. The Manual measurement will be removed from the Information Center display after 1 hour.

The SpO_2 parameter measures the arterial oxygen saturation, that is, the percentage of oxygenated hemoglobin in relation to the total hemoglobin.

If, for example, a total of 97% of the hemoglobin molecules in the red blood cells of the arterial blood combine with oxygen, then the blood has an oxygen saturation of 97%. The SpO_2 numeric that appears on the monitor will read 97%. The SpO_2 numeric indicates the percentage of hemoglobin molecules which have combined with oxygen molecules to form oxyhemoglobin.

- The oxygen saturation is measured using the pulse oximetry method. This is a noninvasive method of measuring the arterial hemoglobin oxygen saturation. It measures how much light, sent from light sources on one side of the sensor, travels through patient tissue (such as a finger or an ear), to a receiver on the other side of the sensor.
- The amount of light passing through depends on many factors, most of which are constant, such as tissue or venous blood. However one of the factors, the blood flow in the arterioles, varies with time because it is pulsatile.

This measurement principle is used to derive the SpO_2 measurement. The numeric that is displayed is the oxygen saturation of the arterial blood - the measurement of light absorption during a pulsation. Correct placement of the sensor is essential for accurate measurements.

Note—Because pulse oximeter equipment measurements are statistically distributed, only about two-thirds of pulse oximeter equipment measurements can be expected to fall with ± *A*rms of the value measured by a CO-oximeter.

SpO_2 Sensors

Familiarize yourself with the instructions for use supplied with your sensor before using it. In particular, check that the sensor being used is appropriate for your patient category and application site. See Appendix A, Accessories, for a complete listing of supported sensors for the MX40.

Selecting an SpO_2 Sensor

Warning

- Use only Philips-approved accessories. Use of product accessories (patient cables, SpO_2 sensors, etc.) other than those specified in this manual may lead to patient injury or result in increased electromagnetic emissions or decreased immunity of the product.
- Reuse: Never reuse disposable sensors, accessories and so forth that are intended for single use, or single patient use only.
- Packaging: Do not use a sterilized accessory if the packaging is damaged.
- Do not use disposable sensors on patients who exhibit allergic reactions to the adhesive.
- When the specified Nellcor® sensors are used, the application must be consistent with the sensor manufacturer's own guidelines.

Philips reusable sensors in adult, pediatric and infant models can be used, as well as Philips and Nellcor® disposable sensors.

Caution

Do not use OxiCliq disposable sensors in a high humidity environment, or in the presence of fluids. These can contaminate sensor and electrical connections, and thereby cause unreliable or intermittent measurements.

The following table will help you in selecting the correct sensor type.

Sensor Type	When to Use
Reusable	You can use reusable sensors on different patients after cleaning and disinfecting them. For care and cleaning instructions, see the instructions accompanying the sensors. Reusable sensors should be changed to another site every four hours or in accordance with your clinical practice guidelines. See the Directions for Use supplied by Nellcor® Incorporated for instructions on preparation and application of reusable sensors.
Disposable	Use disposable sensors only once and then discard. However, you can relocate them to a different patient-site if the first location does not give the desired results. Do not reuse disposable sensors on different patients. ***Note —*** See the Instructions for Use supplied by Nellcor® Incorporated for instructions on preparation and application of disposable sensors.

Sensor Application Safety Information

Warning

Failure to apply a sensor properly can reduce the accuracy of the SpO_2 measurement.

- Loose/Tight sensor: If a sensor is too loose, it can compromise the optical alignment or fall off. If it is too tight, for example because the application site is too large or becomes too large due to edema, excessive pressure can be applied. This can result in venous congestion distal from the application site, leading to interstitial edema, hypoxia and tissue malnutrition.
- Skin irritations or ulcerations can occur as a result of the sensor being attached to one location for too long. To avoid skin irritations and ulcerations, inspect the sensor application site every 2-3 hours, and change the application site at least every 4 hours or according to clinical practice guidelines.

- Venous Pulsation: Do not apply sensor too tightly as this results in venous pulsation, which can severely obstruct circulation and lead to inaccurate measurements.
- Ambient Temperature: Never apply an SpO_2 sensor at ambient temperatures above 37 ºC (99 ºF) because this can cause severe burns after prolonged application.
- Extremities to Avoid: Avoid sites distal to NBP cuff, intra-arterial line, or intravascular venous infusion line.

Applying the Sensor

1. Follow the SpO_2 sensor's Instructions for Use, adhering to all warnings and cautions.
2. If necessary, remove colored nail polish from the application site.
3. Apply the sensor to the patient. The application site should match the sensor size so that the sensor can neither fall off, nor apply excessive pressure.
4. Check that the light emitter and the photodetector are directly opposite each other. All light from the emitter must pass through the patient's tissue.

Connecting SpO_2 Cables

The sensor cable is either directly connected to the blue SpO_2 connector on the MX40 patient cable or is connected to an adapter cable that is then connected to the MX40 SpO_2 connector.

Tone Modulation Indication

The pulse signal tone is controlled by the setting in the **SpO_2 Tone Modulation** menu.

Signal Quality Indicator

The SpO_2 numeric is displayed together with a signal quality indicator which gives an indication of the reliability of the current values.

The level to which the triangle is filled shows the quality of the signal. The signal quality is at a maximum when the triangle is completely filled.

Measuring SpO_2

Warning

- Removal of the SpO_2 sensor from the MX40 patient cable during Continuous SpO_2 monitoring results in a "No Sensor" technical alarm. Silencing this alarm turns the SpO_2 measurement off, however the SpO_2 module is still operating in the background and consuming battery power. If you do not intend to resume continuous SpO_2 monitoring, change to Manual mode.There is no technical alarm for a "No Sensor" condition in Manual mode.
- If you measure SpO_2 on a limb that has an inflated NBP cuff, a non-pulsatile SpO_2 technical alarm can occur. If the monitor is configured to suppress this alarm, there can be a delay of up to 60 seconds in indicating critical patient status, such as sudden pulse loss or hypoxia.

SpO_2 measurements can be made manually on an as-needed basis in Manual mode, or continuously in Continuous mode, depending on your MX40 configuration. While operating in Continuous mode, you can also measure pulse, and display the pleth wave on the MX40 and at the Information Center. The SpO_2 parameter is turned on/off at the MX40 or by a control from the Information Center. SpO_2 monitoring consumes considerable electrical energy. The battery power must be at least 10% full in order to make SpO_2 measurements.

To resume the SpO_2 measurement after it has been turned off, touch the blank measurement area and select **SpO_2** to turn it back on.

Note — Before disabling SpO_2 at the Information Center, acknowledge any active alarms at the MX40.

Setting the mode to Manual or Continuous can be done at the Information Center or at the MX40.

➢ *To select the measurement mode at the MX40:*

1 In **Spo_2 Setup**, select **Mode**.

2 Select **Continuous** or **Manual** mode.

Understanding SpO_2 Alarms

SpO_2 monitoring offers high and low limit alarms, and a high priority (red level) oxygen desaturation alarm. For adult patients, the SpO_2 low limit can be set between 50 and 99% inclusive, in 1% increments. For pediatric patients, the SpO_2 low limit can be set between 30 and 99% inclusive, in 1% increments. The desaturation limit is set automatically at 10 below the Low Limit. You cannot set the low limit below the desaturation limit. The SpO_2 high alarm limit can be set between 51 and 100% inclusive, in 1% increments for adult patients and set for pediatric patients between 31 and 100% inclusive, in 1% increments.

The delay between the physiologic alarm condition and alarm annunciation at the MX40 is <16 seconds. This means that the MX40 will generate an alarm if the averaged numeric value on the display exists beyond the alarm limit for more than a maximum of 16 seconds.

Setting the high SpO_2 alarm limit to 100% is equivalent to switching off the high alarm. Therefore the upper alarm limit for oxygen saturation must be carefully selected in accordance with accepted clinical practices.

The default setting for SpO_2 yellow alarms is latched. That is, when an SpO_2 limit is exceeded, you will need to acknowledge it at the Information Center. The sound will be silenced but the message will remain on the display until the condition is resolved.

See the Alarms chapter for a list of the SpO_2 alarms.

8. Monitoring with other Assigned Devices

This section provides information about the use of the MX40 when it is assigned to other monitoring devices. The MX40 can be assigned to IntelliVue Patient Monitors or IntelliVue Cableless Measurements for SpO_2 and NBP. The connection to these other devices is done by pairing networked devices or using the integrated short-range radio of the MX40.

For additional information on IntelliVue Patient Monitor or IntelliVue Cableless Measurements operation, consult the Instructions for Use that accompanied the device.

Warning

Assignment of the MX40 to IntelliVue Patient Monitors is only supported when the patient monitor (MP5,MP5T,MP5SC, MP2 or X2 only) is equipped with a short-range radio. Monitors that have this equipment will display the short-range radio symbol  on the label.

Note — Assignment of the MX40 to IntelliVue Patient Monitors is not available with patient monitors connected to the M3140 Information Center.

Note — The MP5T and MP5SC are non-networked device as it does not support a connection to the Information Center.

Assigning Devices

Device Assignment at the Information Center

You can assign an MX40 to a patient monitor at the Information Center. The data from the MX40 automatically displays as a permanent overview session in the **Telemetry Data** window on the patient monitor.

At the Information Center the MX40 data and the patient monitor data are integrated in the patient sector.

Warning

All data presented in the Telemetry Data window are delayed for several seconds. If you need realtime data, e.g. for defibrillation, always use the ECG from the patient monitor.

Device Assignment at the MX40

➢ *To assign an MX40 to an IntelliVue Cableless Measurement device:*

1 Press the SmartKey button.

2 Press the **Add/Remove** SmartKey.

3 From the **Add to** menu, select the desired device and press **Confirm**.

The MX40 will attempt to complete the assignment for a 2-minute period. If assignment fails or the MX40 is no longer in range of the other device, the short-range radio turns off to save battery power. Repeat the procedure above to retry or resume the assignment. You may also need to restart the short-range radio at the cableless measurement device if it has entered its power save mode. Touch and hold the left button on the device to restart the short-range radio.

