

IntelliVue MX40

Instructions for Use

Release C.01

PHILIPS

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- What security controls are in place to protect personal and sensitive data.
- How the data is stored and the conditions by which it is stored.
- How the data is transmitted and the conditions under which that data is transmitted.

Protecting personal health information is a primary component of a security strategy. Personal and sensitive information should be protected according to the applicable laws, regulations and directives, such as HIPAA, PIPEDA and/or Council of the European Union security and privacy rules.

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Information Center Product Name

As of Release C.02, the IntelliVue Information Center (also known as IIC iX) is called Patient Information Center iX, or PIC iX. However, any references to IIC iX are considered equivalent to PIC iX.

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 February 2021

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.

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Introducing the IntelliVue MX40

This section introduces the IntelliVue MX40 wearable patient 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 or Masimo SET SpO_2 (continuous, automatic or manual measurement).
- Standard, EASI or Hexad ECG lead system selection.
- Impedance-based Respiration measurement.
- Alarm generation from Pulse measurement (MX40 Release C.01 and Patient Information Center iX Release C.02 or latest release).
- 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, graphical trend, trend upload.
- Local alarming for measurements (requires Philips IntelliVue Information Center Release N or later, Philips IntelliVue Information Center iX and Patient Information Center iX).
- Integrated radio for connection to an Information Center (Philips IntelliVue Information Center Release N or later, Philips IntelliVue Information Center iX and Patient Information Center iX).
- Integrated short-range radio.
- 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.

  Note — The WLAN MX40 (Model Number 865352) is powered only by the 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 two models (ECG only, ECG and SpO_2 (FAST or Masimo SET).

MX40 Release C.01 Compatibility

The MX40 (865350/865351) is compatible for use with IntelliVue Information Center Release N/N.01 only. Release L and M are no longer supported. The MX40 with ECG only or optional FAST SpO_2 remains compatible with IntelliVue Information Center iX Release A.02.08 or latest release. The MX40 with optional Masimo SET technology is compatible for use with IntelliVue Information Center iX Release B.02.15 or latest release. It is not compatible with Information Center Release L or M.

The MX40 (865352) is compatible with IntelliVue Information Center iX Release A.02.08 or latest release. It is not compatible with IntelliVue Information Center Release N or earlier.

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

The MX40 is compatible for use with IntelliVue Cableless Measurements Release C.0 or latest release.

The MX40 (865350/865351) is compatible for use with Access Point Controller 862147, Release B.00.19 or latest release and Access Point Controller 865346, Release C.00.04 or latest release.

The MX40 Patient Cables are 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, MX800/700/600 with MMS or X2 and MX400/450/500/550 with MMS or X2.

Note— 865350 and 865351 Smart-hopping devices operate on Smart-hopping Network infrastructure only. 865352 WLAN devices operate on 802.11 wireless network infrastructure only.

What's New?

This section lists the most important new features and improvements to the MX40 and its user interface (IntelliVue Information Center iX revision dependent). Further information is provided in other sections of this book.

New Features and Enhancements

- **Choice of Masimo SET SpO_2 measurement technology**
- **Alarm generation from Pulse measurement when ECG is not being monitored**
- **Configurable severity for No Pulse INOP condition**
- **Configurable Minimum QRS Detection Threshold**

  PIC iX Release C.03 provides a configuration for the MX40 default value for a minimum QRS detection threshold. The QRS detection threshold defines the value above which a QRS signal is counted. Configuring a minimum QRS detection threshold can prevent P-waves, T-waves and noise from being detected as QRS complexes.

2 What's New?

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.

Warnings

- The MX40 operates exclusively via a wireless network connection, therefore, it should not be used for primary monitoring in applications where momentary loss of the ECG is unacceptable at the Information Center. It sends ECG and, optionally, SpO_2 and/or respiration rate data to the Information Center, where the Information Center displays real-time patient data, provides alarm annunciation, data storage and review applications. The ECG waveform data, technical alarms (INOPs) can always be viewed on the MX40 regardless of the connection to the Information Center.

  A wireless patient monitoring system will never be as reliable as a patient monitoring system that transmits its signal through a wire, due to the inherent nature of radio frequency and the many variables that affect over-the-air communication. This factor should be considered when electing to monitor patients using wireless technologies. If occasional loss of ECG monitoring at the Information Center is not clinically acceptable for certain patients, alternatives must be sought. As the IntelliVue MX40 does not provide a wired network connection, we would recommend the use of an IntelliVue patient monitor with a wired connection to the Information Center for these patients.
- 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.
- This device is not for patient use when connected to a service computer via the USB port.
- 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 “Reducing Electromagnetic Interference” on page 175. 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 screen 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.
- If the MX40 displays a SW License Required message (English text only), 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.

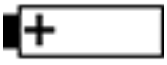
Cautions

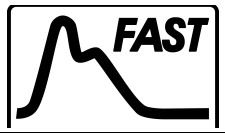
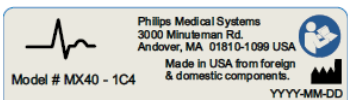
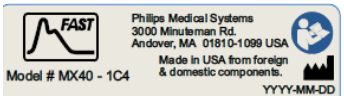
- Philips recommends that when using a pouch to attach the MX40 to your patient that you consider your patient's condition and are careful about the placement of the straps as the straps could present a strangulation hazard.
- Do not use pneumatic tube systems to transport this device or the rechargeable lithium-ion battery. Damage may result.

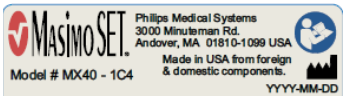
Safety Symbols & Other Marks

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** **Industry Canada Number**
GMDN:	**Global Medical Device Nomenclature**
	**Federal Communications Commission** **Declaration of Conformity**
	**Rechargeable Battery**
	**CE Mark (MX40)** Compliance to Council Directive 93/42/EEC (Medical Device Directive) and the European Radio Equipment Directive (RED), 2014/53/EU
	**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. 2002/96/EC (Waste Electrical and Electronic Equipment).
	**Refer to Instruction Manual/Booklet.**
	**Prescription Device** U.S. Federal Law restricts this device to sale by or on the order of a physician

Label	Definition
	**Wi-Fi Alliance Certification**
	**CSA Mark** Certified by CSA to the applicable Canadian and US standards
	**Defibrillation Proof** Patient connections are protected against defibrillation (DEFIBRILLATION-PROOF) and are a TYPE CF APPLIED PART.
Service #:	**Service Identification Number** Used to identify the equipment during a call to Philips Healthcare (Service)
Model #	**Model Identification Number** Used to identify the equipment during a call to Philips Healthcare (Service).
SN	**Serial Number** Used to identify the equipment during a call to the Philips Healthcare (Service).
REF	**Reference Number** Indicates Philips Product Number
MAC	**MAC Address**
	**Manufacturer and Date of Manufacture** Date of Manufacture: yyyy - month - day
	**Battery Polarity**
IPX7	**IPX Waterproof Rating** Protected against the effects of temporary immersion in water.
	**2D Barcode**

Label	Definition
	**UL Listed Device** Listed by Underwriters Laboratories
	**Caution!** See *Instructions for Use.*
	**Follow Operating Instructions**
	**Package of 1 Part Number** Used to identify the equipment during a call to the Philips Healthcare (Service).
	**Package of 3 Part Number** Used to identify the equipment during a call to the Philips Healthcare (Service).
	**Battery Part Number** Used to identify the equipment during a call to the Philips Healthcare (Service).
	**MX40 ECG Only**
	**MX40 FAST SpO2 or FAST SpO2 Ready**
	**MX40 Masimo SET SpO_2**
	**Primary Label Markings for MX40 ECG Only Hardware**
	**Primary Label Markings for MX40 FAST SpO_2 Hardware**

Label	Definition
	**Primary Label Markings for MX40 Masimo SET SpO_2 Hardware**
	**Regulatory Compliance Mark (RCM) for Australia** The product is safe to supply to the Australian market.
	GOST 50460-92: Mark of Conformity for Mandatory Certification

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/Acknowledge 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 —** If appropriate, patients should be informed that the Multi-function button on the MX40 is not the primary method for generating a Nurse Call.

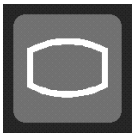
Silence/Acknowledge Alarm Button

Button	Function
	• Initiates a local silence/acknowledgment of all active alarms (IIC). • Initiates a global silence/acknowledgment of all active alarms (PIC iX). • Silences the "Find Device" sound. **Note —** Alarms at the MX40 can be silenced/ acknowledged from the Information Center. When silenced/acknowledged from the Information Center, the alarm sound is not silenced at the Information Center until it receives feedback from the MX40. This may take several seconds.

SmartKeys Button

Button	Function
	Displays the SmartKey Menu on the touch screen.

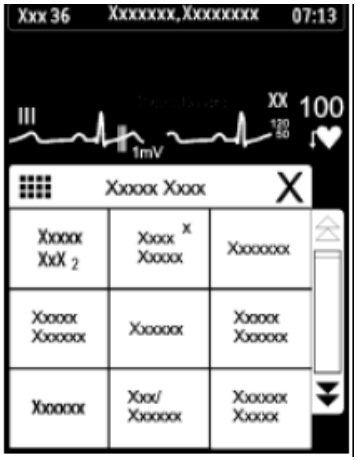
Main Screen Button

Button	Function
	• Activates the display screen if touched for two seconds. • Cycles through the display screens if touched repeatedly. • Resumes from Standby. • When pressed from a sub-menu, returns the display to the Main Screen.

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 SpO2** **Note —** This SmartKey is unavailable when SpO2 mode is continuous.	Starts a manual SpO2 measurement.
	Delayed Record	Starts a delayed recording at the Information Center.
	Alarms	Alarm Volume setting. Review of up to 50 previous alarm conditions (entries are stored during power cycle). Pause Alarms for configured time period (if enabled at the Information Center).
	Mode: Telemtry / Mode: Monitor	Toggles between modes. In Telemetry Mode, display and audio are off; in Monitor Mode, display and audio are always on.
	Standby	Puts the device into Standby locally and at the Information Center. Displays purchased/enabled product options. To resume from Standby, touch the Main Screen button. **Note —** If a battery low condition occurs, Standby is grayed out.

	SmartKey	Function
	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.
	Trends	View up to 24 hours of tabular and graphical trend data (Option C03). One hour tabular trend standard.
	Setup Screen	Determines the time period that the display remains active after user interaction or whether the display is always On or always Off.
	Lock/Unlock	Locks/Unlocks the display.
	Op Modes	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 and the alarm message rotates every 3 seconds.
- A check mark in front of the alarm text signifies that the alarm has been acknowledged by touching the Silence/Acknowledge Alarm button at the MX40 or PIC iX.
- 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. When alarms are paused from the IIC, the display wakes at half brightness to indicate the alarm pause state.
- Local Alarm Audio is off when the alarm volume symbol  is present next to the time. The **Local Audio Off** message is displayed as a reminder that alarms are never annunciated on the MX40 in Telemetry Mode.

Patient Information Area



The Patient Information Area displays the following information:

- Bed Label
- Patient Name (up to 18 characters will display)
- Time

Touching the Patient Information Area displays the **Patient Demogr.** menu which lists the following:

- Patient Name (Last, First, Middle)
- Lifetime ID
- Encounter ID
- Patient Category
- Paced Mode
- Height
- Weight
- Date of Birth
- Gender

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.
3 Pacing algorithm is on. Patient's paced status is unknown.

Display Lock



The Lock symbol appears in the lower left of the display when the MX40 is in a locked state after a configured time of non-use (1-30 minutes, default of 1 minute), or if configured to do so during the start-up process. Locking the display provides additional protection against accidental patient access. The display is unlocked using the SmartKeys menu. Additionally, the MX40 can be configured to require a 3-5 digit numeric only password to unlock the device.

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-ion.

Operating and Navigating

The principal method of operating your MX40 is via the Touch Display. Almost every element on the display 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. This process takes approximately 45 seconds. Subsequent connection to the Information Center then occurs within approximately 30 seconds. 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.

For MX40 WLAN devices, a 

icon will display if AA batteries are inserted into the MX40 to remind the user that only the Philips rechargeable lithium-ion battery pack is to be used.

Warnings

- If the MX40 enters a continuous "boot-up" cycle or the main screen 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, does not update, or the screen elements are non-responsive, remove the device from service and contact your service personnel.
- Should the MX40 fail its alarm sound test (no sound played) or the **Speaker Malfunct** INOP is displayed, remove the device from use and contact Service.

Ensure that your MX40 connects to the Information Center. You can verify this by confirming the following:

- the bed label appears in the top left corner of the display.
- the **No Central Monit.** INOP is no longer displayed and has been replaced by **Local Audio Off**.
- device sounds have ceased, and after one minute (configurable) the display is no longer active.

Check that the above actions occur and that you are connected to the Information Center when in the wireless coverage area. If you are not in range of the Information Center, the device continues to sound and the display remains active.

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

On a daily basis, the clinician should inspect the MX40 and accessories. Replace any damaged equipment or accessories.

Note — A successful power-on self test transitions 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.

Touch Sensitive Display

The display area of the MX40 is touch sensitive and can be touched with your fingertip or thumb through the Philips Waterproof Carrying Pouch or medical gloves. Do not use a pen or stylus. When touched, the element is highlighted. After removing your fingertip or thumb, a white dot is displayed to guide you by showing the location of your touch. When the display is locked, a red dot is displayed.

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**. To provide additional security to prevent patient access, the MX40 can be configured to require a 3-5 digit numeric only password to unlock the device. To unlock the display, the password must be entered every time the configured time of non-use is exceeded.

Display Auto-Lock

The display automatically locks when there is no interaction for the configured time period (1-30 minutes with a default of 1 minute), or if configured to do so during the start-up process.

Function	Display Locked / Display On	Display Locked / Display Off	Display Unlocked / Display On	Display Unlocked / Display Off
Display Touch	No	No	Yes	No
Main Screen Button	No	Yes	Yes	Yes
SmartKeys Button	Yes	No	Yes	No
Silence/ Acknowledge Alarm 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

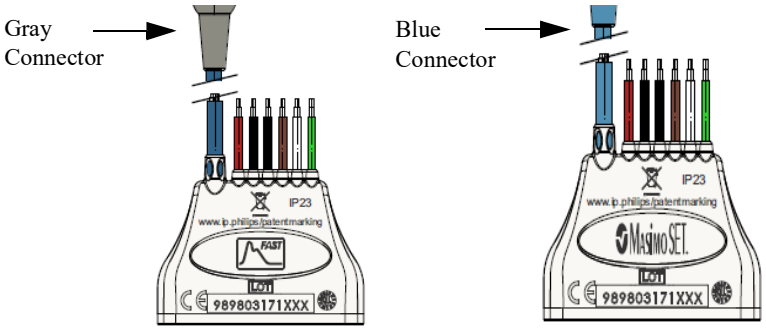
The display of your MX40 is configured/can operate in one of five available orientations:

- Portrait - No Waveforms and six Numerics (PIC iX only)
- Portrait - One Waveform and four Numerics
- Portrait - Two Waveforms and two Numerics (IIC Release N and PIC iX only)
- Landscape - Two Waveforms and three Numerics (IIC Release N and PIC iX only)
- Portrait - Viewable Chest Diagram and two Numerics

Identifying the SpO_2 Patient Cable Type

The patient cable with SpO_2 is available in two versions, Philips FAST and Masimo SET. Each cable contains the markings as shown in the diagram below.

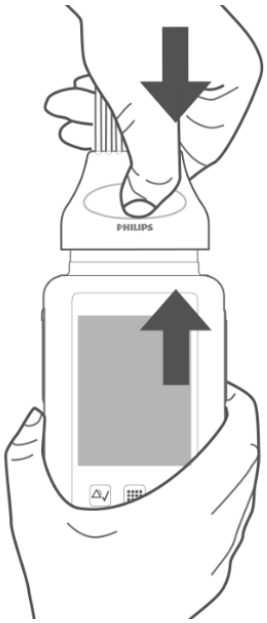
Note — For more information on cable/device identification, see the MX40 SpO_2 Option Quick Card, p/n 4535 648 13471. Also refer to "Safety Symbols & Other Marks" on page 11.



Note — The Philips FAST patient cable is not compatible with Masimo SET devices. The Philips Masimo SET patient cable is not compatible with Philips FAST devices. An **Invalid Leadset** INOP will display, along with instruction to connect the proper patient cable.

Connecting/Disconnecting the Patient Cable

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

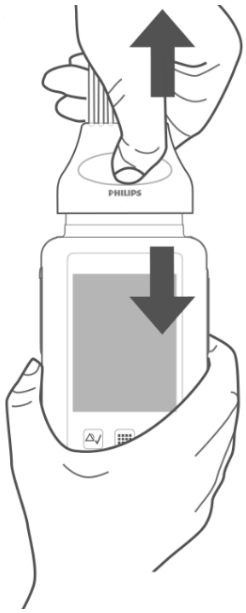


When connecting to the MX40, there is a slight clicking sound that signifies that the cable is securely connected.

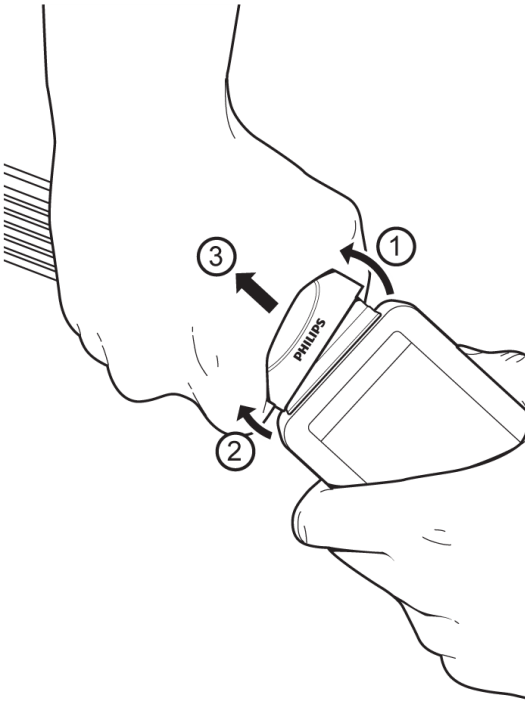
Caution

To avoid dislodging the gasket in the patient cable, use a straight-on approach when attaching. Do not use a pivot motion to attach the patient cable connector to the MX40.

Typically, the patient cable may be disconnected as shown below.



During initial use of the MX40, the secure connection between the patient cable and the device may be difficult to disconnect. Should this occur, use the alternative procedure shown below.



Caution

Never disconnect the patient cable by pulling on the leadwires or the SpO_2 adapter cable, as this may damage the wires over time.

Changing Measurement Settings

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

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.

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 or iX) are reflected at the MX40 when connected on the network.
Primary (used for arrhythmia analysis only) (Set at IIC Release N or PIC iX. View 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) (Set at IIC Release N or PIC iX. View 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 (Set at IIC Release N or PIC iX)	On, Off, Unconfirmed (PIC iX only)
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
ECG	Set ECG On/Off
New Lead Setup	When IntelliVue Patient Monitor lead sets are in use, select 3-wire, or 5-wire.
Va Lead (6-lead only)	Shows position of Va, or Ca, electrodes. Choices are V1-V9, v3R, V4R, V5R. Configured at IIC/PIC iX.
Vb Lead (6-lead only)	Shows position of Vb, or Cb, electrodes. Choices are V1-V9, v3R, V4R, V5R. Configured at IIC/PIC iX.
Change Numeric	Selects parameter numeric to display in place of current numeric.

Note — ECG monitoring is turned off when the SpO_2 only adapter accessory is attached to the MX40. When a battery change occurs, ECG monitoring resumes if the SpO_2 only adapter accessory is no longer attached.

Waveform Settings at the MX40

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

Note — Primary or secondary waveform configuration changes made at the Information Center change what is displayed on the MX40. But changes made locally at the MX40 do not affect settings at the Information Center. Selecting Pleth or RESP to display at the Information Center affects ECG wave storage for future review at the Information Center.

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, MN1500, 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 TELE BATTERY LOW, TELE BATT EMPTY, REPLACE TELE BATT, or TELE BATTERY TEMP alarm, the batteries must be promptly replaced. If these conditions are not corrected, they will result in a device shutdown and cessation of monitoring. These INOPs also apply when monitoring with Cableless Measurements.
- Disposable batteries should be removed from the MX40 at the end of the battery's useful life to prevent leakage.

- Use only the Philips manufactured Rechargeable Lithium-ion Battery.
- Do not use other types of rechargeable batteries. Other types of rechargeable batteries will adversely affect:
  - Battery gauge performance
  - Battery low warnings
  - Battery life performance
- Do not store batteries in the MX40 in a reverse polarity position. This can cause leakage and corrode the battery terminal. This corrosion can create a short in the battery adapter which can cause the batteries to overheat.
- If battery leakage should occur, use caution in removing the battery. The leaked substance may cause eye or skin irritation. Avoid contact with skin. Wash hands. Replace the battery tray if exposed to battery leakage. Continued use increases the risk of batteries shorting and overheating, potentially resulting in burns to the user.
- To eliminate the risk of electrical shock or burn, do not carry loose batteries on your person, e.g. in clothing pockets.
- Use of AA Lithium batteries or batteries with terminal voltage >1.6V may cause damage to the device.

Caution

- When monitoring with the WLAN version of the MX40 (Model 865352), the lithium-ion rechargeable battery is the only approved power source. Use of AA disposable batteries is not supported.

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 90% 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 BATTERY TEMP** **TELE REMOVE BATT** **Note —** When the above INOPs occur, the Tele Battery Low INOP is suppressed.

Rechargeable batteries are charged using the IntelliVue CL Charging Station. For information on charging station use, see "Charging Lithium-ion Rechargeable Batteries" on page 166).

Note — The battery capacity of rechargeable batteries degrades over time and number of recharge cycles. Toward the end of its useful life, the battery capacity may be reduced by 30%. If this reduced battery life is unacceptable based on your use model, Philips recommends replacing the rechargeable battery sooner.

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 90%. 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 charged to at least 90% 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's batteries are removed 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.

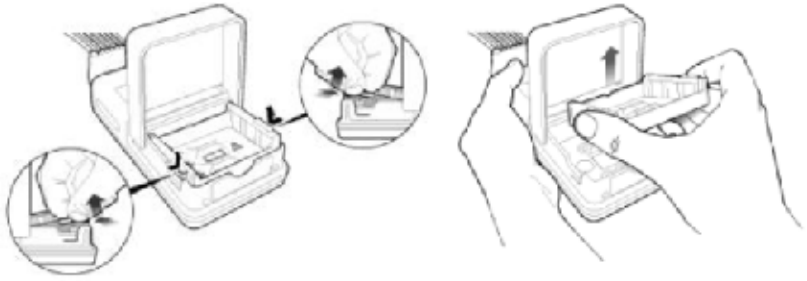
Inserting Batteries

Insert the rechargeable lithium-ion battery using the following procedure:

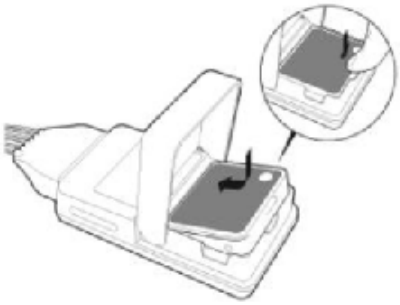
1 Open the battery compartment by lifting up on both bottom sides of the compartment door.



2 Remove the AA battery tray if present.



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



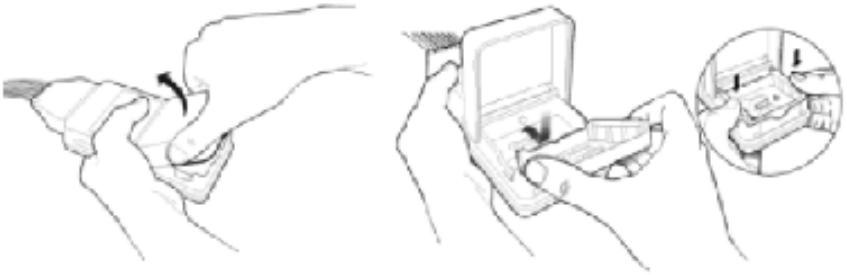
4 Close the battery compartment door.

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

Insert AA 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.



Caution

The MX40 Battery Adapter Tray requires routine inspection, and will require replacement when visible signs of wear are present, including corrosion, cracks, bends, crimping, or curling that can lead to a battery short and overheating, or prevent disposable batteries from remaining securely in the tray. It is recommended that the MX40 Battery Adapter Tray be replaced every 12 months or when visible wear is recognized. A date code is included on the Battery Adapter Tray to help you identify the 12-month time period.

3 Insert three Duracell 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. Use of AA batteries is not supported with the WLAN MX40 (Model Number 865352). Use only the rechargeable lithium-ion battery.

4 Close the battery compartment door.

5 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 AA batteries, open the battery compartment door and push from the opening at the bottom of the compartment to pop the batteries out. To remove the rechargeable battery, open the battery compartment door and lift up on the raised tab on the battery to release it from the battery compartment. Device settings (patient cable type, SpO_2 mode, volume, etc.) are retained when the batteries are removed.

Important— Do not use AA batteries that have different energy levels remaining. Fresh AA batteries are recommended for each new application.

Cautions

- 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.
- Failure to remove the rechargeable battery from the MX40 when the device is not in use may result in damage to the battery, including reduced capacity, inaccurate charge status indicator, failure to charge, and failure to function in the MX40.

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.

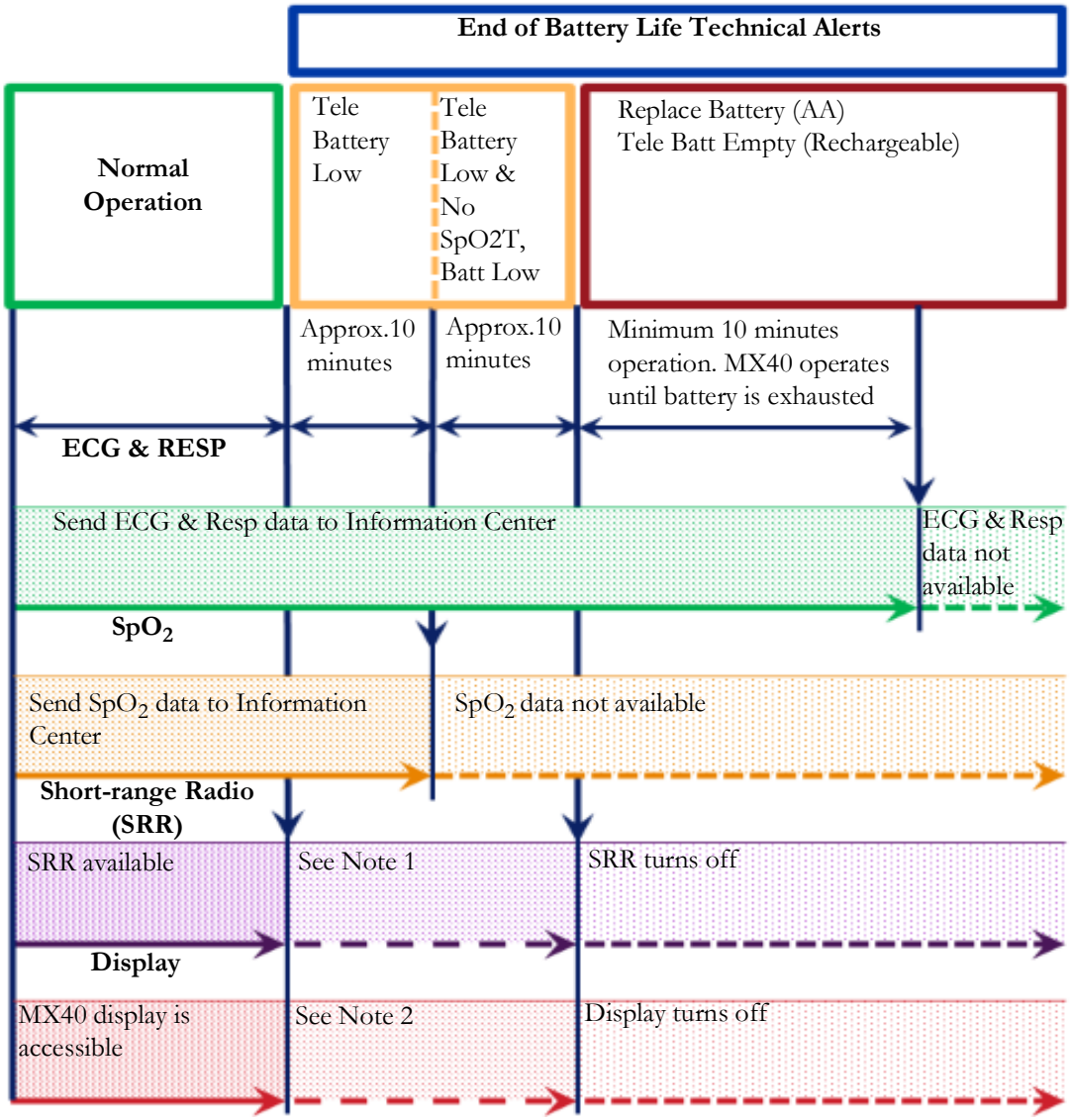
When the MX40 is initially powered-on, it takes approximately 25 seconds for the indicator to populate. During this time, the indicator displays a ? in the battery icon.

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

When monitoring SpO_2 and the battery reaches a low battery state, the **Tele Battery Low** INOP is displayed for approximately 10 minutes. After this time period, **No SpO2T, Batt Low** and **Tele Battery Low** are displayed for an additional 10 minutes (approximate). If you need to continue to monitor SpO_2, replace your batteries during the initial **Tele Battery Low** period. Once the time period has elapsed, a 3rd INOP is displayed - **Tele Replace Batt/Tele Batt Empty**. This INOP is displayed for at least 10 minutes, but can also display for several hours depending on your environment. During the **Tele Replace Batt/Tele Batt Empty** period, the MX40 will continue to send ECG monitoring information to the Information Center for as long as possible. Once battery power is completely depleted, monitoring will stop completely and 2 INOPs are displayed at the Information Center **Replace Tele Batt/Tele Replace Batt** (or **Tele Batt Empty**) and **No Signal/ No Data Tele**. Failure to replace battery power in a timely manner will cause monitoring and physiological alarms to cease.

MX40 Performance at End of Battery Life

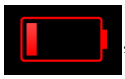
The diagram below is for the MX40 operating in Telemetry Mode, using the specified batteries only. The timing may differ in Monitor Mode, as the device is consuming much more battery power and is also affected by lithium-ion battery age and AA battery quality.



Note 1— If the SRR is already connected, SRR connectivity continues. In this state, it is not possible to start a new SRR connection.

Note 2— If the display is already turned on, the display will dim, but will continue to function. In this state, it is not possible to turn the display on if it is off.

Note 3—If the Tele Battery Low INOP occurs and then the MX40 disconnects from the network, the behavior and timing described in the diagram above does not apply. The screen activates to show a large

red battery icon  , and the device plays an escalating double beep sound to indicate that it is disconnected from the network. Alarm and SpO_2 monitoring are no longer available locally. The MX40 will attempt to reconnect to the Information Center to transmit the battery INOP condition.

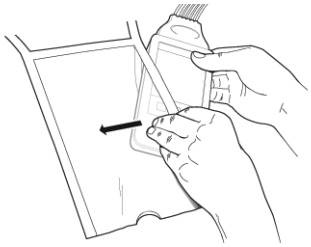
Pouch Use

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 Chapter 15, "Accessories" for ordering information.

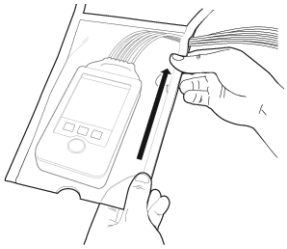
Securing the Pouch

1 See the *Carry Pouch, Waterproof, Instructions for Use*, P/N 453564380391, for more information.

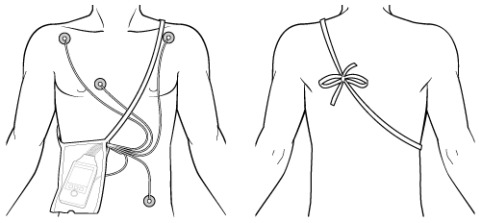
2 Insert the MX40 into the pouch with lead wires and SpO_2 sensor cable, if used, exiting from the side opening of the pouch. Pinch the velcro enclosures together to close the pouch around the cables.



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.

Cautions

- The pouch is designed to be used exclusively with the MX40. It is not intended to be used to store patient's personal devices, e.g. cell phones.
- Philips recommends that when using a pouch to attach the MX40 to your patient, consider your patient's condition and be careful about the placement of the straps, as the straps could present a strangulation hazard.

Showering

Warning

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

Cautions

- 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/disposable batteries and adapter tray.

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 battery/disposable 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/disposable batteries.

Caution

The MX40 should not be used for monitoring if the battery compartment is wet. Remove the batteries and adapter tray 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 on page 159 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, however audible alarm indicators are not annunciated. 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. Be aware that when the display is on and alarms are audible, battery consumption will increase.

To use Monitor Mode:

1 Press the SmartKeys Button.

2 Press the **Mode: Telemtry / Mode: Monitor** SmartKey and choose **Mode: Monitor**.

Note—Anytime you are disconnected from the Information Center, the MX40 automatically activates Monitor mode. The MX40 reverts to Telemetry mode when connection to the Information Center is re-established. If the MX40 is not connected to the Information Center, the alarm is only announced locally. For additional information regarding battery status during Monitoring Mode, see Note 3 under the "Battery Charge Status" section starting on page 32.

Standby Behavior

When the MX40 is placed in Standby, either at the Information Center or at the device, the measurement waveform and numeric settings at the MX40 revert to their default settings.

The Standby time period may differ between the device and the default setting at the Information Center. The duration is determined by the location of the Standby selection, i.e. placing the MX40 in Standby mode at the device or at the Information Center. When the MX40 comes out of Standby at either location, the device is activated in both locations.

MX40 WLAN devices (p/n 865352) resume from Standby automatically if the PIC iX enters Local Mode. For more information on Local Mode operation, see the *Patient Information Center iX Instructions for Use* or *Online Help*.

If a **Tele Battery Low** INOP condition occurs during a Standby or Transmitter Off state, the MX40 will attempt to resume from Standby and reconnect to the Information Center to transmit the INOP condition. This requires the device to be in the coverage area in order to reconnect to the Information Center and transmit the battery INOP. This may result in the MX40 resuming from Standby sooner than anticipated, but this behavior prevents battery exhaustion while not connected to the Information Center.

To Resume Monitoring from Standby:

1 Press the blue Main Screen Button, or

2 Disconnect/reconnect the MX40 patient cable.

Radio Frequency (RF) Auto Shutoff Behavior

If RF Auto Shutoff is enabled at the Information Center, wave data, alarm detection, monitoring, and connection to the Information Center shuts off after the combination of 10 minutes of a Leads Off condition, no continuous SpO_2 measurement, and no short-range radio communication. A **Transmitter Off** INOP is displayed at the Information Center. To resume communication with the Information Center, reconnect the MX40 patient cable. When operating in SpO2 Only Mode, the setting for this configuration choice is not used. The connection to the Information Center continues, regardless of measurement frequency, i.e. continuously, manually, or automatically.

Briefing the Patient

Warning

Patients should be instructed not to interact with the 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 (IIC)” on page 144 and “Global Settings (PIC iX)” on page 152.

4 Basic Operation

Alarms

The section provides alarm information that applies to the MX40. Measurement-specific alarm information is discussed in the sections on individual measurements. A listing of Informational Messages and their associated conditions is also provided.

Alarms Overview

The MX40 has two different types of alarms: physiological alarms and technical alarms (INOPs).

Once alarm settings are communicated to the MX40 from the Information Center, alarms are available locally on the MX40 regardless of network connection to the Information Center. Alarm settings are as configured by the Information Center. Changes to physiological alarm settings can only be made at the Information Center. Audible alarm indicators are annunciated only when operating in Monitor Mode or when the MX40 is not networked connected.

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)
- **Leadset Unplugged** (Patient Information Center iX revision dependent)
- **SpO2T No Pulse** (Patient Information Center iX revision dependent)

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 additional ECG Performance specification information see the *Patient Information Center iX Instructions for Use.*

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 at the MX40. Upon activating the screen, the alarm volume is set to zero.

Alarm Message

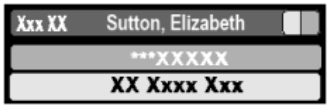
An alarm message text appears in the alarm status area at the top of the screen indicating the source of the alarm. The background color of the alarm message matches the alarm priority: red for red alarms, yellow for yellow alarms, light blue for standard INOPs, red for red INOPs and yellow for yellow 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. If more than one alarm is present, there is a downward facing arrow symbol at the right side and the active alarm/inop messages rotate every three seconds.

Alarm limit violation messages on the MX40 are displayed in extended text format, for example **** <SpO2 Label> xx < yy**. At the Patient Information Center iX, they can be configured as either extended or standard text format.

Alarm Indicator

An Alarm Indicator on the MX40 main screen 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 an unacknowledged 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 physiological alarms are present, and no INOPs, the physiological 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 physiological 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.

Alarm Priority

The following rules apply when determining what alarm or INOP has the highest priority:

Rule 1: Red alarms are higher priority than red severe INOPs. Red severe INOPs are higher in priority than yellow cardiac alarms. Yellow cardiac alarms are higher in priority than yellow non cardiac alarms. Long yellow non-cardiac alarms are higher in priority than Severe yellow INOPs. Severe yellow inops are higher in priority than severe cyan inops. Severe cyan INOPS are higher in priority than Hard INOPs. Hard INOPs are higher in priority than soft INOPs.

Rule 2: When there is more than one highest priority level alarm, cardiac alarms have higher priority over non-cardiac alarms. When there are multiple yellow alarms, alarm text rotates and the alarm sound annunciated is medium priority yellow.

Rule 3: When there is more than one highest priority level cardiac alarm (or more than one highest priority non-cardiac alarm if no cardiac alarms are present), alarm text rotates.

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 every two seconds.
- Two-star yellow alarms and yellow INOPs: A lower pitched sound is repeated every four 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 four 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 physiological alarms and INOPs, touch the Silence/Acknowledge Alarm button. This switches off the audible alarm indicators, if present, and acknowledges alarm messages at the MX40 and at the Patient Information Center iX.

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.

For non-latched alarms, if the alarm condition is no longer present, all alarm indicators stop and the alarm is reset. Red alarms are latched at the PIC iX as long as the MX40 is connected to the PIC iX. Red alarms are latched at the PIC regardless of connection to the PIC and the audible alarm indicator and message will continue until silenced/acknowledged.

Switching off the alarms for the measurement in alarm, or switching off the measurement itself, does not remove the alarm indication. It must also be acknowledged.

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.

Note — When wirelessly connecting to an assigned device, the MX40 only responds to an alarms paused initiated at the Information Center after the short-range radio link quality test time period is completed.

To Pause All Alarms

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

While Alarms are Paused

- In the alarm field, the MX40 displays the message ALARMS PAUSED 1:28 or ALARMS OFF, together with the alarms paused symbol or the alarms off symbol. The display is lit at half brightness for the duration of the pause time.
- 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.

Warning

If connection to the Information Center is lost during an alarms paused period, upon reconnection, alarms remain paused at the Information Center for the set time. You can resume alarms from the Patient Window at the Information Center at any time.

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 setting the high alarm limit to the maximum of 100 switches the high alarm off, or setting the low alarm limit to the minimum of 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.



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 or transfer a patient, or if you change to Demonstration Mode. Alarm data survives power cycling, e.g. battery change.

Review Alarms Window

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

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

Note — Alarms that occur during an alarm suspend period or during a period when the MX40 is not connected to the Information Center, will appear in the Review Alarms window, however, they are not communicated to the Information Center.

Alarm Reminders

The MX40 provides alarm reminders when operating with IIC Release N or PIC iX. The reminder time period is selected at 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 Silence/Acknowledge Alarm button. The alarm latching setting is a configuration setting at the Information Center.

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), the device restores the latest alarm settings from the Information Center. When a patient is discharged, the device restores the default settings from the Information Center.

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

Warning

If a "**No Alarm Display**" message appears after a battery change, physiological alarms are not active. Remove the device from use and contact your service personnel. (PIC iX only.)

Physiological Alarms

Red physiological alarms indicate a life-threatening situation, and yellow physiological alarms indicate a less urgent situation such as heart rate beyond limits.

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

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

Note — Alarm tones are always available at the Information Center. On the MX40 they are only audible in Monitor Mode.

Note — The physiological alarm messages displayed on the MX40, release B.01 or earlier, use a short text format. The physiological alarm messages displayed on the MX40, release B.02 or later, use an extended text format.

Alarm Message	From	Condition	Indication
* AFIB	ECG/Arrhythmia	An irregular rhythm of beats labeled as N **AND** variability in PR intervals **AND** P-wave variability (For adult patient category only)	yellow alarm lamp, short yellow alarm tone
*** Apnea x:yy *** Apnea >10 min (PIC iX only)	Resp	Respiration has stopped for longer than the preset apnea time. "x:yy" denotes the Apnea duration in minutes and seconds	numeric flashes, red alarm lamp, alarm tone
*** Asystole	ECG	No beat detected for a period > the asystole threshold (2.5 to 4.0 seconds)	numeric flashes, red alarm lamp, alarm tone
*** Brady/P xxx < yyy (PIC iX ≥ C.02)	SpO_2/Pulse	Pulse rate < the extreme bradycardia alarm limit. xxx denotes the lowest measured value; yyy is the extreme bradycardia limit.	numeric flashes and alarm limit is highlighted, red alarm lamp, alarm tone
*** Desat xx < yy	SpO_2	The SpO_2 value has fallen below the desaturation alarm limit. xx denotes the lowest measured value, and yy is the desaturation limit.	numeric flashes, red alarm lamp, alarm tone
* End AFIB	ECG	Atrial Fibrillation no longer detected for the Afib end delay time (For adult patient category only)	yellow alarm lamp, short yellow alarm tone
* End Irregular HR	ECG	Irregular HR rhythm no longer detected for the irregular HR end delay time	yellow alarm lamp, short yellow alarm tone
* /** HR xx > yy	ECG	Heart Rate > the high HR limit	numeric flashes and high limit is highlighted, yellow alarm lamp, alarm tone. If configured to short yellow, the sound switches off after 5 seconds. If configured to **, the alarm sound is continuous. Yellow HR alarms are always ** when in Cardiotach mode (Arrhythmia Off).