➢ *To assign an MX40 to an IntelliVue Patient Monitor:*

1 Press the Smartkey button.

2 Press the **Add/Remove** Smartkey. The measurement selection key on the monitor will change to show the "assign telemetry" icon  .

3 In the Assign Telemetry Device menu, select the correct equipment label for the device.

When connected the  icon appears at the Information Center.

The MX40 is assigned to the monitor. A "Tele Device Assigned" message appears on the monitor. If the ECG wave now appears on the monitor, the signal from the MX40 is successfully transmitting to the monitor. To confirm that the correct MX40 has been assigned, open the ECG Setup menu by touching the ECG waveform or HR numeric. The title of the menu contains the equipment label of the MX40. Check that this is the correct label.

When assigned to the monitor, the display of the MX40 appears as shown below:

The display is primarily inactive, and there is no viewable patient data displayed, however, battery status information is available.

If a monitor is already paired to another device, you cannot assign an MX40 to that monitor.

If the MX40 goes out-of-range or loses the short-range radio connection, it will switch over to standard telemetry transmission to the Information Center. In this case, the telemetry data is displayed in the Telemetry Data Window.

If the devices are unassigned, the short-range radio connection is ended

➢ *To remove an assigned device from the MX40:*

1 Press the Smartkey button.

2 Press the **Add/Remove** Smartkey.

3 From the **Remove from** menu, select the desired device and press **Confirm**.

Device Assignment at the Patient Monitor

At the patient monitor, you can assign an MX40 to the patient monitor using the **Telemetry** menu on the patient monitor.

When the devices are networked, all data is sent to the Information Center. When non-networked, only the additional parameters measured at the patient monitor (NBP, SpO_2, and predictive temperature) are sent to the Information Center. The **Telemetry Data** window is not displayed when devices are non-networked.

Controls Available when Assigned to IntelliVue Cableless Measurements

Action	At the MX40	At the IntelliVue Cableless Measurement Device	At the IIC
SpO_2			
Start SpO_2	Yes	Yes	Yes
Change SpO_2 Mode	Yes	Yes	Yes
Select SpO_2 Repetition Time	No	Yes	No
Assign SpO_2 Pod	Yes	Yes	No
Remove SpO_2 Pod	Yes	Yes	Yes
Change Alarm Limits	No	No	Yes
Place Device in Standby	No	No	No
Alarm Silence	Yes (local only)	No	Yes
Alarm Off/Pause	Yes (if enabled)	No	Yes
NBP			
Start/Stop/Stat NBP	Yes	Yes	Yes
Change NBP Mode	Yes	Yes	No
Change NBP Repetition Time	No	Yes	No
Change Alarm Limits	No	No	Yes
Assign NBP Pod	Yes	Yes	No
Remove NBP Pod	Yes	Yes	Yes
Place Device in Standby	No	No	No
Alarm Silence	Yes (local only)	No	Yes
Alarm Off/Pause	Yes (if enabled)	No	Yes

Controls Available when Assigned to IntelliVue Patient Monitors

Action	At the MX40	At the IntelliVue Patient Monitor	At the IIC
SpO_2			
Start SpO_2	Yes	Yes	Yes
Change SpO_2 Mode	Yes	Yes	Yes
Select SpO_2 Repetition Time	No	Yes	No
Assign SpO_2 Pod	Yes	Yes	No
Remove SpO_2 Pod	Yes	Yes	Yes
Change Alarm Limits	No	Yes	Yes
Place Device in Standby	No	No	No
Alarm Silence	Yes (local only)	Yes	Yes
Alarm Off/Pause	Yes (if enabled)	Yes	Yes
NBP			
Start/Stop/Stat NBP	Yes	Yes	Yes
Change NBP Mode	Yes	Yes	No
Change NBP Repetition Time	No	Yes	No
Change Alarm Limits	No	Yes	Yes
Assign NBP Pod	Yes	Yes	No
Remove NBP Pod	Yes	Yes	Yes
Place Device in Standby	No	No	No
Alarm Silence	Yes (local only)	Yes	Yes
Alarm Off/Pause	Yes (if enabled)	Yes	Yes

MX40 Display when Wirelessly Connected to a Patient Monitor

When the MX40 is wirelessly connected to a patient monitor via the short-range radio, its display is primarily inactive. There is no viewable patient data on the display, however, battery status information is available if the display is turned on.

9. Monitoring with the MX40 at the Information Center

This section describes the behavior of the MX40 as it relates to what is displayed at the Information Center.

MX40 Controls in the Patient Window

The Patient Window at the Information Center (accessed from the Patient Window control in the Patient Sector) includes controls for a number of MX40 operations. For detailed instructions on these operations, see the *IntelliVue Information Center Instructions for Use* or the *Online Help*.

➢ *To View ECG or SpO_2 Alarm Limits*

1 Move the cursor over the HR or SpO_2 label to display the current high and low alarm limits.

➢ *To Change ECG or SpO_2 Alarm Limits*

1 Move the cursor over the High or Low numeric to display up/down arrow controls for adjusting the limit.

2 After adjusting the limit, move the cursor away from the area to dismiss the limit controls.

➢ *To Change ECG Waveform Size*

1 Move the cursor over the ECG waveform to display the ECG Waveform Size control.

2 Select the desired size from the list.

➢ *To Select Lead*

1 Move the cursor over the ECG waveform to display the Lead Selection control.

2 Select the desired lead from the list.

Important — Do not set the primary and secondary channels to the same lead.

➢ *To Change Va and Vb Default Lead Settings (6-lead only)*

1 Move the cursor over the ECG waveform to display the Lead Selection popup.

2 Select the label from the label list.

3 For Va or Vb, select Va or Vb, then select the lead to be assigned. Assignment of the same V lead to both Va and Vb is not allowed.

Important — Do not set the primary and secondary channels to the same lead.

➢ *To Initiate a Spot Check (Manual) Spo_2 Measurement*

1 Move the cursor over the SpO_2 label.

2 Click on the Spot Check (Manual) icon.

Locating the MX40 (Find Device)

The Find Device feature enables you to generate an alternating pitch repeated tone at the MX40 to assist in locating a missing device. This function is initiated in the Telemetry Setup Window. Find Device requires that the MX40 has sufficient battery power and is within the coverage area.

➢ *To locate an MX40:*

1 From the Patient Window, select **Telemetry Setup**.

2 Select **Find Device** to generate a repeated tone at the MX40.

To silence this tone, touch the silence key on the MX40.

Viewing Device Location and Location History (optional)

You can see the location of an MX40 in the Patient Window. The Device Location information is identified in the Patient Window by a compass icon followed by the location name of the access point that the MX40 is currently connected to. If the location of the device changes, the Patient Window is updated within 5 seconds of the location change.

You can view the location history for a particular MX40 in the Device Location History field in the Telemetry Setup window. The field displays the five most recent Device Location descriptions in ascending order and updates every time there is a change in location for the device. The total timespan of the log is 60 minutes.

Warning

Because the coverage range of Access Points can sometimes overlap, including different floor levels, the IntelliVue Device Location feature is not intended for use when attempting to locate a patient.

Note — If there is a change in location while viewing the Telemetry Setup window, you must re-enter Telemetry Setup to see the change, as it does not update automatically.

Using the Device Location Client (optional)

The Device Location Client application is an optional software application that allows you to display and locate devices visually, using Floor Plans associated with your hospital's layout. Device location history is also available. The application is accessible using a separate PC's web browser. For additional installation information, see the *IntelliVue Device Location Installation Guide*.

Warning

Because the coverage range of Access Points can sometimes overlap, including different floor levels, the IntelliVue Device Location feature is not intended for use when attempting to locate a patient.

Displaying and Locating Devices

The left side of the Client display screen contains a list of clinical units associated with the current Floor Plan. Each unit contains a list of bed labels. You view the beds listed within a unit by clicking on the plus sign next to the unit name.

Note — The beds listed are only those equipped with traditional IntelliVue telemetry devices or the MX40.

To identify and locate the device associated with the bed, simply click on the desired bed label. The floor plan and the status bar above the floor plan image now display the location of the device. Additionally, the status bar lists the Access Point the device is currently associated with.

Viewing Device Location History

The location history of a particular device is also available. Select a device from the Device List box and then click on the down arrow in the status bar. The last five known locations of the device are displayed.

Patient Configurable Settings in Telemetry Setup

The Telemetry Setup window enables you to configure the MX40 for patient-specific settings. All patient-specific settings will be reset to the unit defaults upon patient discharge. To access the window, from the Patient Window click Telemetry Setup.

The following settings can be adjusted in this window:

Patient-Configurable Settings in Telemetry Setup			
Control	**Function**	**Setting Choices**	**Factory Default**
Telemetry/ Multi-Function Button	Determines the Information Center response when the Multi-Function Button is pressed.	*Nurse Call* - generate nurse call alarm that can be retrieved from Alarm Review for later use. *Record* - generate a recording strip *Nurse Call* and *Record* - generate nurse call alarm and recording strip *None*	Nurse Call
Fixed Pacer Amplitude	Sets the appearance of the pacer spikes to a fixed size as they appear in the patient window.	*enable* *disable* ***Note —*** this does not affect the appearance of the pacer spikes on the MX40.	disable
SpO_2 Enabled	Enable/disable the SpO_2 measurement at the Information Center and the MX40.	*enable* *disable*	enable
SpO_2 Mode	Determine the MX40 SpO_2 measurement behavior. ***Note —*** Pulse Rate and Pleth Wave are not available in Spot Check (Manual) mode.	*Spot Check (Manual)*- Provides manual measurements so the clinician can check as needed. Measurement can be initiated at the MX40 from the SmartKeys menu or the SpO_2 Setup menu and at the Information Center by selecting the Spot Check SpO_2 icon in the Patient Window. *Continuous* - Sends an SpO_2 parameter value to the Information Center every second. If selected, Pulse Rate and Pleth Wave may also be sent.	Spot Check (Manual)

Patient-Configurable Settings in Telemetry Setup			
Control	**Function**	**Setting Choices**	**Factory Default**
Suppress SpO_2 INOPs with NBP	Enable/disable the SpO_2 algorithm to suppress sending technical alarms from the MX40 during an NBP measurement for 60 seconds. Warning If you measure SpO_2 on a limb that has an inflated NBP cuff, a non-pulsatile SpO_2 technical alarm can occur. If the monitor is configured to suppress this alarm, there can be a delay of up to 60 seconds in indicating critical patient status, such as sudden pulse loss or hypoxia.	*enable* *disable*	enable
Pleth Wave	Enable/disable the transmission of the Pleth wave (and its subsequent display) to the Information Center. For Continuous SpO_2 mode only.	*enable* *disable* ***Note —*** When enabled, the Pleth wave replaces the Vb wave in the Patient Window during 6-lead monitoring.	disable (Pleth is not displayed.)
Pulse	Enable/disable display of the Pulse rate at the Information Center. For Continuous SpO_2 mode only.	*enable* *disable*	disable (Pulse rate is not displayed.)
SpO_2 Alarm	Turn SpO_2 alarms on/off at the Information Center and the MX40.	*enable* (on) *disable* (off)	enable
Unit Settings	Change current settings back to last saved clinical unit settings.	(none)	

Unit Configurable Settings

Unit Settings provide access to clinical configuration items that affect all patients on an Information Center. Changes in unit settings take effect upon discharge, except for Standby duration and SpO_2 mode, which take effect immediately.

Access to unit settings requires a password, and the displays are in English. Telemetry specific settings are accessed through All Controls -> Unit Settings -> Telemetry Setup. The setting for telemetry non-arrhythmia yellow alarms and INOP severity is located in All Controls -> Unit Settings -> Alarms. For all other information on unit settings, see *IntelliVue Information Center Instructions for Use*.

Unit Settings - Telemetry Setup			
Control	**Function**	**Settings**	**Factory Default**
Patient Type	Set patient type used for SpO_2 and NBP alarm limits.	*Adult* *Pediatric*	Adult
Telemetry/ Multi-Function Button	Determine the Information Center response when Telemetry Button is pressed.	*Nurse Call* - generate nurse call alarm that can be retrieved from Alarm Review for later use. *Record* - generate a recording strip *Both* - generate nurse call alarm and recording strip *None*	Nurse Call
Standby Duration	Sets the standby duration on the device.	*Infinite* *10 minutes* *20 minutes* *30 minutes* *1 hour* *2 hours* *3 hours* *4 hours*	Infinite
Enable Remote Suspend	Enable/disable alarm pause/suspend at the MX40.	*enable* *disable*	disable
Suspend Duration	Sets the alarm suspend duration time for each assigned device on the Information Center.	*1, 2, or 3 minutes*	2 minutes
Battery Gauge on Information Center	Display/disable a battery gauge for each assigned device on the Information Center.	*enable* *disable*	enable (battery gauge is displayed) ***Note —*** the battery gauge is always displayed on the MX40.

Unit Settings - Telemetry Setup			
Control	**Function**	**Settings**	**Factory Default**
RF Auto Shutoff	Enable/disable RF operation during an extended situation of all leads off for more than 10 minutes and the SpO_2 is not being measured continuously.	*enable* *disable*	enable (MX40 will shut off after 10 minutes of Leads Off condition and SpO_2 is not being measured continuously. Reconnect the patient cable to resume monitoring.)
Fixed Pacer Amplitude	Sets the appearance of the pacer spikes to a fixed size as they appear in the patient window.	*enable* *disable*	disable
Autopair	Enable/disable the autopairing of the MX40 and the IntelliVue Patient Monitor at the Information Center.	*enable* *disable*	enable
Enable SpO_2	Enable/disable the SpO_2 measurement at the Information Center.	*enable* *disable*	enable

Unit Settings - Telemetry Setup			
Control	**Function**	**Settings**	**Factory Default**
SpO_2 Mode	Determine the MX40 SpO_2 measurement behavior. ***Note —*** Pulse Rate and Pleth Wave are not available in Spot Check (Manual) mode.	*Spot Check (Manual)*- Provides manual measurements so the clinician can check as needed. Measurement can be initiated from the SmartKeys menu, the SpO_2 Setup menu or by selecting the Spot Check SpO_2 icon in the Patient Window. *Continuous* - Sends an SpO_2 parameter value to the Information Center every second. If selected, Pulse Rate and Pleth Wave may also be sent.	Spot Check (Manual)
Suppress SpO_2 Inops with NBP	Enable/disable the SpO_2 algorithm to detect NBP running and suppress sending technical alarms from the MX40 for 60 seconds. Warning If you measure SpO_2 on a limb that has an inflated NBP cuff, a non-pulsatile SpO_2 technical alarm can occur. If the monitor is configured to suppress this alarm, there can be a delay of up to 60 seconds in indicating critical patient status, such as sudden pulse loss or hypoxia.	*enable* *disable*	enable

Unit Settings - Telemetry Setup			
Control	**Function**	**Settings**	**Factory Default**
Pleth Wave	Enable/disable the transmission of the Pleth wave and its subsequent display to the Information Center. For Continuous mode only.	*enable* *disable* ***Note —*** When enabled, during 6-lead monitoring, the Pleth wave will replace the Vb wave in the Patient Window.	disable (Pleth wave is not displayed.)
Pulse	Enable/disable the transmission of the Pulse rate and its subsequent display to the Information Center. For Continuous mode only.	*enable* *disable*	disable (Pulse rate is not displayed.)
SpO_2 Alarm	Turn SpO_2 alarms on/off at the Information Center.	*enable* (on) *disable* (off)	enable
SpO_2 Limits High	Increment/decrement SpO_2 high alarm limit by 1 (in %).	Limit maximum is 100. Limit minimum is 51 (adult) or 31 (pediatric). High and low limit must be at least 1% apart.	100 (adult, pediatric)
SpO_2 Limits Low	Increment/decrement SpO_2 low alarm limit by 1 (in %).	Limit maximum is 99. Limit minimum is 50 (adult) or 30 (pediatric). High and low limit must be at least 1% apart.	90 (adult, pediatric)

Unit Settings - Default Leads			
Control	**Function**	**Settings**	**Factory Default**
3-wire	Set the unit default lead.	*I*, *II*, *III*	II
5-wire, ECG1	Set the unit default lead.	*I*, *II*, *III*, *MCL*, *AVR*, *AVL*, *AVF*, *V*	II
5-wire, ECG2	Set the unit default lead.	*I*, *II*, *III*, *MCL*, *AVR*, *AVL*, *AVF*, *V*	V
5-wire, ECG3	Set the unit default lead.	*I*, *II*, *III*, *MCL*, *AVR*, *AVL*, *AVF*, *V*	III
5-wire EASI, ECG1	Set the unit default lead.	*I*, *II*, *III*, *AVR*, *AVL*, *AVF*, V_1, V_2, V_3, V_4, V_5, V_6	II
5-wire EASI, ECG2	Set the unit default lead.	*I*, *II*, *III*, *AVR*, *AVL*, *AVF*, V_1, V_2, V_3, V_4, V_5, V_6	V_2
5-wire EASI, ECG3	Set the unit default lead.	*I*, *II*, *III*, *AVR*, *AVL*, *AVF*, V_1, V_2, V_3, V_4, V_5, V_6	III
5-wire EASI, ECG4	Set the unit default lead.	*I*, *II*, *III*, *AVR*, *AVL*, *AVF*, V_1, V_2, V_3, V_4, V_5, V_6	V_5
6-wire, ECG1	Set the unit default lead.	*I*, *II*, *III*, *MCL*, *AVR*, *AVL*, *AVF*, V_1, V_2, V_3, V_4, V_5, V_6, V_7, V_8, V_9, V_{3R}, V_{4R}, V_{5R}	II
6-wire, ECG2	Set the unit default lead.	*I*, *II*, *III*, *MCL*, *AVR*, *AVL*, *AVF*, V_1, V_2, V_3, V_4, V_5, V_6, V_7, V_8, V_9, V_{3R}, V_{4R}, V_{5R}	V_2; V lead choice is determined by Va and Vb settings
6-wire, ECG3	Set the unit default lead.	*I*, *II*, *III*, *MCL*, *AVR*, *AVL*, *AVF*, V_1, V_2, V_3, V_4, V_5, V_6, V_7, V_8, V_9, V_{3R}, V_{4R}, V_{5R}	III
6-wire, ECG4	Set the unit default lead.	*I*, *II*, *III*, *MCL*, *AVR*, *AVL*, *AVF*, V_1, V_2, V_3, V_4, V_5, V_6, V_7, V_8, V_9, V_{3R}, V_{4R}, V_{5R}	V_5; V lead choice is determined by Va and Vb settings

Unit Settings - NBP Setup			
Control	**Function**	**Settings**	**Factory Default**
Patient Type	Set patient type used for NBP alarm limits.	*Adult* *Pediatric*	Adult
NBP Alarm	Set NBP alarm notification.	*Systolic or Diastolic* *Systolic* *Diastolic* *Mean* *Off*	Systolic or Diastolic
Systolic High	Increment/decrement NBP high alarm limit by 1.	*Limit Maximum is 260* *Limit Minimum is 160 (Adult)* *Limit Maximum is 260* *Limit Minimum is 75 (Ped.)*	160 Adult 120 Pediatric
Systolic Low	Increment/decrement NBP low alarm limit by 1.	*Limit Maximum is 155* *Limit Minimum is 28 (Adult)* *Limit Maximum is 255* *Limit Minimum is 28 (Ped.)*	90 Adult 70 Pediatric
Diastolic High	Increment/decrement NBP high alarm limit by 1.	*Limit Maximum is 260* *Limit Minimum is 90 (Adult)* *Limit Maximum is 260* *Limit Minimum is 45 (Ped.)*	90 Adult 70 Pediatric
Diastolic Low	Increment/decrement NBP low alarm limit by 1.	*Limit Maximum is 85* *Limit Minimum is 28 (Adult)* *Limit Maximum is 40* *Limit Minimum is 28 (Ped.)*	50 Adult 40 Pediatric
Mean High	Increment/decrement NBP high alarm limit by 1.	*Limit Maximum is 260* *Limit Minimum is 65 (Adult)* *Limit Maximum is 260* *Limit Minimum is 55 (Ped.)*	110 Adult 90 Pediatric
Mean Low	Increment/decrement NBP low alarm limit by 1.	*Limit Maximum is 60* *Limit Minimum is 28 (Adult)* *Limit Maximum is 50* *Limit Minimum is 28 (Ped.)*	60 Adult 50 Pediatric

Unit Settings - Alarms			
Control	**Function**	**Settings**	**Factory Default**
Non-arrhythmia Yellow Alarms	Set latched/non-latched status for SpO_2, ST, and other non-arrhythmia yellow alarms.	*Latched* *Non-latched*	Latched
Leads Off	Adjust the severity level of this technical alarm (INOP).	*Cyan* *Yellow* *Red*	Cyan
Replace Battery	Adjust the severity level of this technical alarm (INOP).	*Cyan* *Yellow* *Red*	Cyan

10. Operating with Information Center Release L or M

This section covers performance differences when operating the MX40 with previous releases of the Information Center (Release L or M).