Alarm Message	From	Condition	Indication
* /** HR xx < yy	ECG	Heart Rate < the low HR limit	numeric flashes and low limit is highlighted, yellow alarm lamp, alarm tone. If configured to short yellow, the sound switches off after 5 seconds. If configured to **, the alarm sound is continuous. Yellow HR alarms are always ** when in Cardiotach mode (Arrhythmia Off).
* Irregular HR	ECG/Arrhythmia	An irregular rhythm of beats labeled as N (irregular R-R intervals changes greater than 12.5%)	numeric flashes, yellow alarm lamp, short yellow audible alarm
* Missed Beat	ECG/Arrhythmia	No beat detected for a period > 1.75 times the average R-R interval for HR < 120, **OR** no beat detected for > 1 second with HR > 120 (Paced mode Off)	numeric flashes, yellow alarm lamp, short yellow audible alarm
* Multiform PVCs	ECG/Arrhythmia	The occurrence of two differently shaped beats labeled as **V** within the last 60 beats **AND** each occurring at least twice within the last 300 beats	numeric flashes, yellow alarm lamp, short yellow audible alarm
** NBP xxx > yyy	NBP	The measured NBP value is above the high alarm limit. **s**, **d**, or **m** after the label indicates whether the systolic, diastolic or mean pressure has crossed the limit.	numeric flashes and high limit is highlighted, yellow alarm lamp, alarm tone
** NBP xxx < yyy	NBP	The measured NBP value is below the low alarm limit. **s**, **d**, or **m** after the label indicates whether the systolic, diastolic or mean pressure has crossed the limit.	numeric flashes and low limit is highlighted, yellow alarm lamp, alarm tone
* Non-Sustain VT	ECG/Arrhythmia	A run of consecutive beats labeled as **V** with run length < the V-Tach Run Limit **AND** ventricular HR > the V-Tach HR limit	numeric flashes, yellow alarm lamp, short yellow audible alarm
* Nurse Call	MX40	The multi-function button has been activated by a user. This results in a Nurse Call alarm and generates a recording depending on configuration at the Information Center.	yellow alarm lamp

Alarm Message	From	Condition	Indication
* Pacer Not Capt	ECG/Arrhythmia	No beat detected for a period > 1.75 times the average R-R interval **AND** pace pulse(s) detected. (Paced mode On)	numeric flashes, yellow alarm lamp, short yellow audible alarm
* Pacer Not Pacing	ECG/Arrhythmia	No beat detected for a period > 1.75 times the average R-R interval **AND** no pace pulse(s) detected. (Paced mode On)	numeric flashes, yellow alarm lamp, short yellow audible alarm
* Pair PVCs	ECG/Arrhythmia	Two consecutive beats labeled as **V** between two beats not labeled as **V**	numeric flashes, yellow alarm lamp, short yellow audible alarm
* Pause	ECG/Arrhythmia	No beat detected for a period > the pause alarm threshold (1.5 to 2.5 seconds). When the setting for Pause and Asystole are both set at 2.5 seconds, if an event occurs at 2.5 seconds, the Asystole alarm will be annunciated.	numeric flashes, yellow alarm lamp, short yellow audible alarm
** Pulse yyy > xxx (PIC iX ≥ C.02)	SpO_2/Pulse	Pulse rate higher than Pulse High alarm limit.	numeric flashes, yellow alarm lamp, yellow audible alarm
** Pulse yyy < xxx (PIC iX ≥ C.02)	SpO_2/Pulse	Pulse rate lower than Pulse Low alarm limit.	numeric flashes, yellow alarm lamp, yellow audible alarm
* PVCs/min xxx > yyy	ECG/Arrhythmia	Within 1 minute, the number of beats labeled as **V** > the PVCs/min limit	numeric flashes, yellow alarm lamp, short yellow audible alarm
** QTc xxx > yyy	ECG/QT	QTc value has exceeded the QTc high limit for more than 5 minutes	numeric flashes, yellow alarm lamp, alarm tone
** ΔQTc xxx > yyy	ECG/QT	ΔQTc value has exceeded the ΔQTc high limit for more than 5 minutes	numeric flashes, yellow alarm lamp, alarm tone

Alarm Message	From	Condition	Indication
* R-on-T PVCs	ECG/Arrhythmia	For HR < 100, a beat labeled as V with R-R interval < 1/3 of the average R-R interval followed by a compensatory pause > 1.25times the average R-R interval **or** 2 such beats labeled as V without a compensatory pause occurring within 5 minutes of each other (Note: When HR > 100, 1/3 of the R-R interval is too short for detection)	numeric flashes, yellow alarm lamp, short yellow audible alarm
** RR yyy > xxx (PIC iX only)	RESP	The respiration rate has exceeded the high alarm limit.	numeric flashes and high limit is highlighted, yellow alarm lamp, alarm tone
** RR yyy < xxx (PIC iX only)	RESP	The respiration rate has dropped below the low alarm limit.	numeric flashes and low limit is highlighted, yellow alarm lamp, alarm tone
* Run PVCs High	ECG/Arrhythmia	A run of > 2 consecutive beats labeled as **V** with run length ≤ Vent rhythm limit **AND** ventricular HR ≤ V-Tach HR limit	numeric flashes, yellow alarm lamp, short yellow audible alarm
** <SpO2 Label> xx>yy	SpO_2	The arterial oxygen saturation has exceeded the high alarm limit.	numeric flashes and high limit is highlighted, yellow alarm lamp, alarm tone
** <SpO2 Label> xx<yy	SpO_2	The arterial oxygen saturation has fallen below the low alarm limit.	numeric flashes and low limit is highlighted, yellow alarm lamp, alarm tone
**ST Multi <n>,<n>	ECG/ST	Two contiguous ST leads <n> and <n> have exceeded elevation or depression limits for more than 60 seconds. The limit violations for both leads must be with respect to the same limit; either both above the high limit or both below the low limit.	numeric flashes, yellow alarm lamp, alarm tone
**STE <n>,<n>	ECG/ST	Two contiguous leads <n> and <n> are above their respective STE limits	numeric flashes, yellow alarm lamp, alarm tone

Alarm Message	From	Condition	Indication
** ST-<n> xx > yy	ECG/ST	The ST elevation in lead <n> is higher than the limit. Lead is not contiguous with any other lead.	numeric flashes and high alarm limit is highlighted, yellow alarm lamp, alarm tone
** ST-<n> xx < yy	ECG/ST	The ST depression in lead <n> is lower than the limit. Lead is not contiguous with any other lead.	numeric flashes and low alarm limit is highlighted, yellow alarm lamp, alarm tone
* SVT	ECG/Arrhythmia	A run of consecutive beats labeled as S with run length ≥ the SVT run limit **AND** heart rate > the SVT HR limit.	numeric flashes, yellow alarm lamp, alarm tone
*** Tachy/P xxx > yyy (PIC iX ≥ C.02)	SpO_2/Pulse	Pulse rate > the extreme Tachycardia alarm limit. xxx denotes the highest measured value; yyy is the extreme tachycardia limit.	numeric flashes and alarm limit is highlighted, red alarm lamp, alarm tone
*Vent Bigeminy	ECG/Arrhythmia	A dominant rhythm of beats labeled as **N, V, N, V, N**	numeric flashes, yellow alarm lamp, short yellow audible alarm
*** Vent Fib/Tach	ECG	Fibrillatory wave (sinusoidal wave between 2 – 10 Hz) for 4 consecutive seconds.	numeric flashes, red alarm lamp, alarm tone
* Vent Rhythm	ECG/Arrhythmia	A run of consecutive beats labeled as **V** with run length > the Vent rhythm limit **AND** ventricular HR ≤ the V-Tach HR limit	numeric flashes, yellow alarm lamp, short yellow audible alarm
* Vent Trigeminy	ECG/Arrhythmia	A dominant rhythm of beats labeled as **N, N, V, N, N, V, N, N**	numeric flashes, yellow alarm lamp, short yellow audible alarm
*** VTach	ECG, Arrhythmia	A run of consecutive beats labeled as **V** with run length ≥ the V-Tach Run limit **AND** ventricular HR > V-Tach HR limit	numeric flashes, red alarm lamp, alarm tone
***xBrady xxx < yyy	ECG	Heart rate < the extreme Brady limit.	numeric flashes and alarm limit is highlighted, red alarm lamp, alarm tone
***xTachy xxx > yyy	ECG	Heart rate > the extreme Tachy limit.	numeric flashes, alarm limit is highlighted, red alarm lamp, alarm tone

NBP Alarm Priority

The NBP measurement generates low and high limit alarms for systolic, diastolic and mean blood pressure.

Depending on the selected alarm parameter, one, two or all three limit alarms are active in parallel.

If the NBP measurement can derive a mean blood pressure value only and the limits for the mean blood pressure are exceeded, then NBP will alarm on the mean blood pressure independently of the selected alarm parameters (systolic and/or diastolic and/or mean).

The alarm priorities are:

- Mean blood pressure low alarm (highest)
- Mean blood pressure high alarm
- Systolic blood pressure low alarm
- Systolic blood pressure high alarm
- Diastolic blood pressure low alarm
- Diastolic blood pressure high alarm (lowest)

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.
- **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**, and **Leadset Unplugged** INOPs 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
Cannot Analyze ECG **Source - MX40 and Information Center (PIC iX only)**	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.
Cannot Analyze QT	Soft	The QT Arrhythmia algorithm cannot reliably analyze the QT data on any monitored leads.	• Change electrodes and/or electrode position. • Change Primary lead.
Cannot Analyze ST	Soft	The ST Arrhythmia algorithm cannot reliably analyze the ST data on any monitored leads.	• Change electrodes and/or electrode position. • Change Primary lead.

Alarm Text	Priority	Condition	What to do
!! Check Pairing **Source - MX40 and Information Center (IIC only)**	Yellow Technical Alarm	• There is a problem with device assignment. • When the MX40 is wirelessly assigned with an X2 patient monitor (no label) docked with a larger networked MP series monitor, the network connection is lost.	• Check that the bedside monitor or cableless measurement device is correctly assigned. • Select the correct device to be assigned.
Chk PulseT Limits **Source - MX40**	Hard	The HR/Pulse alarm limit is set too high/low for the pulse measurement range.	Set alarm limit within pulse measurement range. Pulse rate measurement range = > 25bpm - < 240 (Masimo SET); > 30bpm - < 300 (Philips FAST).
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 NBP Batt Empty **Source - Cableless Measurement Device**	Hard	CL NBP Pod empty battery condition. Monitoring is not possible.	• Replace CL NBP Pod. • Recharge depleted CL NBP Pod.
cl NBP Batt Low **Source - Cableless Measurement Device**	Hard	CL NBP Pod weak battery condition.	Charge CL NBP Pod.
cl SpO2 Batt Empty **Source - Cableless Measurement Device**	Hard	CL SpO_2 Pod empty battery condition. Monitoring is not possible.	• Replace CL SpO_2 Pod. • Recharge depleted SpO_2 Pod.
cl SpO2 Batt Low **Source - Cableless Measurement Device**	Hard	CL SpO_2 Pod weak battery condition.	Charge CL SpO_2 Pod.

Alarm Text	Priority	Condition	What to do
cl SpO2 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.
Cuff Not Deflated **Source - Cableless Measurement Device**	Severe	Cuff pressure has exceeded the specified safety limit.	Remove cuff and tubing and expel air.
ECG/Arrh AlarmsOff **Source - MX40**	Soft	ECG is turned off. This is normal behavior if operating in SpO_2 only mode.	• Turn on ECG. • Attach ECG/SpO_2 patient cable.
<ECG Lead>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.
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.
Invalid Leadset **Source - MX40**	Hard	• FAST SpO2 leadset attached to MX40 with Masimo SET option. • Masimo SET leadset attached to MX40 with FAST SpO2. (MX40 Revision dependent.)	Replace with compatible leadset.
Leadset Life **Source - MX40**	Soft	The single-patient use leadset has exceeded its limit of 25 cycles.	Replace with new leadset.

Alarm Text	Priority	Condition	What to do
Leadset Unplugged **Source - MX40** **Note —** If supported by your revision of PIC iX, this INOP may also be configured to display as a Red or Yellow Technical Alarm. **Note —** The message will initially display for up to 3 seconds as "ECG Leads Off" at the MX40 and at the PIC iX.	Red or Yellow or Hard Technical Alarm	• Patient cable has been unplugged from the MX40. • Incompatible leadset attached to patient cable. Masimo leadset attached to MX40 with FAST SpO2. (MX40 Revision dependent.)	• Re-attach the patient cable. • Replace the leadset. • Replace with compatible leadset.
Local Audio Off **Source - MX40** **Note —** This is normal operation in Telemetry Mode.	Soft	There is no alarm audio notification when operating in Telemetry Mode.	Change to Monitor Mode.
NBP Cuff Overpress **Source - Cableless Measurement Device**	Severe	Cuff pressure has increased above overpressure safety limits.	Remove cuff and tubing and expel air.
NBP Equip Malf **Source - Cableless Measurement Device**	Hard	• Tubing may be obstructed or kinked. • Hardware malfunction.	• Check tubing. • If condition persists, contact Service.
NBP Interrupted **Source - Cableless Measurement Device**	Hard	The preset maximum time for the total measurement has been exceeded.	Reduce patient movement and avoid interaction with the cuff and tubing.
NBP Measure Failed **Source - Cableless Measurement Device**	Hard	Measurement values cannot be derived.	• Attach cuff to new location on patient. • Replace cuff.
No Alarm Display **Source - MX40**	Soft	No local alarming at the MX40, networked or non-networked.	• IIC - Configuration specific setting. • PIC iX - Contact Service.

Alarm Text	Priority	Condition	What to do
No Central Monit. (appears at MX40 only) **Source - MX40**	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.
No Host Monitoring **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 SpO2T, Batt Low	Hard	Battery power is too low to support SpO_2 measurement.	Insert fresh batteries to continue monitoring SpO_2.
Replace Battery **Source - MX40** **Note —** This INOP may also be configured to display as a Red or Yellow Technical Alarm. This INOP configuration setting also affects the Tele Batt Empty INOP.	Red or Yellow or Hard Technical Alarm, Latched	Disposable battery power is close to depleted. At least 10 minutes of monitoring time remains. Depending on your environment, you may see this message for several hours. Monitoring ceases immediately when batteries are depleted.	To avoid loss of monitoring, replace batteries when this INOP is present.
Resp Equip Malf **Source - MX40**	Hard	• Malfunction in the Resp equipment. • MX40 requires calibration.	Contact Service.
Resp Leads Off **Note —** OR leadsets cannot be used to monitor Resp with the MX40. **Source - MX40**	Hard	Resp lead off.	Re-attach lead to patient.
Some ECG AlarmsOff	Soft	Some ECG alarms have been turned off at the Information Center.	For information only.
Speaker Malfunct **Source - MX40**	Soft	The MX40 Power-on Self Test detected a speaker failure.	• Remove the MX40 from use. • Contact Service.

Alarm Text	Priority	Condition	What to do
<SpO2 Label> **Erratic** (FAST SpO2 only) **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.
<SpO2 Label> **Equip Malf** **Source - MX40**	Hard	Malfunction in the SpO_2 equipment	Contact Service.
<SpO2 Label> **Extd.Update** (FAST SpO2 only) Numeric is displayed with 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.
<SpO2 Label> **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.
<SpO2 Label> **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.
<SpO2 Label> **No Pulse** **Note —** For FAST SpO2 only this INOP may also be configured to display as a Red or Yellow Technical Alarm. **Source - MX40**	Red or Yellow or Hard Technical Alarm	Pulse is too weak or not detectable.	Check connection to patient.

Alarm Text	Priority	Condition	What to do
<SpO2 Label> **No Sensor** **Warning** Silencing this technical alarm turns off the SpO_2 measurement on the MX40 and at the Information Center when operating in Manual or Continuous mode. It does not turn the measurement off when operating in Auto mode. **Source - MX40**	Hard	No sensor attached to SpO_2 device.	Attach SpO_2 sensor.
<SpO2 Label> **NoisySignal** **Source - MX40**	Hard	Excessive patient movement or electrical interference is causing irregular pulse patterns	Reduce movement or electrical noise sources.
<SpO2 Label> **Poor Signal** **Source - MX40**	Soft	Although a measurement may be possible, its accuracy may be reduced due to poor signal quality.	• Apply the sensor according to the manufacturer's instructions. • Relocate the sensor to a different site on the patient.
<SpO2 Label> **Pulse?** (FAST SpO2 only) **Source - MX40**	Hard	The detectable pulsations of the SpO2 signal are outside the specified pulse rate range.	• Check connection to patient. • Avoid excessive motion at the measurement site.

Alarm Text	Priority	Condition	What to do
<SpO2 Label> **Replc Cable** (Masimo SET SpO2 only) **Note —** Depending on PIC iX revision, this may appear there as "Unknown" or "!!Cable life". Contact Service to upgrade your PIC iX to the compatible revision. The MX40 will display "!! ReplcCable" as expected. **Source - MX40**	Hard Yellow	Hard condition - The connected SpO2 sensor cable is approaching expiration. (95%).	Replace Masimo patient cable.
<SpO2 Label> **ReplcSensor** (Masimo SET SpO2 only) **Note —** Depending on PIC iX revision, this may appear there as "Unknown" or "!!Sensor life". Contact Service to upgrade your PIC iX to the compatible revision. The MX40 will display "!! ReplcSensor" as expected. **Warning** Failure to replace the sensor when this condition is present will result in loss of SpO2 monitoring. **Source - MX40**	Hard Yellow Technical Alarm	Hard condition - the connected SpO2 sensor or adhesive life is approaching expiration. (95%). Yellow alarm condition - the connected SpO2 sensor or adhesive life has expired.	Replace sensor.
<SpO2 Label>**Searching** **Source - MX40**	Soft	The patient signal is analyzed, but a valid numeric is not available yet.	Wait for the measurement to complete.

Alarm Text	Priority	Condition	What to do
<SpO2 Label> **Sensor Off** **Note —** The ability of the algorithm to detect this condition depends on the sensor type in use.	Hard	The algorithm has determined that a sensor is connected, but not properly applied to the patient.	• Apply the sensor according to the manufacturer's instructions. • If the condition persists, relocate the sensor to a different site on the patient.
<SpO2 Label> **Sensor Malf** **Source - MX40**	Hard	Malfunction of the SpO_2 sensor/adapter cable	Replace sensor and/or adapter cable.
<SpO2 Label> **Unkn.Sensor** **Source - MX40**	Hard	The connected SpO_2 sensor and/or adapter cable is not supported by the hardware version.	Use specified sensor and/or adapter cable.
<SpO2 Label> **Upgrade** (FAST SpO2 only) **Source - MX40**	Soft	SpO_2 hardware is in upgrade process. SpO_2 Monitoring is not possible.	Wait for the upgrade process to complete.
Tele Batt Empty **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	Lithium-ion battery power is close to depleted. At least 10 minutes of monitoring time remains. Depending on your environment, you may see this message for several hours. Monitoring ceases immediately when battery is depleted.	To avoid loss of monitoring, insert a charged lithium-ion battery pack when this INOP is present.
Tele Battery Low **Source - MX40** **Note —** This INOP may also be configured to display as a Red or Yellow Technical Alarm.	Hard or Soft based on Tele Batt Empty INOP configuration setting (cyan = soft, red or yellow = hard).	• There is < 20 minutes of monitoring time remaining (AA batteries). • Lithium-ion battery level is < 10% or has < 20 minutes remaining time.	• Replace batteries promptly to avoid shutdown and cessation of monitoring. • Insert a charged lithium-ion battery pack.

Alarm Text	Priority	Condition	What to do
Tele Battery Temp **Note —** When the above INOP occurs, the Tele Battery Low INOP is suppressed. **Source - MX40**	Hard	The temperature of the lithium-ion battery is above 55° C or below -5° C.	Remove the current battery from patient use, replace the lithium-ion battery.
Tele Malfunction **Source - MX40**	Hard	MX40 internal malfunction or self-test failure.	Contact Service to replace the MX40.
Tele Check Battery **Note —** When the above INOP occurs, the Tele Battery Low INOP is suppressed. **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 No Signal (appears at the Information Center only) **Note —** When operating with PIC iX, the INOP will display as No Data Tele. **Source - Information Center**	Hard, Latched	• The MX40 is outside the coverage area, or • No batteries in the MX40 • The MX40 is receiving a weak signal for > 10 seconds with high data loss from the AP, 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. • Contact Service
Tele Remove Batt **Note —** When the above INOP occurs all other battery related INOPs are suppressed. **Source - MX40**	Hard, Latched	The temperature of the lithium-ion battery is >60° C and the battery must be removed.	• Remove the current battery from patient use, replace the lithium-ion battery. • Dispose of old battery properly.
Tele Service Batt **Note —** When the above INOP occurs, the Tele Battery LowINOP is suppressed. **Source - MX40**	Hard	The lithium-ion battery has exceeded the maximum charge cycle limit and reached the end of its useful life.	• Replace the lithium-ion battery. • Dispose of old battery properly.

Alarm Text	Priority	Condition	What to do
Tele Weak Signal **Source - MX40**	Soft	• Patient is at out of range of the radio coverage area. • The MX40 is receiving a weak signal for > 6 seconds with high data loss from the AP. • Condition may exist 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.
Transmitter Off **Source - MX40**	Hard	RF Auto Shutoff after 10 minutes of all leads off, no SpO_2 sensor connected, and no short-range radio communication.	Reattach ECG leads to patient.
Unsupported LAN **Source - MX40**	Hard	The MX40 (WLAN) is connected to the Access Point, but cannot obtain an IP address.	Correct the IP address issue.

Informational Messages

The following table lists the Informational Text messages that may appear in the Status Area of the MX40 display.