Display

An MX40 operating with either Release L or M of the Information Center has a fixed display showing either one measurement waveform and four numeric parameter values or the ECG lead placement chest diagram along with two numeric parameter values, depending on configuration.

Alarms

An MX40 operating with Release L or M of the Information Center does not have physiological alarm capability locally at the device (networked or non-networked). A **No Alarm Display** message is present along with the **Alarms Paused** icon.

Technical alarms (INOPs) are communicated and can be silenced using the **Alarm Silence** button.

Technical alarms can be reviewed using the **Alarms** SmartKey.

Note — Not all rechargeable battery technical alarms are communicated via the Alert Data Integration paging system. The following alarms are not communicated:

- TELE CHECK BATT
- TELE SERVICE BATT
- TELE BATTERY TEMP

However, these technical alarms are still transmitted to the Information Center.

11. Trends (Optional)

This section covers the trend functionality of the MX40. Trends are patient data collected over time and displayed in tabular form to give you a picture of how your patient's condition is developing. Trend information is stored in the MX40 for continuously-monitored measurements, such as ECG, as well as for aperiodically-measured parameters, such as SpO_2.

Viewing Vital Trend Information

➢ *To view Vital Trend information:*

1. Touch the SmartKeys button.
2. From the **SmartKeys** menu, select **Vitals Trend**.

➢ *To change the time columns:*

1. Touch the time column.
2. Select a different time period.

12. Maintenance

This section provides procedures for maintaining the MX40 after installation, including equipment label assignment, cleaning, and troubleshooting information for common problems.

Cleaning

The procedure in this section keeps the MX40 and its accompanying patient cable clean and provides protection against infectious agents and bloodborne pathogens. Both the outside and the inside of the MX40 battery compartment and the patient cable must be kept free of dirt, dust, and debris.

Important — After exposure, the MX40 and the patient cable must be cleaned as per the instructions contained herein. Sterilization of the MX40 has been qualified using the STERRAD 100NX System. For more information and instruction on sterilizing the MX40, contact your service personnel.

➢ *Perform the following steps to clean the MX40 and the patient cable of visible surface contamination.*

Note — when cleaning, the use of protective gloves is encouraged.

1. Remove the batteries and disconnect the patient cable.
2. If using disposable AA batteries, remove the battery tray and clean separately.
3. Wipe the MX40 and the patient cable clean by using a cloth dampened modestly with one of the approved cleaning agents listed in the table below.
4. Follow the manufacturer's instructions with regard to application duration.
5. Wipe the M40 and inside the patient cable housing with distilled water or alcohol to prevent residue build-up.
6. Allow to air-dry, or dry with a non-lint producing cloth.

Cleaning Materials for the MX40

Caution

- Use of abrasive cleaning materials, or disinfectants or cleaning agents not listed herein, on any part or component of the MX40 may damage the components.
- The Gore-tex patch in the battery compartment of the MX40 can be damaged by the use of glutaraldehyde and anti-bacterial soap.

- Sharp or pointed instruments should not be used to remove soil from recessed areas on the MX40.

Approved Cleaners

Cleaner	Active Ingredient
Isopropyl Alcohol based	Isopropyl Alcohol (≥70%)
Hydrogen Peroxide	Hydrogen Peroxide (3%)
Chlorine Bleach	Sodium Hypochlorite (1:10 concentration, mixed < 24 hours)
Caltech Dispatch 5200 Wipes	Sodium hydroxide (<0.2%) Sodium metasilicate (<0.6%) Sodium hypochlorite (<1.0%)
Incidin Liquid	Propanol-2 (20%) Ethanol (10%) Benzalkoniumchlorid (<1.0%)
Metrex CaviWipes	Isopropyl alcohol (15-18%) Sodium hydroxide (0.1%) 2-butoxyethanol (1-5%)
Viraguard	Isopropanol (70%)
Resert XL HLD	Hydrogen peroxide (1.4-2-3%) 2-Fumic Acid (<2.5%)
Sporox II Sterilizing & Disinfection Solution	Hydrogen peroxide (7.5%) Phosphoric acid (0.85%)
Sanicloth Plus Germicidal Cloths	Isopropyl alcohol (55%) Quaternary ammonium (0.5%)
WipesPlus Disinfecting Wipes	Phenylphenol (0.28%), Benzyl-p-chlorophenol (0.03%)
TechSpray General Purpose Cleaner	Isopropyl alcohol (70%)
Oxivir Tb Cleaner Disinfectant	Hydrogen peroxide (2.5-3.5%)
Oxivir Tb Wipes	Hydrogen peroxide (3%)
Sanicloth HB	Quaternary ammonium (1%)

Cleaner	Active Ingredient
Sanicloth Plus	Quaternary ammonium (0.25%) 2-Butoxyethol (1-4%) Isopropyl alcohol (14.85%)
Super Sanicloth	Quaternary ammonium (<1%) Isopropyl alcohol (55%)
Carpe Diem TM/ MC Tb Wipes	Hydrogen peroxide (0.5%) Benzyl alcohol (3.1%)

Note —The cleaners listed above are also suitable for cleaning the patient cable and the lithium-ion battery.

Label Assignment for Replacement MX40

During installation, an equipment label is assigned to each MX40 in a clinical unit so that the device can be identified during operation within the wireless system. If an MX40 is lost, the Assign Label function at the Information Center enables you to unassign the label from a lost device, and re-assign its label to a replacement device. Labels are limited to those available in an individual clinical unit. The Label Assignment function requires a password for access, and its controls are available in English only.

Re-assigning an Equipment Label

➢ *To re-assign an equipment label to a replacement device:*

1 At the Information Center, clear the sector that the original equipment label was assigned to (**Patient Window -> Sector Setup -> Clear Sector -> OK**).

Note — Before clearing the sector, ensure that the equipment label of the lost device is not actively assigned to a patient being monitored.

2 Select **All Controls -> Label Assignment**.

3 Enter password.

Note — The remaining screens will be in English only.

4 Insert battery power into the MX40 and if attached, disconnect the patient cable.

5 Select **Refresh**.

6 Select the MAC address of the replacement device from the **New Devices** list. If the address does not appear, remove battery power and re-insert. Select **Refresh**.

Note — The MAC address appears on the rear label of the MX40.

7 Select the equipment label that was assigned to the previous device from the **Equipment Label** list.

8 Select **Assign Label** to initiate programming of the equipment label into the replacement MX40.

9 When prompted, press **Confirm** on the MX40 to accept the assignment. The confirmation must occur within 30 seconds of the prompt.

10 Wait for the new_device label to change to the selected equipment label.

11 In **Sector Setup**, select the **Bed Label** and **Equipment Label** and then press **OK**.

Charging Lithium-ion Rechargeable Batteries

The li-ion rechargeable battery is recharged using the IntelliVue CL Charging Station.

To charge a battery, place it onto a charger slot on the charging station. The battery power indicators will supply information about the charge status.

Warning

- Always use the supplied power cord with the grounded mains plug to connect the charging station to a grounded AC mains socket. Never adapt the mains plug from the power supply to fit an ungrounded AC mains socket.
- Do not use AC mains extension cords or multiple socket outlets. If a multiple portable socket outlet without an approved isolation transformer is used, the interruption of its protective grounding may result in leakage currents equal to the sum of the individual ground leakage currents, so exceeding allowable limits.
- Do not connect any devices that are not supported as part of the system.

Battery Power Indicators

There are various indications which help you keep track of the battery power status.

- LEDs on the charging station slots
- battery status information on both the MX40 and the charging station's display
- INOP messages

The indicators always show the remaining capacity in relation to the battery's actual maximum capacity which may lessen as the battery ages.

Charging Station LEDs

The nine charger slot LEDs show the battery status of the device in their slot and are switched off if no battery is inserted.

If a battery is put on a charging station slot, the corresponding LED will flash yellow until the battery's current state has been identified. Then a beep is issued and the LED reflects the battery status as described in the table below.

Status	LED
no battery on charger slot	off
battery put on charger slot	flashing yellow
battery not properly recognized, error	cyan
battery recognized, battery charging	yellow
battery recognized, battery full (≥90%)	green

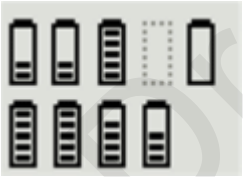
The **AC Power / Error LED** is

- green when the charging station is connected to AC power
- cyan during startup or to indicate a general charging station error

Note — Wiping of battery contacts with an alcohol solution after cleaning is recommended.

Battery Status on the Charging Station Display

The IntelliVue CL Charging Station display provides a quick overview of all the connected devices and their battery status. The screen is arranged in the same layout as the charger slots.



Battery Lifetime Management

The lifetime of a li-ion battery depends on the frequency and duration of use. When properly cared for, the useful life is approximately 4 years or 500 complete charge-discharge cycles, whichever comes first. In addition, experience indicates that the incidence of failure may increase with battery service life due to the accumulated stresses of daily use. We therefore strongly recommend that li-ion batteries be replaced after 2 years or 500 complete charge-discharge cycles.

The age of a li-ion battery begins at the date of manufacture. The date of manufacture is listed on the side of the battery.

➢ *To check the number of charge-discharge cycles:*

Touch the battery gauge on the display.

The number of cycles is listed as xx/500 on the **Device Status** menu.

Battery Disposal

Discharge the battery and insulate the terminals with tape before disposal. Dispose of used batteries promptly and in accordance with local recycling regulations.

13. Safety Standards & Specifications

This section describes the regulatory standards that the IntelliVue MX40 complies with, along with product and measurement specifications.

Regulatory Information

Software Hazard Prevention

Potential hazards arising from errors in the software program have been identified. Mitigations applied to reduce the associated risk of such hazards are included as part of the Risk Management, Clinical Evaluation, and Verification and Validation phases of the product's development.

AC Power Source

The system is not intended for connection to the public mains as defined in CISPR-11.

Industrie Canada Compliance (Canada)

This Class B ISM device complies with Canadian ICES-001.

Cet ISM de la classe B est conforme à la norme NMB-001 du Canada.

Safety Standards

The device complies with the following safety requirements for medical electrical equipment:

- EN 60601-1:1990 + A1:1993 + A2:1995 +A11:1993 +A12:1993 + A13:1996 General Requirements for Safety (with worldwide deviations, including U.S. deviations)
- CSA C22.2 #601.1:1992 Medical Electrical Equipment - General Safety
- UL 60601-1 Medical Electrical Equipment - General Safety
- UL 2054 Standards for Household and Commerical Batteries
- EN 60601-1-1:2006 System Requirements
- EN 60601-1-4:2000 Safety Requirements for Programmable Electronic Medical Systems
- EN 50371:2005 Low Power Electronic and Electronic Apparatus Electromagnetic Exposure
- EN ISO 9919:2005 Requirements for SpO_2 Pulse Oximeters
- EN ISO 10993-1:2003 Biocompatibility
- EN ISO 10993-1:2003 Biocompatibility (for leadwires and pouch)

- EN ISO 9919:2005 Pulse Oximeters
- IEC 60601-1-2:2001 Electromagnetic Compliance
- IEC 60601-1-4:1999 +A1 Requirements for Programmable Electrical Medical Systems
- IEC 60601-1-6:2006 General requirements for basic safety and essential performance - Collateral standard: Usability
-
- IEC 60601-1-8:2006 General Requirements for Safety for Alarm Systems
- IEC 60601-2-49:2001 Particular Requirements for Safety for Patient Monitoring Equipment
- IEC 60601-2-27:2005 Particular Requirements for Safety for Electrocardiograph Monitoring Equipment
- IEC 62133:2002 Safety Requirements for Portable Sealed Secondary Cells (alkaline, lithium-ion)
- AAMI EC 13:2007 Performance Standard, Cardiac Monitors
- AAMI EC 53:1995 (R) 2001 ECG Cables/Leadwires (excluding 4.2.1)

Intended Use Statement

Intended for monitoring and recording of and to generate alarms for, multiple physiological parameters of adults and pediatrics in a hospital environment and during patient transport inside hospitals. Not intended for home use. Intended for use by health care professionals.

Indications for Use

Indicated for use by health care professionals whenever there is a need for monitoring the physiological parameters of patients. Intended for monitoring and recording of, and to generate alarms for, multiple physiological parameters of adults and pediatrics in hospital environments and during transport inside hospitals.

Intended Uses of MX40

The MX40 is to be used primarily as a traditional telemetry medical device. It connects to the IntelliVue Information Center by way of a wireless network. When the MX40 is connected the IntelliVue Information Center the IntelliVue Information Center provides the primary patient monitoring and alarming function. The MX40 does not automatically provide local monitoring or alarming when connected to the Information Center.

The MX40 can provide time-limited local monitoring when it is not connected to the wireless network.

Unlike a traditional bedside monitor which operates on AC power, the MX40 is powered by battery and cannot provide continuous monitoring.

Authorized EU Representative

Philips Medizin Systeme Deutschland
Hewlett-Packard-Strasse 2
D 71034, Boeblingen
Germany

Patient Population

This device is not for use with infant or neonatal patients.

Use of the device is restricted to one patient at a time.

The components/accessories which come into contact with the patient's skin are in compliance with the relevant requirements of EN ISO 10993-1 for Biocompatibility. The device is not designed for direct contact with the patient's skin. The accompanying pouch is the appropriate means for holding the device.

Rx

Federal Law restricts this device to sale by or on the order of a physician.

Essential Performance

The IntelliVue MX40 provides Essential Performance (EP) under normal operating conditions (includes EMC exposure) only as a complete Medical Electrical System, consisting of the MX40, MPx companion monitor (Optional), IntelliVue CL SpO_2 and NBP Cableless Measurement devices(Optional), IntelliVue Telemetry Network Infrastructure, and the M3290 Information Center Software.

The System achieves its Essential Performance exclusively through alarm generation at the M3140-55 IntelliVue Information Center and locally at the MX40, based on configuration.

The IntelliVue MX40 protects the patient from unacceptable immediate clinical risk by generating specific Physiological Alarms when appropriate. If the system cannot generate Physiological Alarms, then relevant Severe or Hard-Level Technical Alarms (Inops) are created.

Electromagnetic Compatibility

Medical electrical equipment can either generate or receive electromagnetic interference. This product has been evaluated for electromagnetic compatibility (EMC) with the appropriate accessories according to IEC 60601-1-2:2001, the international standard for EMC for medical electrical equipment. This IEC standard has been adopted in the European Union as the European Norm, EN 60601-1-2:2001.

Radio frequency (RF) interference from nearby transmitting devices can degrade performance of the product. Electromagnetic compatibility with surrounding devices should be assessed prior to using the product.

Fixed, portable, and mobile radio frequency communications equipment can also affect the performance of medical equipment. See your service provider for assistance with the minimum recommended separation distance between RF communications equipment and the product.

The cables, sensors/transducers, and other accessories for which compliance is claimed are listed in the Service and User documentation accompanying the product.

Warnings

- The use of accessories, transducers and cables other than those specified in the product service and user documentation can result in increased electromagnetic emissions or decreased immunity of the product.
- Short-range radio connections are subject to interruption due to interference from other radio sources in the vicinity, including microwaves, bluetooth devices, and DECT phones. Outside the frequency band and 5% above and below, i.e. the exclusion band according to IEC 60601-1-2, the short-range radio connection is immune up to 3V/m in the frequency range from 80MHz to 2.5 GHz. Depending on the strength and duration of the interference, the interruption may occur for an extended period. Any interruption of the signal due to interference, moving out of range, or for other reasons is indicated with a Tele Disconnected INOP message.
- The product should not be used next to or stacked with other equipment. If you must stack the product, you must check that normal operation is possible in the necessary configuration before the product is used on patients.

Reducing Electromagnetic Interference

The MX40 and associated accessories can be susceptible to interference from other RF energy sources and continuous, repetitive, power line bursts. Examples of other sources of RF interference are other medical electrical devices, cellular products, information technology equipment, and radio/television transmission. If interference is encountered, as demonstrated by artifact on the ECG or dramatic variations in physiological parameter measurement values, attempt to locate the source. Assess the following:

- Is the interference due to misplaced or poorly applied electrodes or sensors? If so, re-apply electrodes and sensors correctly according to directions in Chapter 6.
- Is the interference intermittent or constant?
- Does the interference occur only in certain locations?
- Does the interference occur only when in close proximity to certain medical electrical equipment?

Once the source is located, attempt to attenuate the interference by distancing the MX40 from the source as much as possible. If assistance is needed, contact your local service representative.

Restrictions for Use

Artifact on ECG and other physiological waveforms caused by electromagnetic interference should be evaluated by a physician or physician authorized personnel to determine if it will negatively impact patient diagnosis or treatment.

Electromagnetic Compatibility (EMC) Specifications

Take special precautions regarding electromagnetic compatibility (EMC) when using medical electrical equipment. You must operate your monitoring equipment according to the EMC information provided in this book. Portable and mobile radiofrequency (RF) communications equipment can affect medical electrical equipment.

Accessories Compliant with EMC Standards

All accessories listed in the accessories section comply, in combination with the MX40, with the requirements of IEC 60601-1-2:2001 + A1:2004.

Warning

Using accessories other than those specified may result in increased electromagnetic emission or decreased electromagnetic immunity of the monitoring equipment.

Electromagnetic Emissions

Emissions Test	Compliance	Avoiding Electromagnetic Interference
Radio Frequency (RF) emissions	Group 1	TheMX40 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 MX40 is suitable for use in all establishments.
Harmonized emisssions	Not Applicable	Device is battery powered only
Voltage fluctuations/Flicker emissions IEC 61000-3-3	Not Applicable	

Electromagnetic Immunity

The MX40 is suitable for use in the specified electromagnetic environment. The user must ensure that it is used in the appropriate environment as described below.

Immunity Test	IEC 60601-1-2 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%.

Immunity Test	IEC 60601-1-2 Test Level	Compliance Level	Electromagnetic Environment Guidance
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be a t levels characteristic of a typical location in a typical commercial and/or hospital environment

Recommended Separation Distance

Warning

The MX40, equipped with a wireless network interface, intentionally receives RF electromagnetic energy for the purpose of its operation. Therefore, other equipment may cause interference, even if that other equipment complies with CISPR emission requirements.

In the following table, P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m).

Portable and mobile RF communications equipment should be used no closer to any part of the MX40, including cables, than the recommended separation distance calculated from the equation appropriate for the frequency of the transmitter.

Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey, should be less than the compliance level in each frequency range.

Interference may occur in the vicinity of equipment marked with this symbol: 

Immunity Test	IEC 60601-1-2 Test Level	Compliance Level	Electromagnetic Environment Guidance
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz	3 VRMS	Recommended separation distance: $d = 1.2\sqrt{P}$

Immunity Test	IEC 60601-1-2 Test Level	Compliance Level	Electromagnetic Environment Guidance
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2.5 GHz	3 V/m	Recommended separation distance: 80 MHz to 800 MHz $d = 1.2\sqrt{P}$ 800 MHz to 2.5 GHz $d = 2.3\sqrt{P}$

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 monitor is used exceeds the applicable RF compliance level above, the MX40 should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the monitor.

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

The MX40 is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or user of the monitor can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment and the monitor as recommended below, according to the maximum output power of the communications equipment.

In the following table, P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m).