Information Text	Condition	What to Do...
Check Revisions	The revision of the Information Center that the MX40 is trying to connect to is not supported.	Connect only to supported revisions of the Information Center.
cl NBP assigned	Short-range radio is assigned to an NBP Cableless Measurement Device	Cleared automatically after one minute.
cl SpO2 assigned	Short-range radio is assigned to an SpO_2 Cableless Measurement Device	Cleared automatically after one minute.
Config (flashing text)	The MX40 is operating in Configuration Mode.	Cleared when the MX40 is changed to a different operating mode.
Demo (flashing text)	The MX40 is operating in Demo Mode	Cleared when the MX40 is changed to a different operating mode. Patient monitoring is not possible in Demo Mode. Measurements cannot be performed, and alarms cannot be communicated. Remove and reinsert the battery to resume patient monitoring.
Incompatible Option	Masimo SET or FAST SpO2 device configured with wrong option.	Cleared automatically after temporary display.
No OR-ECG leadset connected	IntelliVue Patient Monitor leadset adapter is in use. This message is a reminder not to use OR-ECG leadsets with the adapter.	Continues to flash as a reminder while the leadset adapter is in use. Cleared when adapter is removed from MX40.
Resp Available	User confirms that an OR-ECG leadset is not attached with the adapter.	Cleared automatically after one minute.
Resp Not Available	The Resp feature is not enabled.	Software option must be installed to enable Resp.
Service (flashing text)	The MX40 is operating in Service Mode	Cleared when the MX40 is changed to a different operating mode. Patient monitoring is not possible in Service Mode. Measurements cannot be performed, and alarms cannot be communicated. Remove and reinsert the battery to resume patient monitoring.

Information Text	Condition	What to Do...
Settings synchronized to Central	The MX40 is returned to use and settings are synchronized to reflect any changes that may have occurred at the Information Center.	Cleared after setting synchronization is complete. The message displays for a minimum of 30 seconds, depending on the number of settings changes.
SpO2 Not Available	SpO_2 sensor is connected to MX40 but the device does not have the SpO_2 option enabled/available.	Enable MX40 software option/upgrade hardware.
SRR Started	Short-range radio is powered on (used with Cableless Measurement Devices and when paired to a patient monitor).	Cleared automatically.
SRR Network Scan	Short-range radio channel scan in progress.	Cleared automatically when complete.
SRR Channel: <chan num>	Short-range radio channel scan is complete and best channel is selected.	Cleared automatically after selection.
SRR Searching Sensor	Short-range radio is attempting to associate with Cableless Measurement Devices.	Cleared automatically.
SRR Stopped	Short-range radio is in power saving mode and no longer searching for Cableless Measurement Device until the Add/Remove SmartKey is touched again.	Cleared automatically or when the Add/ Remove SmartKey is touched.
SRR Searching Monitor	Short-range radio is attempting to associate with a patient monitor.	Cleared automatically.
SRR Connected	Short-range radio is connected to a patient monitor.	Cleared automatically.

Information Text	Condition	What to Do...
SRR Link Test	Short-range radio link testing is in progress before final association.	Cleared automatically. Icon replaces message.
SRR unavailable with Resp	Respiration monitoring is enabled, therefore the connection to the patient monitor is disabled. If desired, short-range radio link can still be established with cableless measurement devices.	To use the short-range radio connection to a patient monitor, the Resp option must be disabled on the MX40. Contact Service.
Switch to Masimo SET Leadset	Incorrect leadset is connected to Masimo SET device.	Cleared automatically after connecting Masimo SET leadset.
Switch to Philips FAST Leadset	Incorrect leadset is connected to Philips FAST device.	Cleared automatically after connecting Philips FAST leadset.

5 Alarms

ECG and Arrhythmia Monitoring

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

ECG Safety Information

Warnings

- The MX40 operates exclusively via a wireless network connection, therefore, it should not be used for primary monitoring in applications where momentary loss of the ECG is unacceptable at the Information Center. It sends ECG and optionally pulse oximetry data to the Information Center, where the Information Center displays real-time patient data, provides alarm annunciation, data storage and review applications. The ECG waveform data, alarms and optionally SpO_2 can always be viewed on the MX40 regardless of the connection to the Information Center.
- Always confirm MX40 and Information Center observations with clinical observation of the patient before administering interventions.
- 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. For more information, see the *QT Interval Monitoring Application Note,* p/n 452299159161.
- To avoid patient injury, assure that the patient cable, and if in use, extender 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 and Hexad derived 12-lead ECGs and their measurements are approximations to conventional 12-lead ECGs. As the 12-lead ECG derived with EASI or Hexad is not exactly identical to the 12-lead conventional ECG obtained from an electrocardiograph, it should not be used for diagnostic interpretations.
- Hexad 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 or Hexad 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 MX40. See the *Patient Information Center Instructions for Use* for additional information on monitoring paced patients.
- When an external transcutaneous 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 can create fusion beats, which occur when an intrinsically conducted beat and a paced beat occur simultaneously, that may not 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. Standard lead, Hexad and EASI lead placements can be used with the MX40.

The Heart Rate calculation resides in the arrhythmia algorithm on the MX40. Arrhythmia analysis is either Cardiotach, 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 Patient 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.

Clinicians will tend to see more motion related artifact on the ECG of ambulatory patients than on patients that are restricted to a bed. Proper skin preparation and electrode application are very important in reducing this problem.

Problems with the ECG signal stem from two main sources:

1 Patient-related sources with noise on the waveform caused by clinical considerations such as poor skin prep, dry electrodes, and poor electrode adhesion, as well as by patient motion and muscle artifact

2 Frequency-related sources resulting in dropouts from signal disturbances and loss of signal. See “Risk Management Considerations” on page 173.

Even in complex situations where problems overlap, most of the time you’ll be able to greatly enhance performance by taking corrective action.

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

When multilead analysis is used, 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.

Only the primary lead is used if your device is configured for 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.

Note — Paced status is set at the Information Center and can only be changed at the Information Center.

When Paced Mode is set to On:

- 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 in white.

When Paced Mode is set to Off:

- The Pacer Algorithm is switched off.
- Pacer Spikes are shown in green, the same color as ECG.
- The paced symbol with X is displayed in green.

When Paced Mode is set to Unconfirmed (PIC iX only):

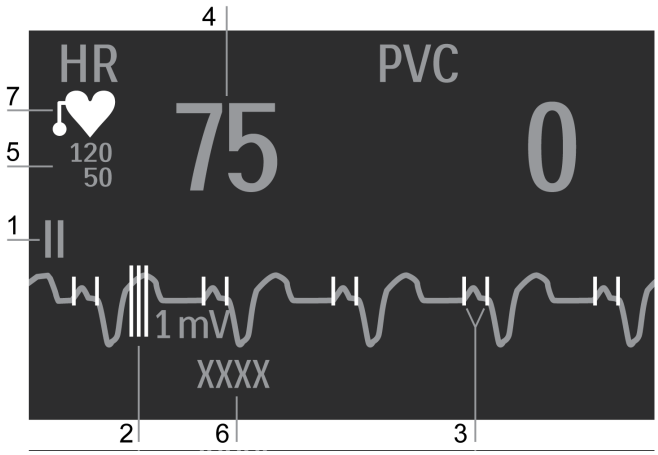
- Pacer Algorithm is switched on. This means that pacemaker pulses are not counted as extra QRS complexes.
- The pacer spikes are shown in white.
- The paced symbol with ? is displayed.

Warning

- Pace pulse rejection must be switched on for paced patients by setting Paced Mode to On. 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.



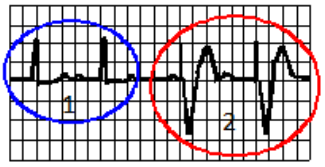
1. Lead label of the displayed wave
2. 1 mV calibration bar
3. Pacer spikes
4. Current heart rate
5. Current heart rate alarm limits
6. EASI/Hexad lead placement label (located here when active)
7. Paced status

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

Consideration for ECG lead(s) selections:

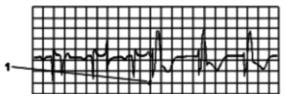
- Paced complexes should be between 1 and 2 millivolts in size and taller than the pace pulse.
- Ventricular paced beats should be wider than the normal QRS complex.
- Pace pulses should not have visible repolarization (overshoot/undershoot). Repolarization causes increased width to the pace pulse and could result in the pace pulse being detected as a beat during pacing not capturing.

- Avoid fusion and pseudofusion beats. Fusion beats happen when an intrinsically conducted beat and a paced triggered beat occur simultaneously. Depending on the relative timing between the intrinsic beat and the paced beat, the QRS morphology can vary widely. Pseudofusion beats happen when an ineffective pace pulse occurs near or in a QRS. Usually there is no major distortion of the QRS morphology unless the intrinsic QRS is very narrow.
- Choose a lead where the ventricular pace pulse has the same polarity (i.e. points in the same direction) as the QRS complex.
- Choose a lead with a normal QRS complex which is large but not too narrow.
- If ventricularly paced, change the ventricular paced rate to above the patient's intrinsic rate if appropriate.
- For AV pacing, change the AV delay of the pacemaker to avoid pseudofusions if appropriate.

Optimizing Lead Selection for Paced Patients

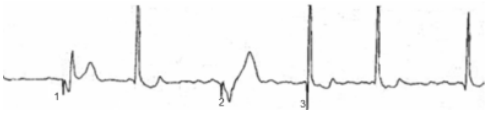
Some unipolar pacemakers display pace pulses with repolarization tails. These tails may be counted as QRSs in the event of cardiac arrest or other arrhythmias.

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



1 Repolarization tail (note width)

Avoid fusion and pseudofusion beats in order to calculate heart rate correctly.



1 Fusion
2 Paced
3 Pseudofusion

Changing the Size of the ECG Wave

If any of the displayed ECG waves on the MX40 are 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 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 Touch the **HR** parameter.

2 In the **Setup ECG** menu, scroll to the second page and select **Adjust Size**.

3 Select the required adjustment factor from the list.

- Size X0.5 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

or

4 Touch the **ECG wave**.

5 Select the required adjustment factor from the list.

Choosing EASI or Standard Lead Placement

Choose either standard lead placement or EASI lead placement (when using a 5-lead patient cable):

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.

Note — When there is a change in lead placement selection, the new selection is retained through discharge and battery change.

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 beginning on page 79 for electrode placement diagrams.

Derived 12-lead ECG

Hexad

When operating with the Patient Information Center iX, the optional Hexad ECG placement generates a Mason-Likar 12-lead ECG from a 6-wire leadset (including four limb electrodes and two chest electrodes) placed according to the Mason-Likar 6-electrode placement.

To generate a derived 12-lead ECG using this configuration, 8 out of the 12 leads are directly acquired (I, II, III, aVR, aVL, aVF and the two directly-recorded V leads) and only 4 precordial leads need to be derived. This means that 8 of 12 are identical to the 12 leads acquired using a full set of 10-wire standard ECG lead set. The other four leads are derived. For more information refer to the *Hexad 12-lead ECG Monitoring Using a 6-wire Lead Set Application Note*, Part Number 452299108161.

Caution

Hexad derived chest leads and their measurements are approximations to the standard ECG, and should not be used for diagnostic interpretation. Hexad is supported for adult patients only.

EASI

The EASI placement, a method of deriving 12 ECG leads using a five-electrode configuration (4 monitoring electrodes and a ground electrode), has been developed to better address the goals and challenges of continuous ECG monitoring. EASI monitoring makes it possible to obtain 12-lead ECG information under continuous monitoring conditions across the continuum of care. The electrodes are placed on the upper sternum (S), the lower sternum (E) at the level of the fifth intercostal space, and on the right and left midaxillary lines (I and A) at the same level as the lower sternum electrode. A fifth ground electrode can be placed anywhere.

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 6-wire patient cable can be used for either standard or Hexad 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

Arrhythmia analysis resides in the arrhythmia algorithm on the MX40. Arrhythmia analysis is always turned on for telemetry patients unless operating with the Patient Information Center iX, where it can be turned off. Arrhythmia analysis is either Cardiotach, Basic or Enhanced (optional).

ECG Leads Monitored

Depending on the patient cable connected to the MX40, a different set of viewable leads is 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 Factory 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 Factory 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) Factory 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.

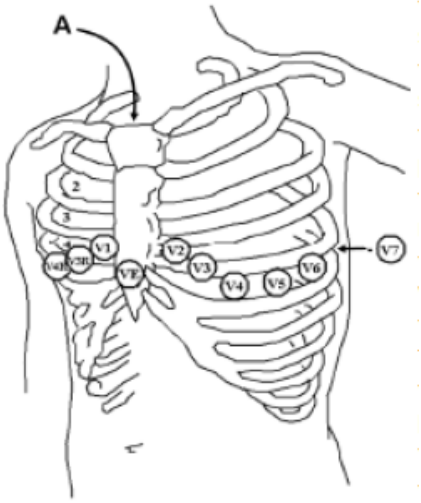
If you are using....	these leads can be selected at the MX40 and the Information Center
6-wire	I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6, V7, V8, V9, V3R, V4R, V5R. Sourced (raw) waves are received as: Channel 1 = II Channel 2 = III Channel 3 = Va Channel 4 = Vb Factory Defaults are II, Va = 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 or Resp is enabled at the Information Center, the second chest lead (Vb) is not available for monitoring.
6-wire (Hexad Mode) (PIC iX only)	I, II, III, MCL, aVR, aVL, aVF, V1-V6. Sourced (raw) waves are received as: Channel 1 = II Channel 2 = III Channel 3 = Va Channel 4 = Vb Factory Defaults = Off Derived leads are labeled, e.g. dV3. Hexad pairs are pre-defined and consist of V1/V3, V1/V4, V1/V5, V2/V4, V2/V5, V3/V5, and V3/V6.

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

Chest Electrode Placement



A - Angle of Louis

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

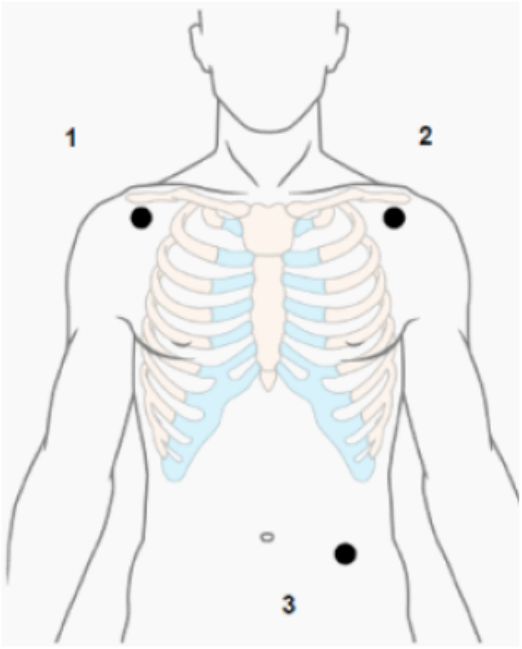
For accurate chest electrode placement and measurement, it is important to locate the fourth intercostal space.

To locate the fourth intercostal space:

1 Locate the second intercostal space by first palpating the Angle of Louis (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.

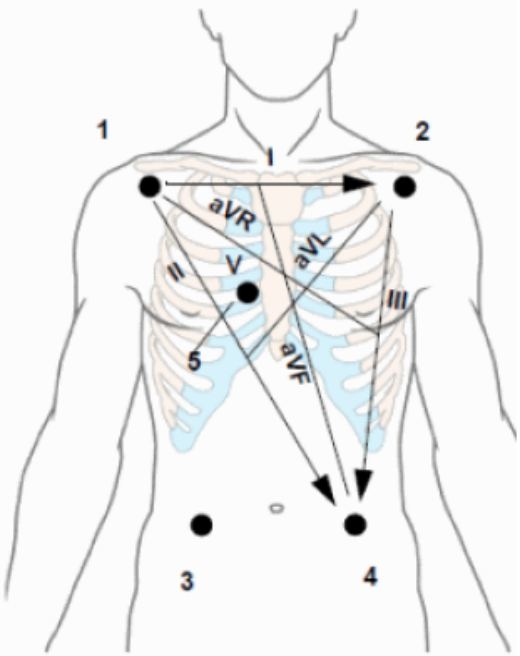
2 Palpate and count down the chest until you locate the fourth intercostal space.

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

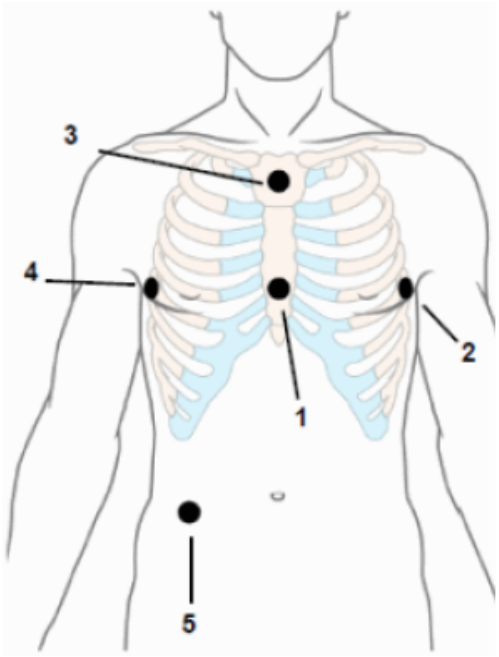
5-Wire Placement (Standard)



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 right lower abdomen
4 LL on the left lower abdomen
5 V on the chest, the position depends on your required lead selection.

- 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)



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

For a 6-lead placement use the positions from the 5-lead diagram above but with two chest leads. The two chest leads, Va and Vb, can be positioned at any two of the V1 to V6 positions shown in the chest electrode diagram below.

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.

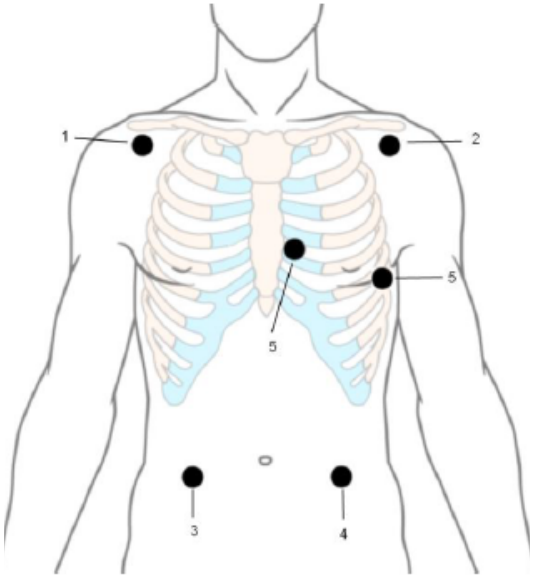
The lead placement for the Va and Vb lead labels must be appropriate. If your unit uses other precordial leads for Va and Vb, they may be assigned in Unit Settings at the Information Center as defaults for your whole unit, or you may need to assign the new positions on a per-patient basis in the Patient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

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.

6-Wire Placement (Hexad)

The diagram below shows the Mason-Likar Placement using 6 electrodes. Chest electrodes are placed according to the selected pair configured at the Patient Information Center iX for chest lead pair selection.



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 right lower abdomen
4 LL on the left 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

Note — In Hexad mode, V leads are chosen in pairs at the Patient Information Center iX.

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.

Extended Monitoring

If both the primary and secondary leads are in a "Leads Off" condition, the ECG source on the MX40 will switch to any available lead. Relearning will occur in this condition.

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, ES, 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 to gain information for treatment, to monitor adequacy of treatment, or to exclude causes of symptoms.

About Arrhythmia Monitoring

For additional information on the ST/AR Algorithm, refer to the *Arrhythmia Monitoring ST/AR Algorithm Application Note*, part number 452299165051, on your documentation CD.

Arrhythmia analysis provides information on your patient's condition, including heart rate, PVC rate, rhythm, and ectopics. The monitor uses the user-selected primary and secondary ECG leads for single lead or multi-lead arrhythmia analysis. During arrhythmia analysis, the MX40 continuously:

- optimizes ECG signal quality. This is important for arrhythmia analysis. The monitor continuously filters the ECG signal to remove baseline wander, muscle artifact, and signal irregularities. Also, if the Patient Paced status is set to On, pace pulses are filtered out to avoid processing them as QRS beats.
- detects beats, for example, QRS complexes, identifying them for further analysis.
- measures signal features such as R-wave height, width, and timing.
- creates beat templates, and classifies and labels beats to aid in rhythm analysis and alarm detection.
- examines the ECG signal for ventricular fibrillation, asystole, and noise.

Choosing an ECG Lead for Arrhythmia Monitoring

It is important to select a suitable lead for arrhythmia monitoring. Guidelines for non-paced patients are:

- QRS complex should be tall and narrow (recommended amplitude > 0.5 mV)
- R-Wave should be above or below the baseline (but not biphasic)
- T-wave should be smaller than 1/3 R-wave height
- the P-wave should be smaller than 1/5 R-wave height.

For paced patients, in addition to the above:

- Paced complexes should be between 1 and 2 millivolts in size and taller than the pace pulse.
- Ventricular paced beats should be wider than the normal QRS complex.
- Pace pulses should not have visible repolarization (overshoot/undershoot). Repolarization causes increased width to the pace pulse and could result in the pace pulse being detected as a beat during pacing not capturing.
- Avoid fusion and pseudofusion beats. Fusion beats happen when an intrinsically conducted beat and a paced triggered beat occur simultaneously. Depending on the relative timing between the intrinsic beat and the paced beat, the QRS morphology can vary widely. Pseudofusion beats happen when an ineffective pace pulse occurs near or in a QRS. Usually there is no major distortion of the QRS morphology unless the intrinsic QRS is very narrow.
- Choose a lead where the ventricular pace pulse has the same polarity (i.e. points in the same direction) as the QRS complex.
- Choose a lead with a normal QRS complex which is large but not too narrow.
- If ventricularly paced, change the ventricular paced rate to above the patient's intrinsic rate if appropriate.
- For AV pacing, change the AV delay of the pacemaker to avoid pseudofusions if appropriate.

To prevent detection of P-waves or baseline noises as QRS complexes, the minimum detection level for QRS complexes is set at 0.15 mV, according to IEC 60601-2-27 and AAMI-EC 13 specifications. Adjusting the ECG wave size on the monitor display (gain adjustment) does not affect the ECG signal

which is used for arrhythmia analysis. If the ECG signal is too small, you may get false alarms for pause or asystole.