Frequency of Transmitter	150 kHz to 80 MHz	80 MHz to 800 MHz	800 MHz to 2.5 GHz
Equation	$d = 1.2\sqrt{P}$	$d = 1.2\sqrt{P}$	$d = 2.3\sqrt{P}$
Rated max. output power of transmitter	Separation distance	Separation distance	Separation distance
0.01 W	0.1 m	0.1 m	0.2 m
0.1 W	0.4 m	0.4 m	0.7 m
1 W	1.2 m	1.3 m	2.3 m

Frequency of Transmitter	150 kHz to 80 MHz	80 MHz to 800 MHz	800 MHz to 2.5 GHz
10 W	3.8 m	3.8 m	7.3 m
100 W	12.0 m	12.0 m	23.0 m

Electrosurgery Interference/Defibrillation/Electrostatic Discharge

The equipment returns to the previous operating mode within 10 seconds without loss of any stored data. Measurement accuracy may be temporarily decreased while performing electrosurgery or defibrillation. This does not affect patient or equipment safety. Do not expose the equipment to x-ray or strong magnetic fields (MRI).

Restart Time

After power interruption, an ECG wave will be shown on the display after 30 seconds maximum.

Battery Specifications

Battery Life

The battery life specifications listed below are based on the use of three Duracell MN 1500 batteries. Battery life for other brands may differ.

Telemetry Mode Networked	Battery Life
ECG Only (only one radio active)	24.7 hours
ECG/SpO_2 Continuous (using legacy SpO_2 cable/sensors. Only one radio active.)	8.9 hours
ECG/SpO_2 Manual	In this mode battery life is dependent on the usage rate and will range between the ECG Only battery life and the ECG/SpO_2 Continuous battery life.

Monitor Mode Non-networked	Battery Life
ECG Only (only one radio active)	7.3 hours
ECG/SpO_2 Continuous (using legacy SpO_2 cable/sensors. Only one radio active.)	4.6 hours

The battery life specifications listed below are based on the use of the Philips Rechargeable Lithium-ion battery.

Telemetry Mode Networked	Battery Life
ECG Only (only one radio active)	25.1 hours
ECG/SpO_2 Continuous (using legacy SpO_2 cable/sensors. Only one radio active.)	14.1 hours
ECG/SpO_2 Manual	In this mode battery life is dependent on the usage rate and will range between the ECG Only battery life and the ECG/SpO_2 Continuous battery life.

Monitor Mode Non-networked	Battery Life
ECG Only (only one radio active)	8.6 hours
ECG/SpO_2 Continuous (using legacy SpO_2 cable/sensors. Only one radio active.)	7.0 hours
ECG/SpO_2 Manual	In this mode battery life is dependent on the usage rate and will range between the ECG Only battery life and the ECG/SpO_2 Continuous battery life.

Nominal Current

Operating Mode	Nominal Current
ECG Only (Display inactive)	67 mA @ 3.6V
ECG/SpO_2 Continuous (Display inactive)	136 mA @ 3.6V

Lithium-ion Battery Charge Time

Definition	Charging Method	Charge Time
Battery pack charge time from 90% depletion state	The Lithium-ion Battery Pack is charged on a separate external charging station. It must be removed from the MX40 to charge.	6.5 hours

Physical Specifications

Parameter	Specification
Height	126.8 mm (4.99 in)
Width	69.9 mm (2.75 in)
Depth	31.5 mm (1.24 in)
Weight • Without batteries, includes SpO_2 and Short-range radio • With 3 AA batteries, includes SpO_2 and Short-range radio • With lithium-ion battery, includes SpO_2 and Short -range radio	 • 1.4 GHz - 240 g (8.5 oz) • 2.4 GHz - 215 g (7.6 oz) • 1.4 GHz - 298 g (10.5 oz) • 2.4 GHz - 324 g (11.4 oz) • 1.4 GHz - 279 g (9.8 oz) • 2.4 GHz - 305 g (10.8 oz)
Display • Type • View Area • Resolution • Backlight • ECG Display Sector Size (height) • ECG Display Sweep Speed	 • 2.8" QVGA Color LCD • 43.2mm x 57.6 mm (1.70" x 2.26") • 240 x 320 • White LED • 13.5mm (portrait), 9.9mm (landscape) • 10mm/s with 4.32 sec of viewable ecg data (portrait), 10mm/s with 5.76 sec of viewable ecg data (landscape)

MX40 1.4 GHz Radio

Parameter	Specification
Frequency Ranges	Bands: 1395-1400 MHz and 1427-1432 MHz Channel Spacing: 1.6 MHz
RF Output Power (existing systems)	8 dBm +2/-1.5 dB (4.5 mW to 10 mW), into antenna load
MX40 Frequency Accuracy during normal operation	<+60/-100 KHz relative to channel frequency, includes temperature compensation and aging effects
Antenna Gain	-3 dBi
Modulation Type	GFSK with Root Raised Cosine filtering (1M60Q7D)
Out of Band Spurious Emission Levels: <= 1394 MHz, >= 1401 MHz <= 1428 MHz, >= 1433 MHz	<-41 dBm in 1 MHz bandwidth for FCC limit
Occupied bandwidth as defined by power in 99% BW	< +/- 800 KHz

1.4GHz WMTS (US only)

This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference. Operation of this equipment requires the prior coordination with a frequency coordinator designated by the FCC for the Wireless Medical Telemetry Service.

MX40 2.4 GHz Radio

Parameter	Specification
Frequency Range	ISM Band: 2400 - 2483.5 MHz
Channel Assignment	48 radio channels assigned from 2401.056 MHz - 2482.272 MHz Channel Spacing: 1.728 MHz
RF Output Power	FCC: Channels 0-46 -17 dBm +/- 1 dB (40 mW to 63 mW, nominal 50 mW), into antenna load. Channel 47 only - 14.5 dBm +/- 1 dB. ETSI: 12 dBm +/- 1 dB (13 mW to 20 mW, nominal 16 mW), into antenna load ARIB: 13.5 dBm +/- 1 dB (18 mW to 28 mW, nominal 22 mW), into antenna load
Transceiver Frequency Accuracy during normal operation	<+ 60 /- 100 KHz relative to channel frequency, includes temperature compensation and aging effects
Modulation Type	GFSK, Gaussian Frequency Shift keying (1M40Q7D)
Modulation Bandwidth	Typically 1.4 MHz (20 dB Bandwidth) Typically 980 KHz (6 dB Bandwidth)
Out of Band Spurious Emission Levels	Meets ETSI, RS210, FCC, ARIB standards

2.4 GHz ISM

FCC and Industry Canada Radio Compliance: This device complies with Part 15 of the FCC Rules and RSS-210 of Industry Canada. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Any changes or modifications to this equipment not expressly approved by Philips Medical Systems may cause harmful radio frequency interference and void your authority to operate this equipment.

The radio device used in this product is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC (Radio Equipment and Telecommunications Terminal Equipment Directive). Class 2 radio equipment. Member states may apply restrictions on putting this device into service or placing it on the market. This product is intended to be connected to the Publicly Available Interfaces (PAI) and used throughout the EEA.

This ISM device complies with Candadian ICES-001. Cet appareil ISM est conforme a la norme NMB-001 du Canada.

MX40 Short-Range Radio

Parameter	Specification
Frequency Ranges	ISM Band: 2400-2483.5MHz
Radio Channel assignment	16 Radio Channel assigned, Fc= 2405 +5*(k-11)MHz, k=11,12,…,26
Frequency Control	Configured via the bedside monitor.
RF Output Power	ˉ1.5 to ˉ4.5 dBm +0/-3dB (0.7 mW to 0.3 mW), into Antenna load.
MX40 Frequency Accuracy during normal operation	<+/-40ppm, includes temperature compensation & aging effects
Modulation Type	Direct Sequence Spread Spectrum (DSSS), O-QPSK with half sine pulse shaping modulation (1M40Q7D)
Modulation Bandwidth	>500KHz, typically +/-950KHz (6dB Bandwidth), typically +/-1.4MHz (20dB Bandwidth)

Environmental Specifications

Parameter	Specification
Temperature	
Operating	0 to 37° C (32 to 99° F)
Storage	-30° C to 50° C (-22° F to 122° F) without batteries
Humidity	
Operating	< 95% RH at 37° C (98.6° F) non-condensing
Storage	< 90% RH at 50° C (112° F) without batteries
Altitude	
Operating & Non-operating	3,000 m (9,842 ft)
Barometric Pressure	72kPa (537 mmHg)

Measurement Specifications

ECG

Parameter	Specification
ECG channel transmitted Leads	
3 electrodes	Channel #1 = I, II, or III
5 electrodes	Channel #1 = II Channel #2 = III Channel #3 = MCL
5 electrodes, EASI	Channel #1 = Va-i Channel #2 = Va-s Channel #3 = Ve-s
6 electrodes	Channel #1= II Channel #2 = III Channel #3 = Va Channel #4 = Vb
Resolution	5 μV
ECG Input	Differential, defibrillator protected against 360 joules discharge into a 100 ohm load
Input Impedance	> 5 megohms (@ 10 Hz
Input Dynamic Range	+/- 9 mV
DC Offset Range	+/- 320 mV
CMRR	> 90 dB @ 50, 60 Hz
Bandwidth +/- 3 dB	0.05 to 40 Hz
Gain Accuracy	+/- 5% at 25 °C (77 °F)
Noise Referred to ECG Input (Peak-to-Peak)	AAMI: 30 μV (as per AAMI EC 13)
Lead Wires	3, 5 or 6-wire patient cable compatible with IntelliVue Patient Monitor, AAMI/IEC color codes
Time to baseline recovery from Defibrillator	AAMI: 5 s max (until ECG wave is on display but not yet centered, monitoring bandwidth)

Parameter	Specification
Pacer Rejection Performance (Pace pulses with no tails).	Positive pacers[1] Amplitude — Width +2 to +700 mV — 0.1, 0.2, 0.5 and 1.0 ms +2 to +500 mV — 1.5 ms +2 to +400 mV — 2 ms Negative pacers[1] Amplitude — Width -2 to -700 mV — 0.1, 0.2, 0.5 and 1.0 ms -2 to -500 mV — 1.5 ms -2 to -400 mV — 2 ms [1] Philips does not claim, verify, or validate support for all available pacemakers.
EMC Performance Limits, radiated immunity	Meets Essential Performance.
ECG Patient Cable Disconnection Safety	All ECG connections are patient safe within 750 msec of patient cable removal, with patient leakage current <10 μA. Exception:Leadset detection pins are protected mechanically to prevent patient contact.