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.

Atrial Fibrillation Alarm

The MX40 performs atrial fibrillation analysis using information about the RR irregularity, PR interval variability, and P-wave variability.

In order to generate an Afib alarm the following criteria must be detected for 1 minute:

- normal beat RR intervals must be irregular
- PR interval deviation must be large
- P-wave region must not match well

Atrial fibrillation analysis is only available for adult patients and atrial fibrillation detection cannot be performed on PVCs or Paced beats.

An ***AFIB** alarm can be falsely detected in the presence of:

- sinus arrhythmia
- muscle noise, or
- electrode motion artifact

An ***End AFIB** alarm will occur when no atrial fibrillation waveform is detected for a configured delay time.

Since most atrial flutters have regular RR intervals, they cannot be detected by the atrial fibrillation algorithm.

Intermittent Bundle Branch Block

Bundle branch and the other 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.

- Cardiotach alarms are available when HR is on and the active alarm source is ECG, but arrhythmia is switched off.
- Basic arrhythmia alarms are available when Arrhythmia is switched on.
- Enhanced arrhythmia alarms are available when Arrhythmia is switched on and the Enhanced Arrhythmia option has been enabled for your MX40.

To check your enabled settings, view the **Standby** screen. C01 indicates that you have Enhanced Arrhythmia.

You can view arrhythmia thresholds and on/off status through the setup ecg menu, touching arrhythmia, or by touching the PVC numeric. You can also view the QRS detection threshold at the bottom of this menu. The QRS detection threshold defines the value above which a QRS signal is counted. Configuring a minimum QRS detection threshold can prevent P-waves, T-waves and noise from being detected as QRS complexes.

The actual threshold at any time depends on the noise level present and the amplitude of the original ECG signal. The QRS detection threshold never goes below the larger of 1/5 the average R-wave height, 150 microvolts (0.15 millivolts), or the minimum detection threshold set by the user. Any peak smaller than this value is not detected. False or missed alarms can occur if the QRS detection threshold is inappropriately set for the patient. To optimize the algorithm performance, adjust the minimum detection threshold to a level above the P-wave and/or noise to avoid these peaks from being counted as QRS complexes. The minimum QRS detection threshold may also need to be adjusted for ECG morphology changes. The QRS threshold can only be changed from PIC iX Information Centers $\geq$ to C.03.0

Cardiotach Alarms	Additional Alarms with Basic Arrhythmia Option	Additional Alarms with Enhanced Arrhythmia Option
***Asystole ***Ventricular Fibrillation/ Tachycardia ***Extreme Bradycardia ***Extreme Tachycardia **High heart rate **Low heart rate	***VTach *Pacer Not Capture *Pacer Not Pacing *PVCs/min HIGH (PVC > limit/min)	*Afib *End Afib *SVT *Missed Beat *Pause *Irregular HR *End Irregular HR *Vent Rhythm *Run PVCs High *Pair PVCs *R-on-T PVCs *Vent Bigeminy *Vent Trigeminy *Non-sustain VT *Multiform PVCs

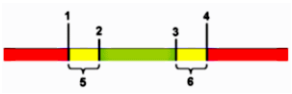
Note — When operating with the IntelliVue Information Center Release N or earlier, the ST/AR Arrhythmia Algorithm operates and generates alarms independently at both the MX40 and the Information Center. Therefore, you may see slight differences between the two, even though the alarm settings and limits are the same.

Using ECG Alarms

At the Information Center, 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 (Δ value)
6 Extreme Tachy (Δ 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 depending on its configuration. They are:

Non-Sustain VT, Vent Rhythm, Run PVCs, Pair PVCs, R-On-T PVC, Vent Bigeminy, Vent Trigeminy, Multiform PVCs, Pause, SVT, HR High, HR Low, Irregular HR (IHR), Missed Beat, PVCs/min High, Pacer Not Capture, Pacer Not Pacing, and **Afib**.

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 Information Center configuration, they may be shown with one or two stars. The heart rate alarms (HR High and HR Low) 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 after the condition ends. 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.

How are Yellow Arrhythmia Alarms Indicated?

When a yellow arrhythmia alarm is generated, it triggers visual and audible indicators. Yellow arrhythmia alarms are always set to latch visually for three minutes except HR High/Low alarms, if configured to standard yellow. Depending on the alarm condition, audible and visual alarm indicators will appear as follows:

Alarm Condition	Example	Short Yellow Alarm Tone Sounds...	Alarm Message Displayed...
Single alarm instance	Non-Sustained V-tach	when alarm condition is initially detected	for three minutes (latching time)
Continuous alarm condition	PVCs/min HIGH	when alarm condition is initially detected and - as an alarm reminder - every time the configured timeout period has expired	until the alarm condition stops, plus a maximum of three minutes latching time
Same intermittent alarm condition	Pair of PVCs	each time the alarm condition is detected, provided that the configured timeout period has expired	

Viewing Arrhythmia Waves

To view arrhythmia beat labels:

1 Touch **HR** to open 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.

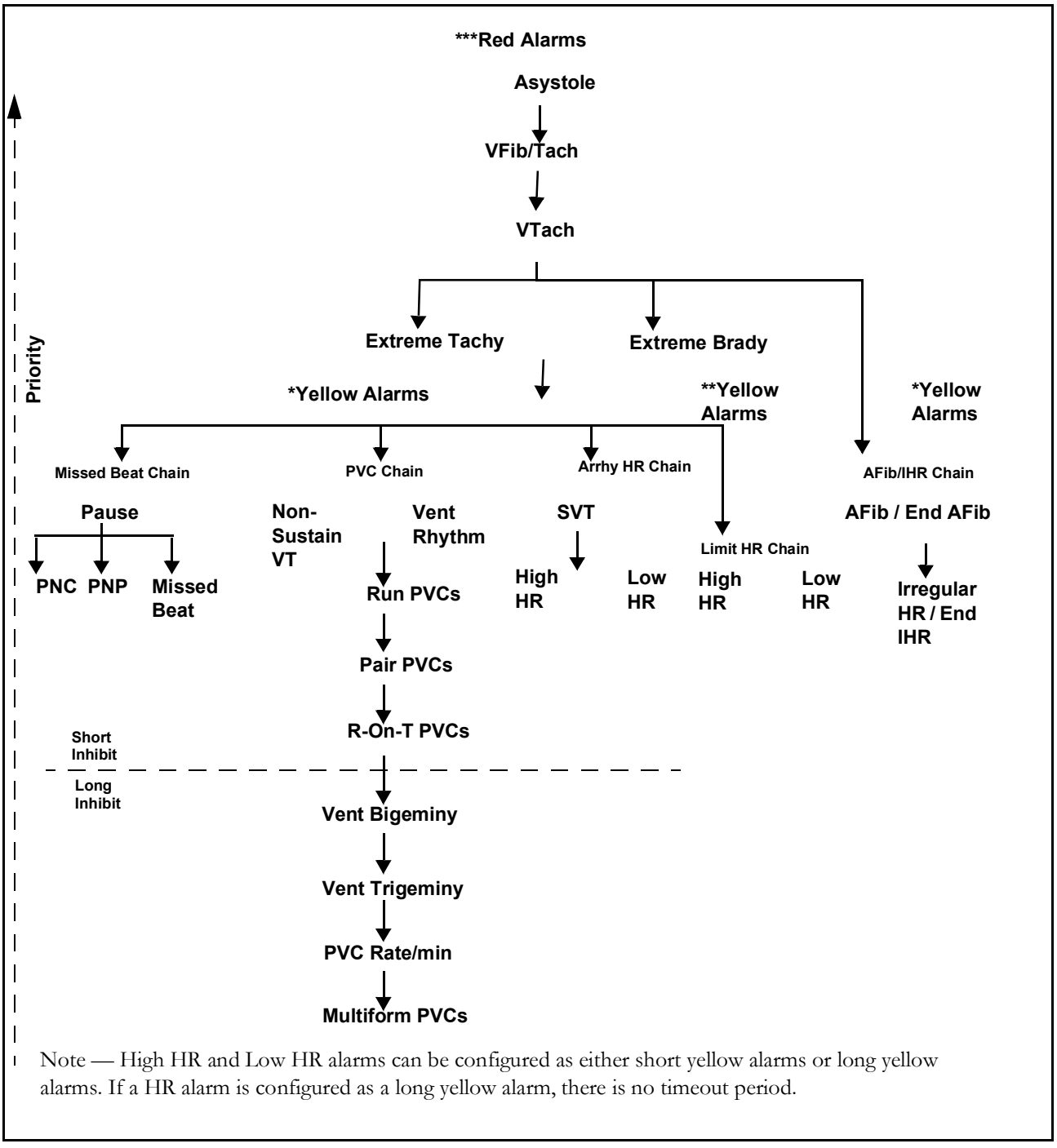
Arrhythmia Beat Labels

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

Beat Label Arrhythmia On	Beat Classification	Beat Label Cardiotach Mode (Arrhythmia Off)
N	Normal	**B**
V	Ventricular Ectopic	**B**
S	Supra-ventricular Premature	**B**
P	Paced	**B**
‘	Pacer Spike	**‘**
“	Biventricular Pacer Spike	**“**
L	Learning Patient’s ECG	**L**
A	Artifact (noisy episode)	**A**
?	Insufficient Information to Classify Beats	**?**
I	Inoperative Condition (e.g., Leads Off)	**I**
M	Pause or Missed Beat	Not Applicable

Enhanced Arrhythmia Chain

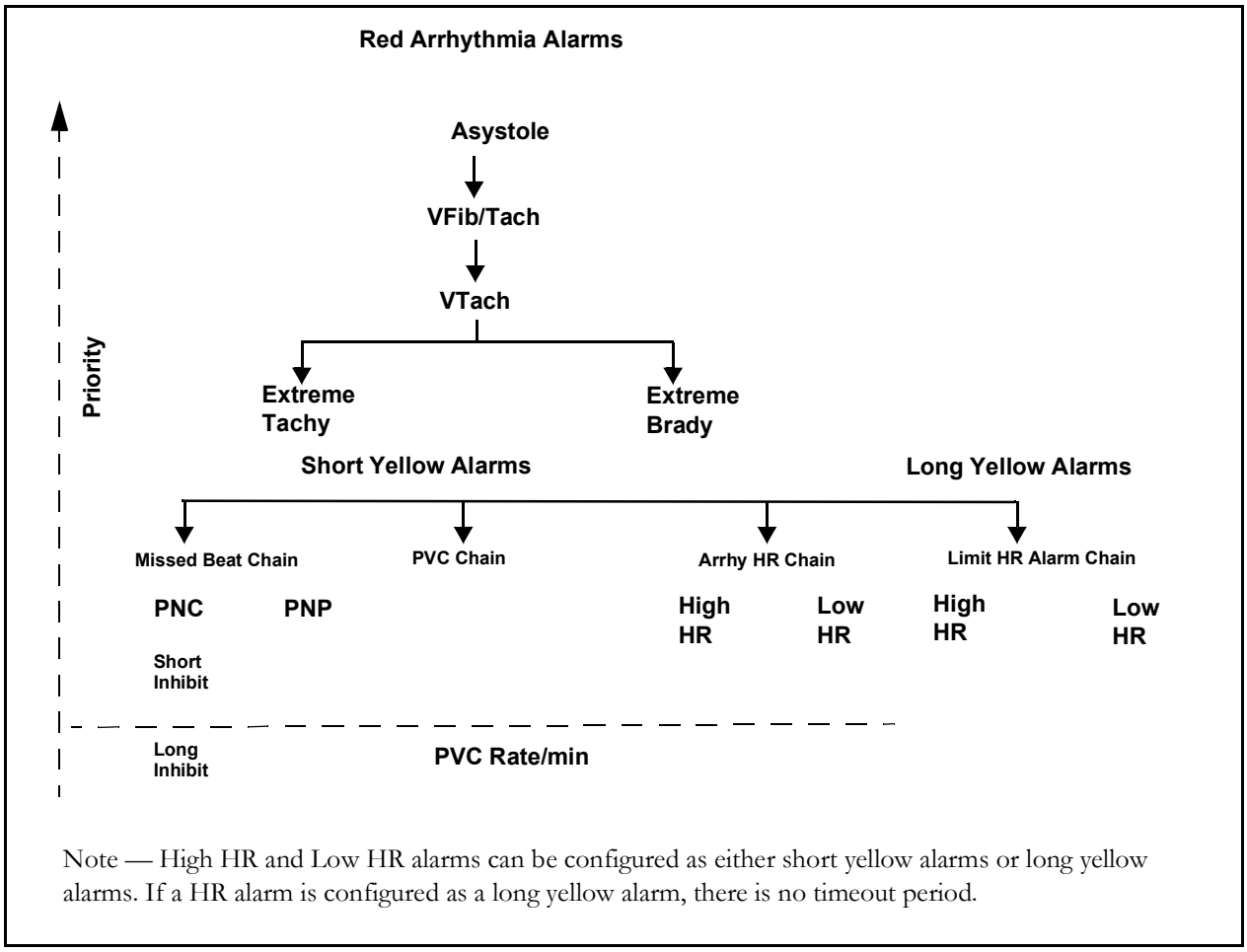
The diagram below shows the alarm condition priority chains for enhanced arrhythmia. The alarm conditions in each category are prioritized according to the level of seriousness.



Note — High HR and Low HR alarms can be configured as either short yellow alarms or long yellow alarms. If a HR alarm is configured as a long yellow alarm, there is no timeout period.

Basic Arrhythmia Chain

The diagram below shows the alarm condition priorities for basic arrhythmia and the timeout levels for yellow alarm conditions.



Note — High HR and Low HR alarms can be configured as either short yellow alarms or long yellow alarms. If a HR alarm is configured as a long yellow alarm, there is no timeout period.

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 learning whenever:

- ECG monitoring is initiated.
- The **Relearn Arrhy** control is activated. See Initiating Arrhythmia Relearning Manually on page 95.
- The ECG Lead or Lead Label is changed manually, or when Fallback occurs. See ECG Fallback on page 83.
- A "Leads Off" INOP condition (that has been active for >60 seconds) ends.
- When the MX40 re-associates with the Information Center (IIC only).

Multilead Analysis

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

- ECG monitoring is initiated.
- The **Relearn Arrhy** control is activated (see Initiating Arrhythmia Relearning Manually on page 95).
- 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.
- When the MX40 re-associates with the Information Center (IIC only).

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 lasting long enough for a lead change to occur, 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:

1 Touch the HR numeric.

2 Scroll to the next page.

3 Touch Arrhythmia.

4 Touch 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 as appropriate.

After relearning is complete, you should check the delayed arrhythmia wave to ensure that the algorithm is labeling the beats correctly. See “Arrhythmia Beat Labels” on page 91..

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

Introduction

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.

The ST/AR ST algorithm monitors ST segment elevation or depression for each available telemetry ECG lead and produces alarms simultaneously.

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 qualified clinician.

ST values update with every measurement period and annunciate, depending upon the severity of the change, and alarms as they are detected.

The ST/AR ST algorithm is approved for use only with adult non-paced and atrially-paced patients.

Caution

Some clinical conditions may make it difficult to achieve reliable ST monitoring, for example:

- if you are unable to select a lead that is not noisy
- if arrhythmias such as atrial fib/flutter are present, which may cause an irregular baseline
- if the patient is continuously ventricularly paced
- if the patient has left bundle branch block

The Measurements

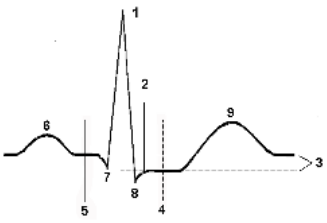
Overview

Note — STE analysis is only available with Patient Information Center iX.

The ST/STE measurement for each beat complex is the vertical *difference* between two measurement points. The isoelectric point provides the baseline for both measurements.

The ST measurement uses the isoelectric point and the ST point. The ST point is positioned with reference to the J-point.

STE is similar to ST but always uses Auto J + 0 for the ST measurement points and cannot be adjusted on a per patient basis.



1 R-wave peak at 0 msec
2 J point
3 Difference = ST value
4 ST measurement point. Default = J+60 msec
5 Isoelectric point. Default = -80 msec
6 P wave
7 Q wave
8 S wave
9 T wave

You can manually adjust the ST measurements on the Information Center's ST Setup application.

Turning ST or STE Analysis On and Off

ST and STE analysis can be turned on and off independently. To turn ST or STE monitoring on or off at the Patient Information Center iX:

1 Select the Measurements ST page.

2 Click the I/O ST or I/O STE Analysis button to toggle ST or STE Analysis on or off as appropriate.

Note — STE monitoring is only available with PIC iX.

To turn ST monitoring on or off at the IntelliVue Information Center Release N:

1 From the Patient Window, click the **All Controls** button.

2 From the All Controls Window, click the **ST Setup** button.

3 From the ST Setup Window, click **ST On/Off** as appropriate.

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 at the MX40 if ST is assigned to a numeric area. Up to 3 values can display in the assigned space. If more than three values are available, the last value will rotate.

ST Lead Groups

ECG Leads are clinically grouped as follows:

ST Lead Group	ECG Leads
Inferior	II, III, aVF
Lateral	I, aVL, V5, V6
Antero-lateral	I, aVL, V4, V5, V6
Anterior	V1, V2, V3, V4
Septal	V1, V2, V3
Right	V3R, V4R, V5R
Posterior	V7, V8, V9

You can change the group displayed using the **ST Views** menu on the MX40.

Displayed STE Data

STE data can only be displayed at the Patient Information Center iX. You can view STE data in the Measurements STE application, Main Screen, or Patient Window.

Derived 12 Lead ECG

In view of the high degree of redundancy among the standard 12-lead ECG leads, it is quite conceivable that a more practical leadset with a smaller number of judiciously chosen leads can be used to reconstruct the missing leads.

For Hexad derived 12-lead, the 6 electrode configuration has the capability of deriving additional chest leads if the two chest electrodes are placed in several pre-specified standard precordial locations.

Using a standard 5-electrode set in EASI lead placement you can monitor up to 12 standard ECG leads simultaneously and continuously. EASI provides a monitoring method for trending ST segment changes that can provide an early indication of ischemia.

Caution

Derived ECG and their measurements are approximations to the standard ECG, and should not be used for diagnostic interpretation.

EASI ST Analysis

With EASI monitoring, ST analysis is performed on up to 12 leads. Assessment of EASI-derived 12-lead ST measurement is recommended for adult patients.

For additional information on ST monitoring, refer to the *ST Segment Monitoring Application Note*, Part Number 452299106281.

ST Index

ST values are presented in the patient sector and Patient Window for derived leads along with STindx (ST Index). The ST Index (STindex) is calculated when ST segment analysis is on and when V2/V5/aVF leads are available (EASI, HEXAD, 6-wire). 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

ST Index is always positive and there are no alarms associated with ST Index. ST Index is only available at the Patient Information Center.

HEXAD ST Analysis

When operating with the Patient Information Center iX, the optional Hexad algorithm generates a Mason-Likar 12-lead ECG from a 6-wire leadset (including four limb electrodes and two chest electrodes) placed according to the Mason-Likar 6-electrode placement.

To generate a derived 12-lead ECG using this configuration, 8 out of the 12 leads are directly acquired (I, II, III, aVR, aVL, aVF and the two directly-recorded V leads) and only 4 precordial leads need to be derived. This means that 8 of 12 are identical to the 12 leads acquired using a full set of 10-wire standard ECG lead set. For more information refer to the *Hexad 12-lead ECG Monitoring Using a 6-wire Lead Set Application Note*, Part Number 452299108161.

ST Alarms

ST Alarms are ** yellow alarms. For telemetry monitored patients, ST Alarm Limits can only be set at the Information Center. Each ST lead has its own alarm limit. ST alarms are triggered when an ST value exceeds its limit for more than one minute. If contiguous leads are present, ST values in two contiguous leads have to exceed the lead specific alarm limits. If no contiguous leads are present, alarms will be based on single lead limit violation. Turning ST Alarms off turns off alarms for all ST leads.

STE Alarms

The STE Alarm is a ** yellow alarm. It is announced after exceeding alarm limits for one minute. It can be turned on and off at the Information Center, however its limits are set during configuration and not adjustable on per patient basis. The STE alarm limits are gender specific and can only be modified in Configuration mode for limb lead, V2/V3 leads and V1, V4, V5, V6 leads. The default values, for example on V2 and V3 1.5 mm for females and 2.0 mm for males, are based on the recommendations from the American Heart Association and American College of Cardiology.

The ST Elevation measurements with automated J-point determination generate ST Elevation alarms, in addition to the ST measurements at the user-defined ST point (J+offset), which may be useful for ST depression alarms. When ST and STE analysis are both in use, this may result in redundant alarms for ST elevations. Because of the different measurement points, there may be different values obtained. Thus there could be an ST alarm and an STE alarm but the STE alarm may announce sooner based upon the values obtained.

ST/AR QT/QTc Interval Monitoring

Intended Use

The intended use of the ST/AR QT/QTc analysis algorithm 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 Interval Monitoring Application Note*, Part Number 452299159161, included on your Documentation CD and in the *PIC iX Instructions for Use*.

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 qualified clinician.

Note — When operating with the Intellivue Information Center Release N or earlier, QT Data, including alarms, is not displayed at the MX40.

Viewing QT data at the MX40

To view QT data at the MX40:

1 Touch any numeric.

2 Select **Change Numeric** (it may be necessary to scroll down).

3 Select **QT**.

QTc and ΔQTC measurements are available.

Monitoring Pulse Rate

This section provides an introduction to the Pulse measurement and its application. The Pulse alarm feature is available only on MX40 Release C.01 or greater and Patient Information Center iX C.02 or greater.

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 (FAST) or 25 to 240 (Masimo SET).

The pulse numeric is displayed at the Information Center and the MX40 when SpO_2 is being measured in any mode (Continuous, Auto and Manual). When in Auto or Manual mode, pulse measurements are displayed at the MX40 with a time stamp. In Manual mode, the measurement can be started using the Smart keys menu or the SpO_2 measurement menu. In Auto mode, the time interval is configured at the Information Center and synchronized with the MX40.

Pulse is turned on in the **Telemetry Setup** window at the IntelliVue Information Center Release N or by using the **Measurements/SpO2** page at the Patient Information Center iX (default setting is On).

Pulse Alarm Availability

For MX40 Release C.01/PIC iX C.02:

- Pulse alarms are available regardless of SpO_2 mode (i.e. Continuous, Auto, or Manual).
- When monitoring SpO_2T only on the MX40 (via adapter, p/n 989803199081, or ECG manually switched off) PulseT Alarms are available.
- When monitoring ECG and SpO_2T on the MX40 and a Leads Off condition occurs, PulseT Alarms are available.

Note — The transition time for the change in alarm source from ECG to pulse is 3 seconds. The transition time from pulse to ECG is a maximum of 10 seconds. The transition time from ECG Leads Off to Pulse alarm is 10 seconds.

Warnings

- When the pulse rate measurement is the active alarm source, HR alarms and arrhythmia alarms, including Asystole, Vfib and Vtach are turned off. The INOP, ECG/Arrh Off is displayed. High and Low Pulse rate and Extreme Bradycardia and Extreme Tachycardia alarms from the pulse rate measurement are active.
- When monitoring with Masimo SET SpO2 technology, do not set the pulse limit > 240 bpm to ensure high pulse rate alarming occurs.

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**.

Monitoring Respiration Rate (Resp)

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

Note — Resp is only available with the Patient Information Center iX and when the purchased option is enabled on the MX40.

Respiration Rate Measurement

For the respiratory measurement (Resp), the MX40 measures the thoracic impedance between the RA and LL electrodes on the patient's chest. Changes in the impedance due to thoracic movement produce the Resp waveform on the display. The MX40 counts the waveform cycles to calculate the respiration rate (RR). The waveform size can be set using the **Setup Resp** menu which is displayed when you touch the Resp measurement area.

Settings for Resp On/Off, alarms, alarm limits and apnea time are defined at the Information Center. When the ECG measurement is turned off, the Resp measurement is not affected and still displayed at the MX40.

Note — When monitoring respiration, connection to IntelliVue Patient Monitors via the Short-range Radio is not supported. In order to be able to connect to IntelliVue Patient Monitors using the Short-range Radio, the license for the respiration option must be disabled on the MX40 using the IntelliVue Service Tool. Monitoring respiration is possible when connected to IntelliVue Cableless Measurements via the Short-range Radio. When not connected wirelessly to a monitor and Resp is being measured, the message **SRR Unavail w/ Resp** is displayed on the MX40.

Note — When monitoring using IntelliVue leadsets (reusable and single-patient use), the respiration measurement is available, however, the use of OR-ECG leadsets is not supported. Users must confirm they are not in use on the **ECG Leadset Type** menu at the MX40. A reminder message to not connect OR-ECG leadsets is displayed.

Resp Safety Information

Warning

Apnea The respiration measurement does not recognize obstructive and mixed apneas. It only indicates an alarm when a pre-adjusted time has elapsed since the last detected breath.

Resp Accessories To monitor respiration, use only non-OR ECG accessories as listed in the Accessories Appendix.

Rate Adaptive Pacemakers Implanted pacemakers which can adapt to the Minute Ventilation rate may occasionally react on the Impedance measurement used by devices for the determination of the Resp value and execute pacing with the maximum programmed rate. Turning off the Resp measurement can prevent this.

Lead Placement for Monitoring Resp

Correct patient skin preparation techniques for electrode placement are important for Resp measurement. See "Connecting and Positioning ECG Electrodes" on page 69.

The Resp measurement uses the standard MX40 patient cable. You can use 3-wire, 5-wire, or 6-wire leadsets, using either Standard or EASI placement. The leads used for the Resp measurement are RA, LL (Standard), or I, A (EASI).

Optimizing Lead Placement for Resp

If you want to measure Resp and you are already measuring ECG, you may need to optimize placement of the two electrodes between which Resp will be measured. Repositioning ECG electrodes from standard positions, especially when you are using EASI placement, results in changes in the ECG waveform and may influence ST and arrhythmia interpretation.

Cardiac Overlay

Cardiac activity that affects the Resp waveform is called cardiac overlay. Cardiac overlay happens when the Resp electrodes pick up impedance changes caused by the rhythmic blood flow. Correct electrode placement can help to reduce cardiac overlay. Avoid the liver area and the ventricles of the heart in the line between the respiratory electrodes.

Abdominal Breathing

Some patients with restricted chest movement breathe mainly abdominally. In these cases, you may need to place the left leg electrode on the left abdomen at the point of maximum abdominal expansion to optimize the respiratory wave.

Displaying Resp on the MX40

To display the Resp waveform and/or numeric:

1. At the Patient Information Center iX, select the **Measurements** button from the Main Setup Window.
2. From the Measurements Window, select **Resp**.
3. Click the **I/O Resp** button to toggle on or off as appropriate.
4. At the MX40, select a waveform area to display the Resp waveform.
5. The **Change Wave** menu is displayed.
6. From the **Change Wave** menu, select **Resp**.

   Note — The **Change Wave** menu is also used to adjust the Resp waveform size at the MX40 and at the Patient Information Center iX.
7. Select any measurement numeric to change to display the Resp numeric.
8. Select **Change Numeric** (it may be necessary to scroll down).
9. From the **Change Numeric** menu, select **Resp**.

SpO_2 Monitoring

This section provides an introduction to the SpO_2 measurement and its application. Information is segmented as follows:

- Measurement Overview
- Safety Information (FAST)
- Safety Information (Masimo SET)
- Measurement Specifications (FAST)
- Measurement Specifications (Masimo SET)

The above sections are then followed by general information and instruction that applies to both measurement technologies, except where noted otherwise.

Measurement Overview

The MX40 (p/n 865350, 865351, 865352) supports optional SpO_2 monitoring using the Philips motion-tolerant signal processing algorithm, based on Fourier artifact suppression technology (FAST) or using Masimo SET technology. It provides three measurements:

- Oxygen saturation of arterial blood (SpO_2) - percentage of oxygenated hemoglobin in relation to the sum of oxyhemoglobin and deoxyhemoglobin (functional arterial oxygen saturation).
- Pleth waveform - visual indication of patient's pulse.
- Pulse rate (derived from pleth wave) - detected pulsations per minute.

For more information, see the *Philips FAST SpO2 Application Note*, p/n 453564404151.

Optional SpO_2 monitoring technology is available via purchased option at time of order or future upgrade option (FAST only). For more information, contact your Philips Sales Representative.

SpO_2 Safety Information (FAST)

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 an 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.
- When the MX40 is connected to a patient monitor using the MX40 / IntelliVue Patient Monitor Adapter Cable, (p/n 989803172211), the SpO_2 sensor must be directly connected to the patient monitor to monitor SpO_2.
- Do not use more than one extension cable (M1941A). See Chapter 15, 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 Safety Information (Masimo SET)

Warnings

As with all medical equipment, carefully route patient cabling to reduce the possibility of patient entanglement or strangulation.

- Do not place the pulse oximeter or accessories in any position that might cause it to fall on the patient.
- Do not start or operate the pulse oximeter unless the setup was verified to be correct.
- Do not use the pulse oximeter during magnetic resonance imaging (MRI) or in an MRI environment.
- Do not use the pulse oximeter if it appears or is suspected to be damaged.
- Explosion hazard: Do not use the pulse oximeter in the presence of flammable anesthetics or other flammable substance in combination with air, oxygen-enriched environments, or nitrous oxide.
- To ensure safety, avoid stacking multiple devices or placing anything on the device during operation.
- To protect against injury, follow the directions below:
  - Avoid placing the device on surfaces with visible liquid spills.
  - Use cleaning solutions only as instructed in this operator's manual.
  - Do not attempt to clean the device while monitoring a patient.
- If any measurement seems questionable, first check the patient's vital signs by alternate means and then check the pulse oximeter for proper functioning.
- Inaccurate SpO2 readings may be caused by:
  - Improper sensor application and placement
  - Elevated levels of COHb or MetHb: High levels of COHb or MetHb may occur with a seemingly normal SpO2. When elevated levels of COHb or MetHb are suspected, laboratory analysis (CO-Oximetry) of a blood sample should be performed.
  - Elevated levels of bilirubin
  - Elevated levels of dyshemoglobin
  - Vasospastic disease, such as Raynaud's, and peripheral vascular disease
  - Hemoglobinopathies and synthesis disorders such as thalassemias, Hb s, Hb c, sickle cell, etc.
  - Hypocapnic or hypercapnic conditions
  - Severe anemia
  - Very low arterial perfusion
  - Extreme motion artifact
  - Abnormal venous pulsation or venous constriction
  - Severe vasoconstriction or hypothermia
  - Arterial catheters and intra-aortic balloon
  - Intravascular dyes, such as indocyanine green or methylene blue

  - Externally applied coloring and texture, such as nail polish, acrylic nails, glitter, etc.
  - Birthmark(s), tattoos, skin discolorations, moisture on skin, deformed or abnormal fingers. etc.
  - Skin color disorders
- Interfering Substances: Dyes or any substance containing dyes that change usual blood pigmentation may cause erroneous readings.
- The pulse oximeter should not be used as the sole basis for medical decisions. It must be used in conjunction with clinical signs and symptoms.
- The pulse oximeter is not an apnea monitor.
- The pulse oximeter may be used during defibrillation, but this may affect the accuracy or availability of the parameters and measurements.
- The pulse oximeter may be used during electrocautery, but this may affect the accuracy or availability of the parameters and measurements.
- The pulse oximeter should not be used for arrhythmia analysis.
- SpO2 is empirically calibrated in healthy adult volunteers with normal levels of carboxyhemoglobin (COHb) and methemoglobin (MetHb).
- Do not adjust, repair, open, disassemble, or modify the pulse oximeter or accessories. Injury to personnel or equipment damage could occur. Return the pulse oximeter for servicing if necessary.

Cautions

- Do not place the pulse oximeter where the controls can be changed by the patient.
- Electrical shock and flammability hazard: Before cleaning, always turn off the device and disconnect from any power source.
- When patients are undergoing photodynamic therapy they may be sensitive to light sources. Pulse oximetry may be used only under careful clinical supervision for short time periods to minimize interference with photodynamic therapy.
- Do not place the pulse oximeter on electrical equipment that may affect the device, preventing it from working properly.
- If SpO2 values indicate hypoxemia, a laboratory blood sample should be taken to confirm the patient's condition.
- If the Low Perfusion message is frequently displayed, find a better perfused monitoring site. In the interim, assess the patient and, if indicated, verify oxygenation status through other means.
- Change the application site or replace the sensor and/or patient cable when a **SpO2T Repl.Sensor, SpO2T Sensor Malf** and/or **SpO2T Repl. Cable**, or persistent poor signal quality INOP, **SpO2T Poor Signal**, is displayed on the host monitor. These messages may indicate that patient monitoring time is exhausted on the patient cable or sensor.
- If using pulse oximetry during full body irradiation, keep the sensor out of the radiation field. If the sensor is exposed to the radiation, the reading might be inaccurate or the device might read zero for the duration of the active irradiation period.
- To ensure that alarm limits are appropriate for the patient being monitored, check the limits each time the pulse oximeter is used.

- Variation in measurements may be profound and may be affected by sampling technique as well as the patient's physiological conditions. Any results exhibiting inconsistency with the patient's clinical status should be repeated and/or supplemented with additional test data. Blood samples should be analyzed by laboratory instruments prior to clinical decision making to completely understand the patient's condition.
- Do not submerge the pulse oximeter in any cleaning solution or attempt to sterilize by autoclave, irradiation, steam, gas, ethylene oxide or any other method. This will seriously damage the pulse oximeter.
- Disposal of product - Comply with local laws in the disposal of the device and/or its accessories.
- Replace the cable or sensor when a replace sensor or when a SpO2T Poor Signal message is consistently displayed while monitoring consecutive patients after completing troubleshooting steps listed in this manual.

Note — A functional tester cannot be used to assess the accuracy of the pulse oximeter.

Note — High-intensity extreme lights (such as pulsating strobe lights) directed on the sensor, may not allow the pulse oximeter to obtain vital sign readings.

Note — Do not loop the patient cabling into a tight coil or wrap around the device, as this can damage the patient cabling.

Note — Additional information specific to the Masimo sensors compatible with the pulse oximeter, including information about parameter/measurement performance during motion and low perfusion, may be found in the sensor's instructions for use (IFU).

Note — Cables and sensors are provided with X-Cal™ technology to minimize the risk of inaccurate readings and unanticipated loss of patient monitoring. Refer to the Cable or Sensor IFU for the specified duration of the patient monitoring time.

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 configurable 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.

Note — The averaging filter time period is configurable at the Patient Information Center iX (default = 10 seconds). For IntelliVue Information Center Release N.00/N.01, the averaging time is fixed at 10 seconds.

Physiological SpO_2 alarm signals will be generated. For adult patients, the SpO_2 low alarm 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 alarm 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. Pulse rate is also derived from the pulsatile SpO_2 measurement, and displayed results can range from 30 to 300 bpm (FAST) and 25 to 240 (Masimo SET).

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.

Performance Specification Details for Philips Sensors

The SpO_2 accuracy was validated in human studies against arterial blood sample reference measured with a CO-oximeter. In a controlled desaturation study, adult volunteers with saturation levels between 70% and 100% SaO_2 were studied as recommended in ISO 80601-2-61.

Note—A functional tester cannot be used to assess the accuracy of a pulse oximeter monitor.

The results of the study are shown below. Representative sensors were tested to cover all of the compatible SpO_2 sensors. All representative sensors were tested with adult subjects with the following characteristics:

- Six male subjects and six female subjects
- Age range of the subjects: 20 to 34 years (20-24 years: 3 subjects; 25-30 years: 7 subjects; 30-34 years - 2 subjects)
- Skin tone was categorized in 6 levels from light to dark: light (3 subjects); medium (1 subject); rose beige (1 subject); sahara (2 subjects); true beige (4 subjects); dark brown (1 subject)

For each tested sensor, at least 270 blood samples were available for comparison, equally spread over the range from 70% to 100% SaO_2.

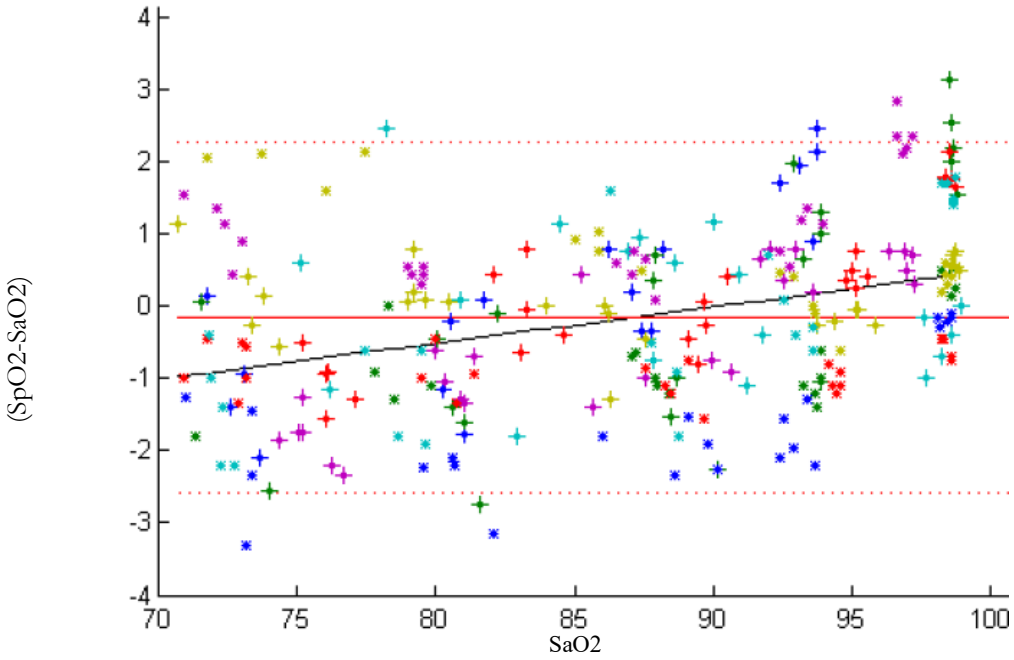
The A_{rms} (SpO_2 Accuracy [root mean square]) values shown below, especially in the sub-ranges from 70-80%, 80-90% and 90-100% SaO_2, represent the results of this study.

In addition to calculating the A_{rms} values over the range from 70% to 100% SaO_2 as required by the international standards for pulse oximeters ISO 8601-2-61,[1,2] the desaturation study data was evaluated according to the method *Agreement Between Methods of Measurement with Multiple Observations Per Individual* described by Bland and Altman.[3]

The sample times and the SpO_2 data reported by the DUTs are recorded for the evaluation and calculation of the A_{rms} value as defined in ISO 80601-2-61.

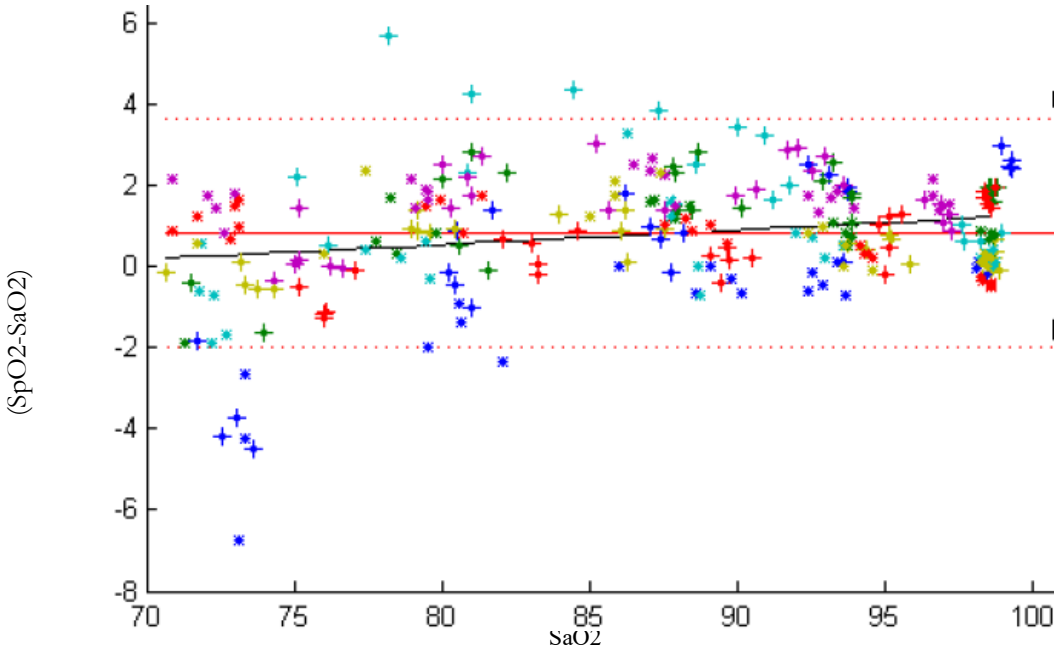
1. ISO 9919:2005: Medical electrical equipment - Particular requirements for the basic safety and essential performance of pulse oximeter equipment for medical use.
2. ISO 80601-2-61:2011: Medical electrical equipment - Part 2-61: Particular requirements for basic safety and essential performance of pulse oximeter equipment.
3. Bland, J. Martin and Altman, Douglas G., (2007) *Agreement Between Methods of Measurement with Multiple Observations Per Individual*, Journal of Biopharmaceutical Statistics, 17:4, 571-582

M1191B/M1191BL



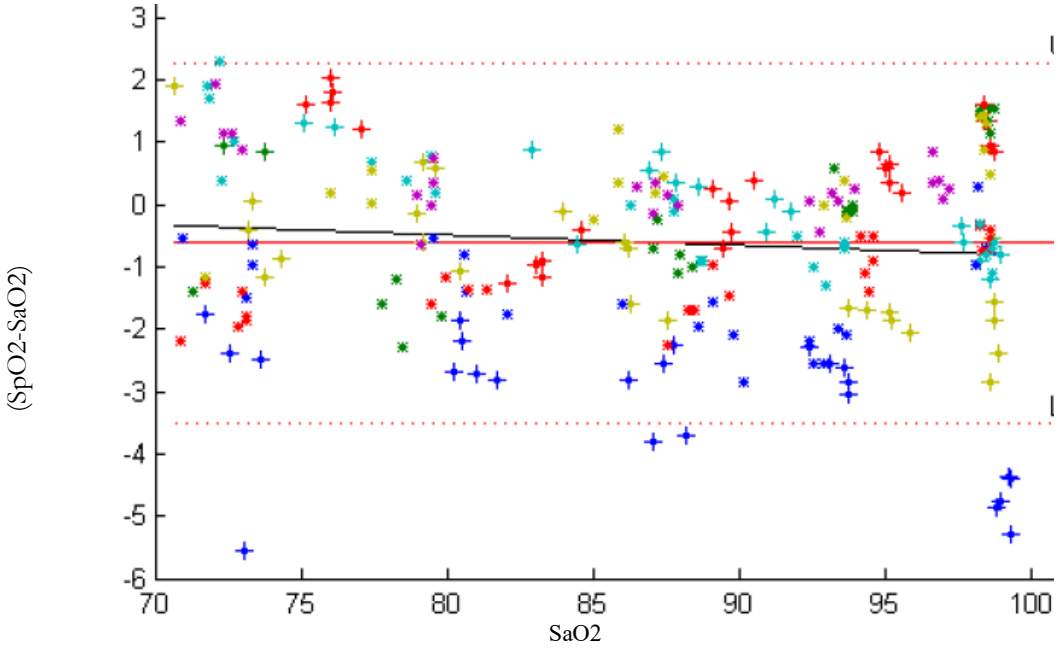
Measured A_{RMS} Values	
Range	**A_{RMS}**
90-100%	1.22%
80-90%	1.11%
70-80%	1.37%