ECG Performance Disclosure/Specifications

Characteristic	Performance Disclosure/Specification (in italics)
Heart Rate Averaging Method	Two different methods are used: • Normally, heart rate is computed by averaging the 12 most recent RR intervals. • If each of 3 consecutive RR intervals are greater than 1200 milliseconds (i.e. rate less than 50 b/min) for adult and pediatric patients, then the 4 most recent RR intervals are averaged to compute the HR.

Characteristic	Performance Disclosure/Specification (in italics)
Heart Rate Meter Accuracy and Response to Irregular Rhythm	Provides correct heart rates (80, 60, 120, 90 b/min) using test waveforms as indicated in ANSI/AAMI EC13 Sec. 3. 1. 2. 1 (5).
Response Time of Heart Rate Meter to Change in Heart Rate	For a rate increase, the average time to reach the specified heart rate using test waveforms as indicated in ANSI/AAMI EC13 Sec. 3. 1. 2. 1 (6) is 8.6 seconds. For a rate drop, the average time is 8.2 seconds.
Time to Alarm for Tachycardia	The ranges of time to alarm using test waveforms as indicated in ANSI/AAMI EC13 Sec. 3. 1. 2. 1 (7) are 6.4 to 9.3 seconds.
Pacemaker Pulse Rejection Capability	Rejects pace pulses using test waveforms as indicated in ANSI/AAMI EC13 Sec. 3. 1. 4 (with amplitude from +/- 2 to +/- 700 mV, width from 0.1 to 2.0 ms).
Range and Accuracy of Heart Rate Meter	Meets the ANSI/AAMI EC13 Section 3.2.7 recommended minimum range and accuracy. Heart rate range is 15 - 300 b/min with accuracy of ± 1% of the range for Adult and Pediatric patients. (Note: for rates equal to or less than 15, the displayed heart rate is 0).
Alarm Limit Range	Meets the ANSI/AAMI EC13 Section 3.2.8.1 standard. Lower alarm limit is 15 -295. Upper alarm limit is 20 - 300.
Resolution of Alarm Limit Settings	Meets the ANSI/AAMI EC13 Section 3.2.8.2 standard. The resolution is ± 5 b/min.
Alarm Limit Accuracy	Meets the ANSI/AAMI EC13 Section 3.2.8.3 standard. Error less than ± 10% or ± 5b/min
Time to Alarm for Cardiac Standstill	Meets the ANSI/AAMI EC13 Section 3.2.8.4 standard: maximum alarm time <10 seconds, using the test waveforms as indicated.
Time to Alarm for Low Heart Rate	Meets the ANSI/AAMI EC13 Section 3.2.8.5 standard: maximum alarm time <10 seconds, using the test waveforms as indicated.
Time to Alarm for High Heart Rate	Meets the ANSI/AAMI EC13 Section 3.2.8.6 standard: maximum alarm time <10 seconds, using the test waveforms as indicated.
Alarm Silencing	The time required for reactivation of a latched, silenced alarm is 3 minutes
ECG Waveform Display Time Base Accuracy	0.8%. *Meets the ANSI/AAMI EC13 Section 3.2.9.6 standard: maximum error = +/-10%.*

Characteristic	Performance Disclosure/Specification (in italics)
Channel Width	40 mm. *Meets the ANSI/AAMI EC13 Section 3.2.9.7(a) standard: minimum = 30mm.*
Trace Width	0.3 mm. *Meets the ANSI/AAMI EC13 Section 3.2.9.7(b) standard: maximum = 1.0mm.*
Aspect Ratio	0.4s/mV. *Meets the ANSI/AAMI EC13 Section 3.2.9.7(f) standard: 0.4s/mV.*
Input Signal Reproduction Accuracy: Overall Error	-2.9%. *Meets the ANSI/AAMI EC13 Section 3.2.9.8(a) standard: maximum = +/- 20%.*
Frequency Response: Sinusoidal	0.67 to 40 Hz (3 db down). *Meets the ANSI/AAMI EC13 Section 3.2.9.8(b) standard: 0.67 to 40 Hz (3 db down).*
Frequency Response: Triangular	0 to 25% reduction. *Meets the ANSI/AAMI EC13 Section 3.2.9.8(b) standard: 0 to 25% reduction.*
Impulse Response: (for waves marked with ST bandwidth)	Displacement = 0.08 mV, slope = 0.11 mV/s. *Meets the ANSI/AAMI EC13 Section 3.2.9.8(c) standard: displacement maximum = 0.1 mV; slope maximum = 0.30 mV/s.*
Pacemaker Pulse Display Capability	Minimum = 0.2 mV RTI. *Meets the ANSI/AAMI EC13 Section 3.2.9. 12 standard: minimum = 0.2 mV RTI.*

FAST SpO_2

Parameter	Specification
SpO_2 Measurement Range (Calibration and Display)	0 to 100%
SpO_2 Accuracy	See table following.
SpO_2 Resolution	1%

Parameter	Specification
SpO_2 Numerics - Averaging	5 - 20 seconds (default = 10 seconds) ***Note—***The update rate for the SpO_2 pulse oximetry value and pulse rate is typically 1 second. This can be extended to a max. 60 s when NBP is measured on the same limb, with a corresponding INOP message after a max. of 30 s, indicating that the displayed values are not current values. The effect of SpO_2 pulse oximetry on data averaging is internally controllable by the patient worn monitorMX40, with no user controls.
SpO_2 & Pulse Numerics - Update Rate	Transmitted once per second. ***Note—***The update rate for the SpO_2 pulse oximetry value and pulse rate is typically 1 second. This can be extended to a max. 60 s when NBP is measured on the same limb, with a corresponding INOP message after a max. of 30 s, indicating that the displayed values are not current values.
Pleth Wave- Sampling Rate	125 sps
Technical Alarms (INOPs)	Triggered if the sensor is disconnected, if a pulse is not detected, if the signal is noisy, if light interference is detected, if the sensor is defective, if the measurement is erratic, or if the module is malfunctioning
Wavelength Range	500 to 1000 nm ***Note—***Information about wavelength range can be especially useful to clinicians (e.g., clinicians performing photodynamic therapy).
Pulse Rate Measurement (available only with Continuous SpO_2)	Range: 30 to 300 bpm Accuracy: +/- 2% Resolution: 1 bpm
Display of SpO_2 numerics	SpO_2 values are displayed as xxx % SpO_2 to meet ISO 9919.
Emitted Light Energy	$\leq$ 15 mW

SpO_2 Sensor Accuracy

Type	Description	Model Number	Accuracy % [A]rms (70-100% Range)
Reusable Sensors			
	Adult Finger, 2m cable	M1191B	2.0
	Adult Finger, 3m cable	M1191BL	2.0
	Adult Finger, 0.45m cable	M1191T	3.0
	Pediatric, Small Adult Finger, 1.5m cable	M1192A	2.0
	Pediatric, Small Adult Finger, 0.45m cable	M1192T	3.0
	Adult &Pediatric Ear Clip, 1.5m cable	M1194A	3.0
	Adult Finger Clip, 3m cable	M1196A	3.0
	Adult Finger Clip, 2m cable	M1196S	3.0
	Adult Finger Clip, 0.9m cable	M1196T	3.0
	LNCS Adult Reusable Sensor	Masimo LNCS DC-I	2.0
	LNCS Pediatric Reusable Sensor	Masimo LNCS DC-IP	2.0
	LNCS Tip-Clip Ear Reusable Sensor	Masimo LNCS TC-I	3.5
	LNOP Adult Reusable Sensor	Masimo LNOP-DC-I	2.0
	LNOP Pediatric Reusable Sensor	Masimo LNOP DC-IP	2.0
	LNOP Tip-Clip Reusable Sensor	Masimo LNOP TC-I	3.5

Type	Description	Model Number	Accuracy % [A]rms (70-100% Range)
Single Patient Use Sensors			
	Adult Finger, > 40kg	M1901B	3.0
	Pediatric 3-20kg	M11902B	3.0
	Pediatric Finger, 10-50kg	M1903B	3.0
	Adult Finger, >30kg	M1904B	3.0
	Adult, Pediatric > 20kg	M1131A	3.0
	Adult Finger, > 30kg	Nellcor OxiMax Max-A	3.0
	Adult Finger, > 30kg	Nellcor OxiMax Max-AL	3.0
	Adult Finger > 40kg	Nellcor OxiMax Max-N	3.0
	Pediatric	Nellcor OxiMax Max-P	3.0
	Pediatric	Nellcor OxiMax Max-I	3.0
	Adult Finger > 30kg	Nellcor Oxisensor II D-25	3.0
	Adult Finger > 40kg	Nellcor Osixensor II N-25	3.0
	Pedicatric Finger 10-50kg	Nellcor Oxisensor II D-20	3.0
	Adult Finger	Nellcor OxiCliq A	3.0
	Pediatric Finger	Nellcor OxiCliq P	3.0
	Pediatric	Nellcor OxiCliq I	3.0
	Adult Finger > 40kg	Nellcor OxiCliq N	3.0
	Pediatric Adhesive	Masimo LNOP PDT	2.0
	Pediatric Adhesive	Masimo LNOP PDTx	2.0
	Adult Adhesive	Masimo LNOP ADT	2.0
	Adult Adhesive	Masimo LNOP ADTx	2.0
	Adult Adhesive	Masimo LNCS ADTx	2.0
	Pediatric Adhesive	Masimo LNCS PDTx	2.0
	Adult Adhesive	Masimo LNCS Neo-3	2.0

A. Accessories

This section lists the accessories for use with the MX40. Accessories are subject to change. Some accessories are not supplied by Philips.

You can order parts and accessories from Philips at www.medical.philips.com or consult your local Philips representative for details.