M1191T/M1192A/M1192T



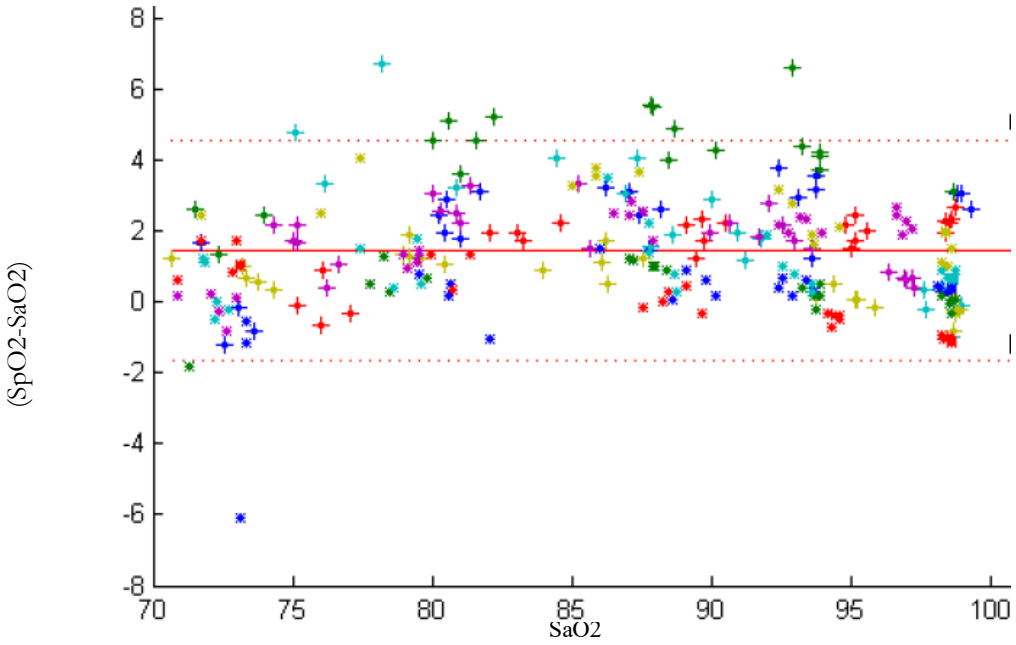
Measured A_{RMS} Values	
Range	**A_{RMS}**
90-100%	1.35%
80-90%	1.76%
70-80%	1.92%

M1194A



Measured A_{RMS} Values	
Range	**A_{RMS}**
90-100%	1.65%
80-90%	1.45%
70-80%	1.49%

M1196A/M1196S/M1196T



Measured A_{RMS} Values	
Range	**A_{RMS}**
90-100%	1.89%
80-90%	2.58%
70-80%	1.86%

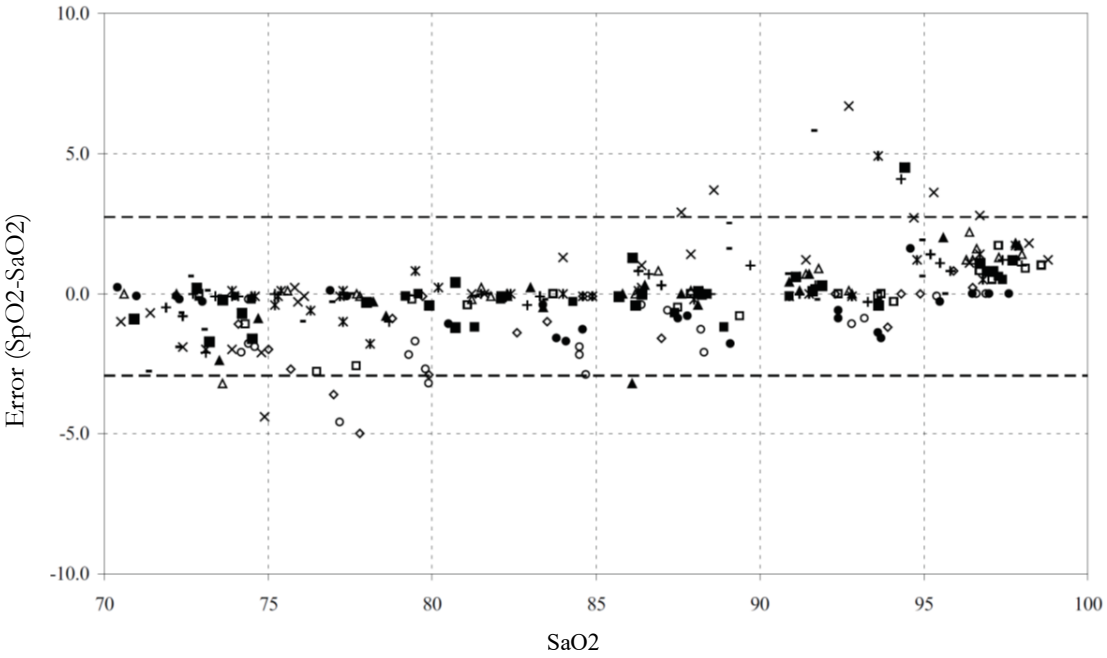
Performance Specification Details for Masimo SET Sensors

The Bland Altman plots displayed below are applicable to the specified Masimo sensor types, regardless of the connection type.

Table information for the plots displayed below show A_{RMS} values measured with Masimo SET Oximetry Technology in a clinical setting.

Masimo M-LNCS, RD SET, and LNCS sensors types have the same optical and electrical properties and may differ only in application type (adhesive/non-adhesive/hook & loop), cable lengths, optical component locations (top or bottom of sensor as aligned with cable), adhesive material type/size, and connector type (RD 15 pin modular plug, LNCS 9 pin, cable based, and M-LNCS 15 pin, cable based). All sensor accuracy information and sensor application instructions are provided with the associated sensor directions for use.

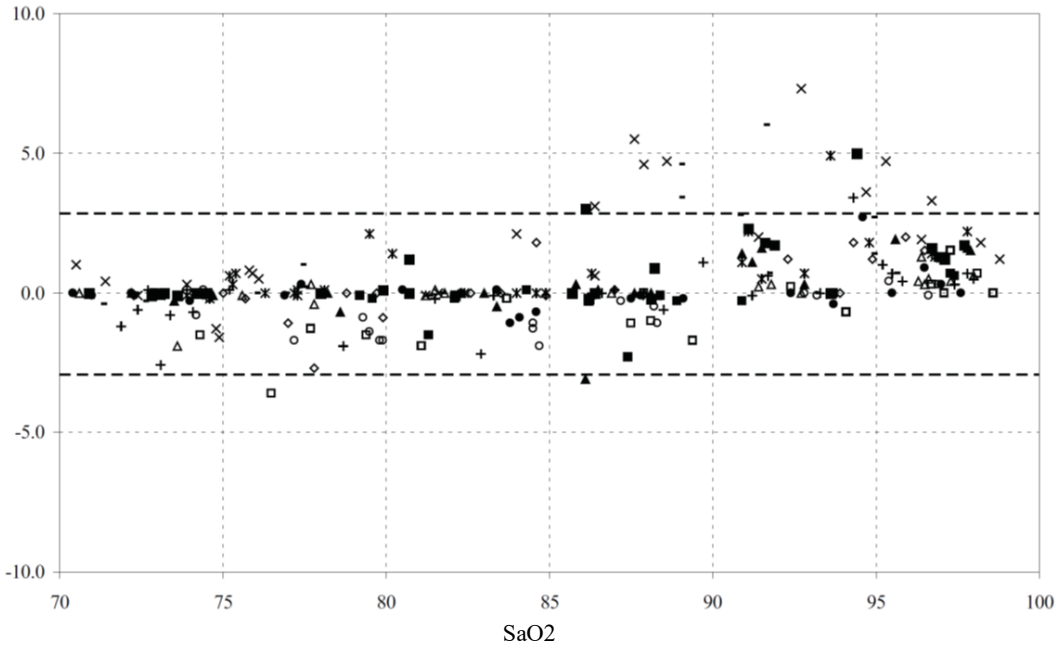
Adtx/Pdtx



Measured A_{RMS} Values	
Range	**A_{RMS}**
90-100%	1.64%
80-90%	1.07%
70-80%	1.55%

Overall Claimed Accuracy Value	
Range	**A_{RMS}**
70-100%	± 2%

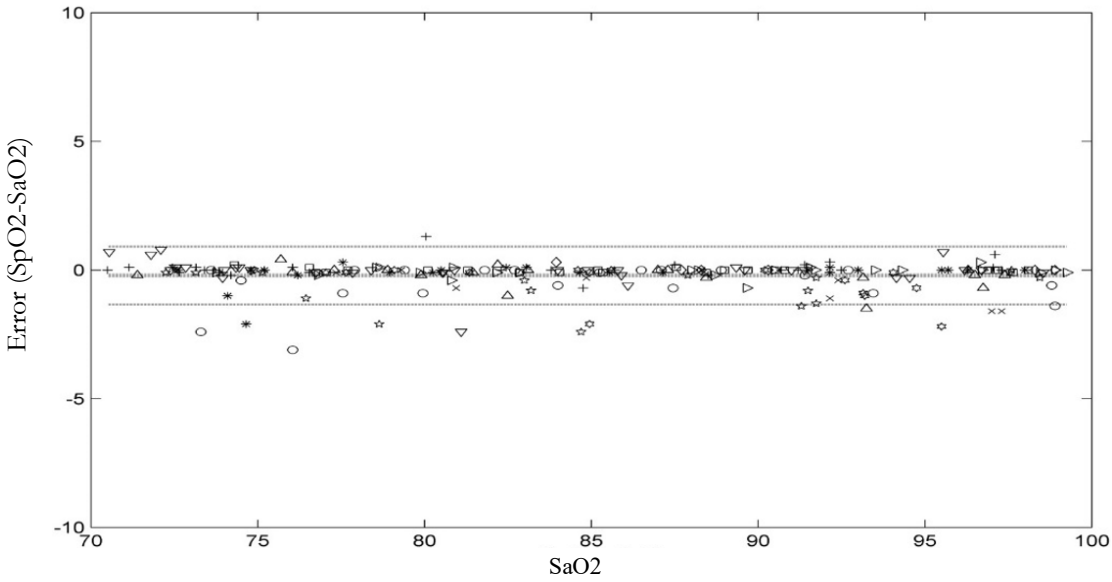
Inf/Neo/NeoPt



Measured A_{RMS} Values	
Range	**A_{RMS}**
90-100%	1.85%
80-90%	1.44%
70-80%	0.89%

Overall Claimed Accuracy Value			
Range	**A_{RMS}**		
	Inf	**Neo***	**Neo Pt***
70-100%	± 2%	± 2% Adult ± 3% Neonatal	± 3%
*The saturation accuracy of the Neonate and Preterm sensors was validated on adult volunteers and 1% was added to account for the properties of fetal hemoglobin.			

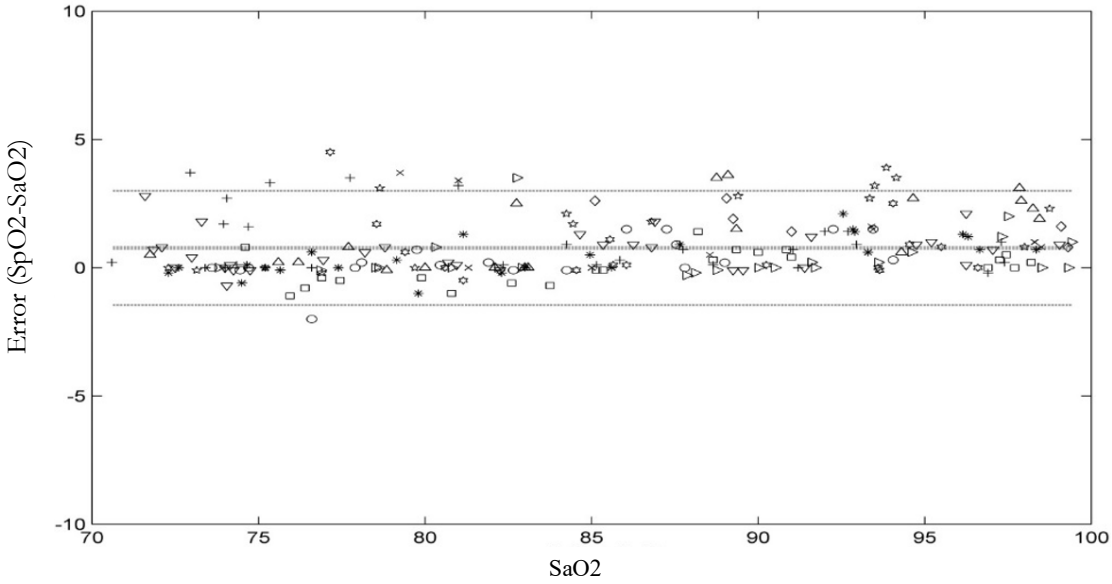
DCI/DCIP



Measured A_{RMS} Values	
Range	**A_{RMS}**
90-100%	0.60%
80-90%	0.54%
70-80%	0.67%

Overall Claimed Accuracy Value	
Range	**A_{RMS}**
70-100%	2%

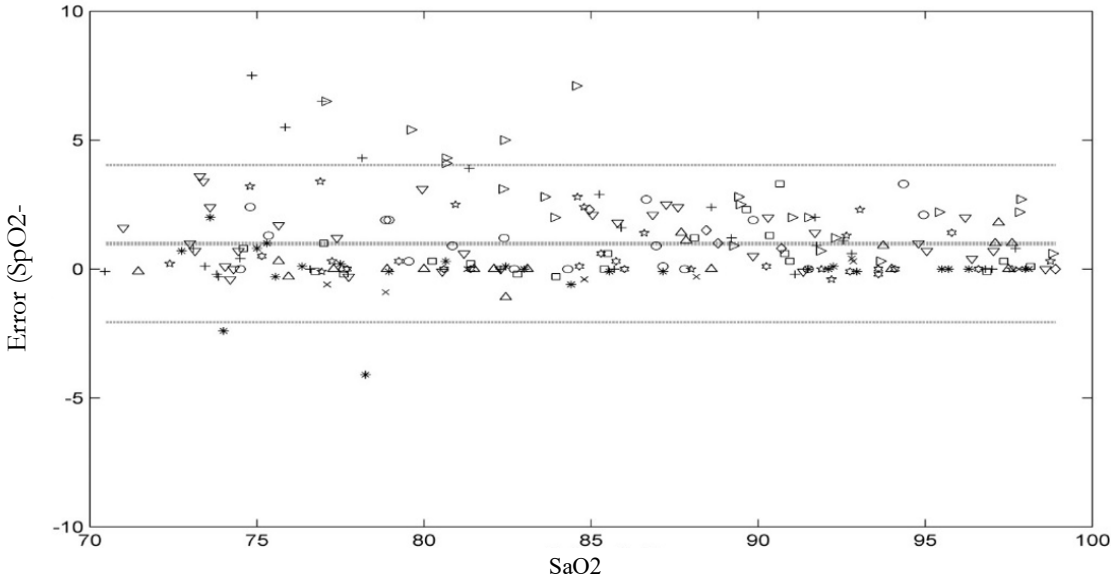
TFI



Measured A_{RMS} Values	
Range	**A_{RMS}**
90-100%	1.45%
80-90%	1.22%
70-80%	1.41%

Overall Claimed Accuracy Value	
Range	**A_{RMS}**
70-100%	2%

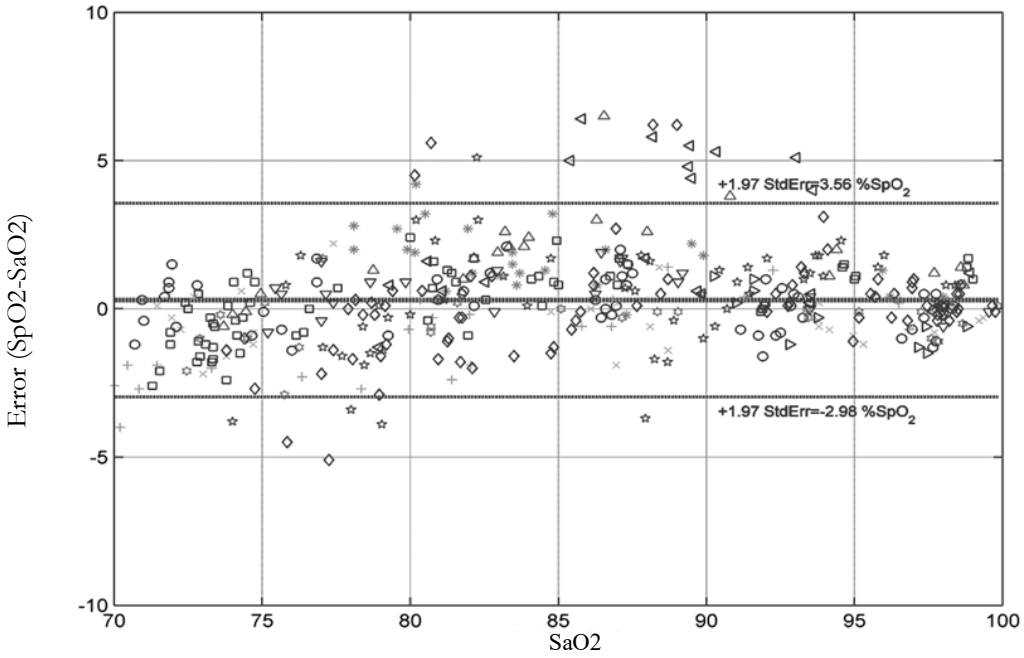
TCI



Measured A_{RMS} Values	
Range	**A_{RMS}**
90-100%	1.05%
80-90%	1.67%
70-80%	2.43%

Overall Claimed Accuracy Value	
Range	**A_{RMS}**
70-100%	3.5%

DBI



Measured A_{RMS} Values	
Range	**A_{RMS}**
90-100%	1.03%
80-90%	2.03%
70-80%	1.03%

Overall Claimed Accuracy Value	
Range	**A_{RMS}**
70-100%	2%

Pulse Oximetry Measurement (FAST)

The MX40 supports an SpO_2 sensor connection using Fourier Artifact Suppression Technology (FAST). SpO_2 can be measured continuously, where a value is sent to the Information Center every second, or as a single, individual manual measurement, or as an automatic measurement at configured intervals (PIC iX only). 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 photodetector 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 within $\pm A$rms of the value measured by a CO-oximeter.

SpO_2 Sensors, Cables and Indicators

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. For a complete listing of supported sensors for the MX40, See “Accessories” on page 197.

Sensor Application Safety Information

Warnings

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° C (99° F) 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.

Selecting an SpO_2 Sensor (FAST)

Warnings

- Use only Philips-approved accessories. Use of product accessories (patient cables, SpO2 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 (an alternative for use on adult patients only) 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. **Note** — See the Instructions 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.

Selecting an SpO_2 Sensor (Masimo SET)

Follow the guidelines as published in the Instructions for Use supplied with your sensor/cable.

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 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 **Tone Modulation** in the **Setup SpO_2** menu.

Note — Tone Modulation Indication is only available when operating in Continuous mode. It is not available when operating in Manual or Auto mode.

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

Warnings

- Removal of the SpO_2 sensor from the MX40 patient cable during Continuous or Auto 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 considerable battery power. If you do not intend to resume Continuous or Auto SpO_2 monitoring, change to Manual mode. There is no technical alarm for a "No Sensor" condition in Manual mode.
- After silencing a “No Sensor” technical alarm and turning the SpO2 measurement off, plugging the sensor back in turns the measurement back on if operating in Continuous mode. If operating in Manual or Auto mode, the measurement must be manually started at either the Information Center or the MX40.
- If you measure SpO_2 on a limb that has an inflated NBP cuff, a non-pulsatile SpO_2 technical alarm can occur (SpO_2 FAST only). 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 hypoxia.

SpO_2 measurements can be made manually on an as-needed basis in Manual mode, continuously in Continuous mode, or automatically in Auto mode (Patient Information Center iX only), depending on your MX40 configuration. A Manual Mode measurement will be removed from the Information Center display after 1 hour. 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.

Note — SpO_2 monitoring requires substantial battery power. Use Continuous or Auto Mode as needed for patient condition or unit protocol. When continuous SpO_2 monitoring is no longer needed, change to Manual mode to extend battery life. Manual mode does not consume battery power other than when the actual measurement is performed. SpO_2 mode can be changed at the MX40 or at the Information Center.

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 SpO_2 mode 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**, **Manual** or **Auto** mode.

3 If using Manual or Auto mode, select **Start**.

SpO_2 Only Operation

The MX40 can operate in SpO_2 only mode in two ways:

- by using the accessory cable, FAST p/n 989803199081, Masimo p/n 989803202391, (ECG remains off after battery changes), or
- by manually turning ECG off (ECG must be turned off every time the battery is changed).

To manually turn off ECG:

1 Touch the **HR** Parameter.

2 In the **Setup ECG** menu, scroll to the second menu page and select **ECG** to toggle **On** to **Off**.

To manually turn ECG back on:

1 Touch any blank Measurement Area on the display.

2 In the **Change Numeric** menu, select **H**R.

When operating in SpO_2 only mode, the INOP **ECG/Arrh AlarmsOff** is displayed to remind the clinician that ECG and Arrhythmia alarms are off.