Warning

- Use only Philips-approved accessories. Use of product accessories (patient cables, SpO_2 sensors, etc.) other than those specified in this manual may lead to patient injury or result in increased electromagnetic emissions or decreased immunity of the product.
- Reuse: Never reuse disposable transducers, sensors, accessories, etc. that are intended for single use, or single patient use only. Reuse may compromise device functionality and system performance and cause a potential hazard.
- Philips' approval: Use only Philips-approved accessories. Using non-Philips-approved accessories may compromise device functionality and system performance and cause a potential hazard.
- Packaging: Do not use a sterilized accessory if its packaging is damaged.

MX40 Accessories

Pouches

Order Number	Description
989803174141	Carry Pouch, Waterproof, box of 50
989803174151	Carry Pouch, Waterproof, box of 200
9300-0768-050	Disp tele pouch w/snaps, 50/box
9300-0768-200	Disp tele pouch w/snaps, 200/box

Miscellaneous

Order Number	Description
989803176501	Protective caps, adapter cable, MX40
989803176491	Protective caps, Reusable leads, MX40
989803174131	MX40 Lithium-ion battery, pkg 3
989803176201	MX40 Lithium-ion battery, pkg 1
989803174891	MX40 AA Battery adapter, pkg 3

ECG Accessories

Electrodes

Order Number	Description
M4612A	Solid gel ECG electrode 5/pouch 300/case
M4613A	Solid gel ECG electrode 30/pouch 300/case
40489E	Adult paper tape ECG electrode, disp. 300/case
40493D	Adult foam ECG electrode, disp. 300/case
40493E	Adult foam ECG electrode, disp. 300/case
M1935A	Disposable EEG/ECG snap electrode 100/case
989803148801	Small adult solid gel snap electrode 1500/case
13941E	Adult cloth ECG electrode, disp. 300/case
13942E	Adult plastic tape ECG electrode, disp. 300/case
13950B	Pediatric cloth ECG electrode, disp. 300/case
13951C	Neo/Pediatric solid gel electrode, disp. 300/case
13955C	Neo/Pedi snap electrode, square, disp.300/case

Leadsets and Patient Cables

MX40 Reusable Patient Cables

Order Number	Description
989803171801	ECG 3 lead grabber AAMI .85m (35")
989803171811	ECG 3 lead grabber AAMI + SpO_2 .85m (35")
989803171821	ECG 5 lead snap AAMI .85m (35")

Order Number	Description
989803171841	ECG 5 lead snap AAMI + SpO_2 .85m (35")
989803171831	ECG 5 lead grabber AAMI .85m (35")
989803171851	ECG 5 lead grabber AAMI + SpO_2 .85m (35")
989803171861	ECG 6 lead grabber AAMI .85m (35")
989803171871	ECG 6 lead grabber AAMI + SpO_2 .85m (35")
MX40 Extender Cable, including Bed Sheet Clip, p/n 989803172241	

Reusable Leadsets for Use with IntelliVue Patient Monitors

Order Number	Description
989803151991	ECG 3 lead snap, gray, AAMI .85m (35")
989803151971	ECG 3 lead grabber, gray, AAMI .85m (35")
989803152071	ECG 5 lead snap, multi AAMI .85m (35")
989803152051	ECG 5 lead grabber, multi AAMI .85m (35")
989803152151	ECG 6 lead snap, multi AAMI .85m (35")
989803152131	ECG 6 lead grabber, multi AAMI .85m (35")
989803152001	ECG 3 lead snap, gray IEC .85m (35")
989803151981	ECG 3 lead grabber, gray IEC .85m (35")
989803152081	ECG 5 lead snap, multi IEC .85m (35")
989803152061	ECG 5 lead grabber, multi IEC .85m (35")
All above leadsets require the MX40 to InvelliVue Adapater Cable, p/n 989803172211	

SpO_2 Accessories

Philips/Nellcor Disposable Sensors

Order Number	Description
989803105481 (A)	M1904B Adult Finger, >30 kg
989803128551	M1133A Neo/Infant/Adult, <3, 10-20 kg, >40 kg
989803164921	M1134A Adh.-free Neo/Infant/Adult, >40 kg
989803128531	M1131A Adult/Pedi, >20 kg
989803111561(A)	M1903B Pedi Finger, 10-50 kg
989803105471(A)	M1902B Infant, 3-20 kg
989803105461(A)	M1901B Neonatal,<3 kg, >40 kg
989801190969 (B)	NellCor OxiMax Max-1, 3-20 kg
989801190966 (B)	Nellcor Oxisensor II D-20, 10-50 kg
989801190967 (B)	Nellcor OxiMax D-25, >30 kg
989801190970 (B)	Nellcor OxiMax N-25, <3 kg, >40 kg
Require M1943A/AL cable to connect to MX40. Sold in packages of 24. (A) Only available from Philips in Europe and (B) Only avialable from Philips in Japan.	

Philips Reusable Sensors

Order Number	Description
989803144371 A, B	M1191B Adult Finger, >50 kg
989803103231 A, B	M1192APedi/Sm. Adult 1.5 m, 15-50 kg
989803103251 A, B	M1194A Adult/Pedi Ear 1.5m, >40 kg
989803144381 A	M1191A Adult Finger 3 m, >50 kg
989803128631 A	M1196A Adult Finger 3 m, >40 kg
989803128591 C, D	M1191T Adult Finger .45 m, >50 kg
989803128611 C, D	M1192T Pedi/Sm. Adults .45 m, 15-50 kg
989803128641 C, D	M1196T Adult Finger .9 m, >40 kg
989803174381 A, B	M1196S Adult Finger 2m, >40 kg

Order Number	Description
All sold as one piece each. A - Sensors plug directly into MX40. B - Supports use of M1941A extension cable. C - Not for use with M1941A extension cable. D - Requires M1943A/AL adapter cable.	

Adapter Cables

Order Number	Description
989803105691	M1943A Adapter Cable, 1. m
989803128651**	M1943AL Adapter Cable, 3 m
989803105681**	M11941A Extension Cable, 2 m
M1020-61100**	Massimo Adapter Cable for LNOP sensors,3.6 m
989803148221**	Massimo Adapter Cable for LNCS sensors, 3 m
**Not to be used with the MX40 extender cable, p/n 989803172241	

B. Default Settings

This section documents the most important default settings of your MX40 as it is delivered from the factory. For a comprehensive list and explanation of default settings, see the *IntelliVue Information Center Release N Configuration Guide*. The MX40's configuration settings can be changed permanently in Configuration Mode.

Alarm Default Settings

Alarm Setting	Factory Default
Alarm Volume	On Network: 0 Off Network: 10
QRS Volume	0
Tone Modulation	On
Alarm Sound	Traditional
Alarm Pause Time	2 min.
Alarm Reminder (Red, Yellow)	On
Alarm Reminder (INOP)	On
Reminder Time	3 min.
ECG Leads Off - Severity	Cyan
Replace Battery - Severity	Cyan
Alarms On	Information Center Release L/M: Disabled Information Center Release N: Enabled

ECG, Arrhythmia, ST and QT Default Settings

ECG Settings	Factory Defaults	
	Adult	**Pedi**
ECG	On	
Primary Lead	II	
Secondary Lead	6-lead: V2 5-lead (Standard): V 5-lead (EASI): V2	
Default ECG Size	x1	
Lead Placement	Standard	
Leadset Type	AAMI	
Analysis Mode	Multi-lead	
High Limit	120 bpm	160 bpm
Low Limit	50 bpm	75 bpm
Asystole Threshold	4.0 sec	

Arrhythmia Settings	Factory Defaults	
	Adult	**Pedi**
Arrhythmia	On	
Pause Threshold	2.0 sec	
VTach HR	100 bpm	120 bpm
VTach Run	5	
Vent Rhythm	14	
SVT HR	180 bpm	200
SVT Run	5	
PVCs/min	10	5
Non-Sustained VT	On	
Run PVCs	On	
Pair PVCs	On	

Arrhythmia Settings	Factory Defaults	
	Adult	Pedi
R-On-T PVCs	On	
V.Bigeminy	On	
V.Trigeminy	On	
PVCs/min	On	
Multif. PVCs	On	
Pacer N. Cap	On	
Pacer N. Pac	On	
Pause	On	
Missed Beat	On	
SVT	On	
Afib	On	
Irregular HR	On	

Configuration Default Settings at the MX40

Setting	Factory Default
Touch Tone Volme	0 - 10 **4**
Default Screen	1 Wave (Portrait) **2 Waves (Portrait)** 2 Waves (Landscape) Chest Diagram
Screen Color	**Blue** Gray Green Pink* Purple* Yellow* (*only display in Standby Mode)
Alarm Sounds	**Traditional** ISO
Unit Defaults	Confirm to restore to unit default settings

C. MX40 2.4GHz WLAN Radio

The MX40 2.4GHz WLAN Radio conforms to the 802.11 b/g standard, operating in the 2.4GHz ISM band.

The Radio characteristics are defined below.

WLAN Radio RF Specs	Specification
802.11b	
Frequency Range	2.4 to 2.483GHz
Transmitter Power	14 to 17 dBm into antenna load
Spectrum Mans (relative to max power spectral density)	≤-30 dBr @ +/-11MHz offset
	≤-50 dBr @ +/-22MHz offset
Modulation Type	CCK modulation
802.11g	
Frequency Range	2.4 to 2.483GHz
Transmitter Power	12 to 15 dBm into antenna load
Spectrum Mans (relative to max power spectral density)	≤-20 dBr @ +/-11MHz offset
	≤-28 dBr @ +/-20MHz offset
	≤-40 dBr @ +/-30MHz offset
Modulation Type	OFDM modulation

ISM Radio

FCC and Industry Canada Radio Compliance: This device complies with Part 15 of the FCC Rules and RSS-210 of Industry Canada. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Any changes or modifications to this equipment not expressly approved by Philips Medical Systems may cause harmful radio frequency interference and void your authority to operate this equipment.

D. Sales and Support Offices

Please call your local Philips Healthcare sales office listed in your telephone directory or a Philips Healthcare regional office listed below for the location of your nearest sales office.

On the web
www.healthcare.philips.com

Via email
healthcare@philips.com

By fax
+31 40 27 64 887

By postal service
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Index

A

C

D

E

I

P

Part Number 453 564 242 441
Printed in USA June 2011
First Edition