To continue uninterrupted SpO_2 monitoring, replace the battery when the **Tele Battery Low** INOP is displayed.

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. 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 alarm delay time is 0 to 30 seconds (adjustable in one second steps) with a default time for Desat of 20 seconds and a default time for High/Low Alarm of 10 seconds. The delay time for alarm availability on the network is less than five 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.

Note — For MX40 FAST SpO_2 devices prior to B.06.5X, The SpO2T No Pulse INOP was available for Continuous measurements only. For MX40 devices B.06.5X and later, the SpO2T No Pulse INOP is available for all measurement modes, but may be delayed by up to 35 seconds after display of invalid data noted by "?".

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 devices is done by assigning 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.

Warnings

- 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 and the feature is enabled. Monitors that have this equipment will display the short-range radio symbol  on the label.
- Each medical device may use different alarm settings. Be sure to confirm the settings for the devices in your area after equipment transitions.
- If the short-range radio connection is terminated or interrupted, measurements from the patient monitor are no longer available at the Information Center.
- As long as the ECG is being measured with the MX40, there will be no signal available at the ECG Analog output or ECG Sync Pulse output.

Caution

When the MX40 patient cable is connected to a patient monitor using the MX40 / IntelliVue Patient Monitor Adapter Cable, (p/n 989803172211), the SpO_2 sensor must be directly connected to the patient monitor to monitor SpO_2.

Note — The MP5T and MP5SC are non-networked devices as they do 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 Own Patient Overview window on the patient monitor.

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

Warnings

- All data presented in the own patient overview window are delayed for several seconds. If you need realtime data, for example for defibrillation, always use the host monitor ECG instead of telemetry or ECG from another monitoring device. As long as the ECG is being measured with another device there will be no ECG signal available at the ECG analog output.
- Should an ECG Leads Off condition occur and Pulse alarming is desired, SpO2T must be the source.

Device Assignment at the MX40

To assign an MX40 to an IntelliVue Cableless Measurement device:

1 At the Cableless Measurement device, press and hold the left hardkey to activate the short-range radio.

2 Press the SmartKey button on the MX40.

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

4 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. Press and hold the left hardkey 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 "add equipment" icon  .

3 In the **Add Cableless** menu, select the correct equipment label for the device.

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 for the device in use.

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



When the devices are networked, all data is sent to the Information Center. 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 Own Patient Overview window.

If the devices are unassigned or the MX40 battery life is low or depleted, the short-range radio connection is ended.

To unassign a Cableless Measurement 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**.

Note — A patient monitor must be unassigned from the MX40 at the patient monitor.

Device Assignment at the Patient Monitor

At the patient monitor, you can assign an MX40 to the patient monitor using the **Main Setup > Measurements > Telemetry > Setup Telemetry** menus on the patient monitor.

Monitoring with Non-networked Devices

To transmit additional measurement data to the Information Center, such as NBP, Pulse from SpO_2, and Predictive Temperature, MX40 devices can be assigned to non-networked patient monitors provided both are equipped with short-range radio capability. Associated INOPs and alarms are also generated.

Note — 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 Own Patient Overview window is not displayed when devices are non-networked. Patient Demographics are only displayed at the Information Center.

Note — When SpO_2 is measured at the patient monitor only, the SpO_2 numeric is transmitted to the Information Center, however, the Pleth wave is only visible at the patient monitor.

Alarm Behavior

When the MX40 is assigned to a non-networked monitor, physiological alarms and technical alarms are generated independently at both the Information Center and the patient monitor. Alarm limits are not synchronized. When you adjust alarm settings at the monitor, the changes do not take effect at the Information Center and vice versa.

More Bed Alarms

The More Bed Alarms INOP is displayed at the Information Center when a physiological alarm or INOP is generated by the patient monitor that is not currently included in the group of alarms that is transmitted to the Information Center by the MX40. The INOP will display using the corresponding severity color of the actual alarm. For example, should the patient monitor generate a "***DESAT alarm", it will display at the Information Center as a red !!!More Bed Alarms INOP.

Warning

***Desat, ***Apnea, and ***<Pressure> High alarms from the patient monitor will appear as red !!!More Bed Alarms INOPs at the Information Center.

Controls Available when Assigned to IntelliVue Cableless Measurements

Action	At the MX40	At the Cableless Measurement Device	At the IIC	At the PIC iX
SpO2				
Start SpO2	Yes	Yes	Yes	Yes
Change SpO2 Mode	Yes	Yes	Yes	Yes
Select SpO2 Repetition Time	No	No	No	Yes
Assign SpO2 Pod	Yes	Yes	No	No
Remove SpO2 Pod	Yes	Yes	Yes	No
Change Alarm Limits	No	No	Yes	Yes
Place Device in Standby	Yes	No	No	Yes
Alarm Silence/ Acknowledge	Yes (local only)	No	Yes	Yes
Alarm Off/Pause	Yes (if enabled)	No	Yes	Yes
NBP				
Start/Stop/Stat NBP	Yes **Note —**During the measurement, the control is grayed out. Use the **Stop All** control.	Yes	Yes	Yes
Change NBP Mode	Yes	Yes	No	No
Change NBP Repetition Time	No	Yes	No	No

Action	At the MX40	At the Cableless Measurement Device	At the IIC	At the PIC iX
Change Alarm Limits	No	No	Yes	Yes
Assign NBP Pod	Yes	Yes	No	No
Remove NBP Pod	Yes	Yes	Yes	No
Place Device in Standby	Yes	No	No	Yes
Alarm Silence/ Acknowledge	Yes (local only)	No	Yes	Yes
Alarm Off/Pause	Yes (if enabled)	No	Yes	Yes

Controls Available when Assigned to Networked IntelliVue Patient Monitors

Action	At the MX40 (N/A)	At the Patient Monitor	At the IIC	At the PIC iX
SpO2				
Start SpO2		Yes	Yes	Yes
Change SpO2 Mode		Yes	Yes	Yes
Select SpO2 Repetition Time		Yes	No	Yes
Assign SpO2 Pod		Yes	No	No
Remove SpO2 Pod		Yes	Yes	No
Change Alarm Limits		Yes	Yes	Yes
Place Device in Standby		No	No	Yes
Alarm Silence/ Acknowledge		Yes	Yes	Yes
Alarm Off/Pause		Yes	No	Yes
NBP				
Start/Stop/Stat NBP		Yes	Yes	Yes
Change NBP Mode		Yes	No	No
Change NBP Repetition Time		Yes	No	Yes
Change Alarm Limits		Yes	Yes	Yes
Assign NBP Pod		Yes	No	No
Remove NBP Pod		Yes	Yes	No
Place Device in Standby		No	No	Yes
Alarm Silence/ Acknowledge		Yes	Yes	Yes
Alarm Off/Pause		Yes	No	Yes

Controls Available when Assigned to Non-Networked IntelliVue Patient Monitors

Action	At the MX40 (N/A)	At the Patient Monitor	At the IIC	At the PIC iX
SpO2				
Start SpO2		Yes	Yes	No
Change SpO2 Mode		Yes	Yes	No
Select SpO2 Repetition Time		No	No	No
Assign SpO2 Pod		Yes	No	No
Remove SpO2 Pod		Yes	Yes	No
Change Alarm Limits		Yes, IPM only	Yes, PIIC only	No
Place Device in Standby		IPM standby only	No	No
Alarm Silence/ Acknowledge		Local only	Yes, PIIC only	Yes, PIC iX only
Alarm Off/Pause		Yes	No	No
NBP				
Start/Stop/Stat NBP		Yes	No	No
Change NBP Mode		Yes	No	No
Change NBP Repetition Time		Yes	No	No
Change Alarm Limits		Yes, IPM only	Yes, PIIC only	Yes, PIC iX only
Assign NBP Pod		Yes	No	No
Remove NBP Pod		Yes	Yes	No
Place Device in Standby		IPM standby only	No	No
Alarm Silence/ Acknowledge		Local only	Yes, PIIC only	Yes, PIC iX only
Alarm Off/Pause		Yes	No	No

Networked Device Synchronized Settings

If the patient's ECG is initially being measured with a patient monitor, and then the patient is connected to the MX40 for monitoring, the Information Center will use the patient monitor settings for the MX40. When the initial ECG source is the MX40, and then the patient is connected to the monitor, the Information Center uses its Telemetry Setup settings. The following settings will be synchronized (MX40 / IntelliVue Patient Monitor Adapter Cable, p/n 989803172211, required):

Heart Rate	HR/Pulse Alarm On/Off, Heart Rate High/Low Limit
ECG	Primary Lead, Secondary Lead, Va Lead, Vb Lead, Lead Placement, Hexad (Va, Vb)
Arrhythmia	On & Unlocked, On & Locked, Off & Unlocked, Off & Locked, Off & Hide, Analysis Mode, Arrhythmia On/Off, Asystole Threshold, Pause Threshold, VTach HR, VTach Run, PVCs/min, Vent. Rhythm, SVT HR, SVT Run, PVCs/min On/Off, Pacer not Capture On/Off, Pacer not Pacing On/Off, Non-sustain On/Off, Vent. Rhythm On/Off, Run PVCs On/Off, Pair PVCs On/Off, Missed Beat On/Off, Pause On/Off, R-on-T On/Off, Vent. Bigeminy On/Off, Vent. Trigeminy On/Off, Multiform PVCs On/Off, Irregular HR On/Off, SVT On/Off, Afib On/Off, Afib/IrrHR End Threshold, Afib Remind Time
ST	ST Analysis On/Off, ST Alarm On/Off, ISO point, J point, ST point, ST Auto/Manual, ST Baseline
STE	STE Analysis On/Off, STE Alarm On/Off
QT	QT Analysis On/Off, QTc High On/Off, QTc High Alarm Limit, ΔQTc High On/Off, ΔQTc High Alarm Limit, QT Lead, QT Baseline
SpO2T	SpO_2 Alarms On/Off, SpO_2 Alarm Limits, NBP Alarm Suppression On/Off, Pulse (SpO_2) On/Off, Desat Limit

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. What is displayed depends on which version of the Information Center is in use, IntelliVue Information Center Release N or later (referred to here as IIC), or Patient Information Center iX (referred to here as PIC iX).

MX40 Connection to the Information Center

Once the MX40 has been assigned to a sector at the Information Center, the settings (alarms, arrhythmia and configured Unit settings) are synchronized with the MX40. You may see a "Settings sync'd" message in the Status Area on connection, re-connection, and anytime the settings are updated at the Information Center. Arrhythmia Learning/Relearn occurs on connection and re-connection to the IIC.

Warning

Since Relearn happens automatically at the IIC, 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.

Upon loss of connection to the Information Center the MX40:

- turns on its display
- displays the "No Central Monit" INOP
- uses the last known settings from the Information Center.
- new physiological alarms are announced locally only.
- Active alarms that occurred prior to the loss of connection can be viewed in the Alarm List.
- Patient Name is retained.
- Vitals Trend data is retained.

When a loss of battery power occurs while not connected to the Information Center, the MX40 retains the last known alarm limits and vitals trends data but this is not sent to the Information Center at re-connection. Patient name is restored at re-connection.

When operating wirelessly via a short-range radio connection to an IntelliVue Patient Monitor, changes made to patient name are updated at the Information Center and the patient monitor, however, they are not reflected in the Patient Information Area on the MX40. The update occurs when network connection is restored.

Because the MX40 retains patient name and vital trends, when the MX40 is to be used to monitor a new patient, ensure the removal of patient name and vitals trends data by discharging the previous patient at the Information Center.

Backfilling Wave Dropouts (MX40 WLAN only)

In case of network dropouts between the Information Center iX and MX40 WLAN (Part Number 865352 Release B.05 or later with PIIC iX B.02 or later), the MX40 will make a best effort attempt to resend up to the last 10 seconds of wave data to the Information Center iX review applications. The Information Center does not backfill wave data in real-time displays.

Warning

Alarms and Events are not uploaded.

Note — The system fills the gaps before it stores the last minute of wave data to the database. Once the gap is in the review application, it is not filled.

Note — There is no guarantee that gaps will be filled because the backfill wave messages can be dropped on the network.

Note — Wave gaps are not backfilled if the MX40 loses association.

MX40 Controls in the Patient Window (IIC)

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 **Adjust 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. 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.

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.



MX40 Controls in the Patient Window (PIC iX)

The Patient Window at the Information Center iX includes controls for a number of MX40 operations. For detailed instructions on these operations, see the *Patient Information Center iX Instructions for Use* or the *Online Help*.

To View ECG, Resp, NBP or SpO_2 Alarm Limits

1 Click on the **Measurement** label in the Patient Window to display the current high and low alarm limits.

To Change ECG, Resp, NBP or SpO_2 Alarm Limits

1 Click on the **Measurement** label in the Patient Window.

2 Click on **High Limit** or **Low Limit** and select the new value from the list.

To Change Paced Status

1 Click on the **HR** label in the Patient Window.

2 Click on **Paced Mode**.

3 Click on **Off** or **On** to select the status.

Warning

At admission/discharge, always check that paced status is correct for the patient.

To Change ECG Waveform Size

1 Click on the appropriate waveform.

2 Select **Size Up** or **Size Down**.

To Select Lead

1 Click the appropriate waveform.

2 Select the desired lead label 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 Click the **Measurements** button.

2 Select **ECG** from the menu on the left.

3 Select **Va** or **Vb** from the **ECG** menu on the right and select from the list.

To Initiate a Manual SpO_2 Measurement

1 Click the **Measurements** button.

2 Select **SpO2** from the menu on the left.

3 Select **Start** from the **SpO2** menu on the right.

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. Find Device requires that the MX40 has sufficient battery power and is within the coverage area.

To locate an MX40 (IIC):

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/Acknowledge Alarm button on the MX40.

To locate an MX40 (PIC iX):

1 Click the **Measurements** application button.

2 Select **Telemetry Setup**.

3 Select **Find**.

To silence this tone, touch the Silence/Acknowledge Alarm button on the MX40.

Viewing Device Location and Location History (optional)

MX40 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.

Location History (IIC)

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. The total timespan of the log is 60 minutes.

Location History (PIC iX)

You can view the location history for a particular MX40 by clicking on the compass icon in the Patient Window. The location and time-stamped history is displayed for each equipment label.

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 history in the Telemetry Setup window, you must re-enter Telemetry Setup to see the change, as it does not update automatically.

Note — The IntelliVue Device Location feature is not supported for use with the MX40 WLAN device, Part Number 865352.

Using the Device Location Client (optional - IIC only)

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 (IIC)

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.	*enabled* *disabled* **Note —** this does not affect the appearance of the pacer spikes on the MX40.	disabled
Enable SpO_2	Enable/disable the SpO2 measurement at the Information Center and the MX40.	*enabled* *disabled*	enabled

Patient-Configurable Settings in Telemetry Setup			
Control	**Function**	**Setting Choices**	**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 at the MX40 from the SmartKeys menu or the SpO2 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)
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.	*enabled* *disabled*	enabled
Pleth Wave	Enable/disable the transmission of the Pleth wave (and its subsequent display) to the Information Center. For Continuous SpO_2 mode only.	*enabled* *disabled* **Note —** When enabled, the Pleth wave replaces the Vb wave in the Patient Window during 6-lead monitoring.	disabled (Pleth is not displayed.)

Patient-Configurable Settings in Telemetry Setup			
Control	**Function**	**Setting Choices**	**Factory Default**
Pulse	Enable/disable display of the Pulse rate at the Information Center. For Continuous SpO_2 mode only.	*enabled* *disabled*	disabled (Pulse rate is not displayed.)
SpO_2 Alarm	Turn SpO_2 alarms on/off at the Information Center and the MX40.	*enabled* (on) *disabled* (off)	enabled
Unit Settings	Change current settings back to last saved clinical unit settings.	(none)	

Unit Configurable Settings (IIC)

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. 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 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

Unit Settings - Telemetry Setup			
Control	**Function**	**Settings**	**Factory Default**
Standby Duration	Sets the standby duration time when Standby is selected at the IIC. **Note —** Standby Duration can also be set at the MX40. The Standby time period may differ between the device and the default setting at the Information Center. The duration is determined by the location of the Standby selection, i.e. placing the MX40 in Standby mode at the device or at the Information Center. When the MX40 comes out of Standby at either location, the device is activated in both locations.	*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.	*enabled* *disabled*	disabled
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	Display/disable a battery gauge for each assigned device on the Information Center.	*enabled* *disabled*	enabled (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.	*enabled* *disabled*	enabled (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.)
Auto Pair	Enable/disable the autopairing of the MX40 and the IntelliVue Patient Monitor at the Information Center.	*enabled* *disabled*	enabled
Enable Cableless Measurements	Enable/disable the use of IntelliVue Cableless Measurements for SpO_2 and NBP	*enabled* *disabled*	disabled (Short-range Radio connection to IntelliVue Patient monitors is possible.)
SRR Fast Transition	Reduce the delay time when fast switching between the MX40 and the patient monitor.	*enabled* *disabled*	enabled
Fixed Pacer Amplitude	Sets the appearance of the pacer spikes at the Information Center to a fixed size as they appear in the patient window.	*enabled* *disabled*	disabled
Enable SpO_2	Enable/disable the SpO_2 measurement at the Information Center.	*enabled* *disabled*	enabled

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 SpO2 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 hypoxia.	*enabled* *disabled*	enabled
Pleth Wave	Enable/disable the transmission of the Pleth wave and its subsequent display to the Information Center. For Continuous mode only.	*enabled* *disabled* **Note —** When enabled, during 6-lead monitoring, the Pleth wave will replace the Vb wave in the Patient Window.	disabled (Pleth wave is not displayed.)

Unit Settings - Telemetry Setup			
Control	**Function**	**Settings**	**Factory Default**
Pulse	Enable/disable the transmission of the Pulse rate and its subsequent display to the Information Center. For Continuous mode only.	*enabled* *disabled*	disabled (Pulse rate is not displayed.)
SpO_2 Alarm	Turn SpO_2 alarms on/off at the Information Center.	*enabled* (on) *disabled* (off)	enabled
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 - Telemetry Setup / Default Leads			
Control	**Function**	**Settings**	**Factory Default**
3-wire Cable	Set the unit default lead.	*I*, *II*, *III*	II
5-wire Cable, ECG1	Set the unit default lead.	*I*, *II*, *III*, *MCL*, *aVR*, *aVL*, *aVF*, *V*	II
5-wire Cable, ECG2	Set the unit default lead.	*I*, *II*, *III*, *MCL*, *aVR*, *aVL*, *aVF*, *V*	V
5-wire Cable, ECG3	Set the unit default lead.	*I*, *II*, *III*, *MCL*, *aVR*, *aVL*, *aVF*, *V*	III
5-wire Cable 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 Cable 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 Cable 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 Cable 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 Cable, Va	Set the unit default lead	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
6-wire Cable, Vb	Set the unit default lead	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

Unit Settings - Telemetry Setup / Default Leads			
Control	**Function**	**Settings**	**Factory Default**
6-wire Cable, 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 Cable, 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 Cable, 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 Cable, 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 - Telemetry Setup / 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 5.	*Limit Maximum is 260* *Limit Minimum is 10*	160 Adult 120 Pediatric
Systolic Low	Increment/decrement NBP low alarm limit by 5.	*Limit Maximum is 260* *Limit Minimum is 10*	90 Adult 70 Pediatric
Diastolic High	Increment/decrement NBP high alarm limit by5.	*Limit Maximum is 260* *Limit Minimum is 10*	90 Adult 70 Pediatric
Diastolic Low	Increment/decrement NBP low alarm limit by 5.	*Limit Maximum is 260* *Limit Minimum is 10*	50 Adult 40 Pediatric
Mean High	Increment/decrement NBP high alarm limit by 5.	*Limit Maximum is 260* *Limit Minimum is 10*	110 Adult 90 Pediatric

Unit Settings - Telemetry Setup / NBP Setup			
Control	**Function**	**Settings**	**Factory Default**
Mean Low	Increment/decrement NBP low alarm limit by 5.	*Limit Maximum is 260* *Limit Minimum is 10*	60 Adult 50 Pediatric

Unit Settings - Alarms			
Control	**Function**	**Settings**	**Factory Default**
ECG 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
Yellow	Set latched/non-latched status for SpO_2, ST, and other non-arrhythmia yellow alarms.	*Latched* *Non-latched*	Latched
Reminders	Enables alarm and INOP reminders.	*Enabled* *Disabled*	*Enabled*

Global Settings (PIC iX)

Global settings for Alarm Management, Telemetry Setup, and ECG Management are listed below with available choices and default settings. Telemetry Profiles including ECG, Arrhythmia, SpO_2 and Resp are documented in the *Patient Information Center iX Release C.02 Configuration Guide*, p/n 453564677041. The guide is included on the MX40 Documentation CD that shipped with your device.

Alarm Management

Control	Function	Setting Choices	Factory Default
Alarms Off Prio	Sets the types of alarms that can be paused for a configured amount of time from the PIC iX.	Red and Yellow Yellow Only (red alarms must be turned off at the device) Not Allowed	Yellow Only
Alarms Off	Sets the amount of time all alarms will be paused if selected.	1, 2, or 3 minutes.	2 min
Audible Latching	Sets which alarms must be silenced/ acknowledged even if the condition no longer exists (applies to non-arrhythmia alarms only).	Red and Yellow Red Only	Red and Yellow

Control	Function	Setting Choices	Factory Default
Alarm Reminder	Sets the appearance and behavior of how an alarm will remind if the alarm condition persists (applies to non-arrhythmia alarms only).	On Realarm Off	On
Inop Reminder	Sets the appearance and behavior of how an Inop will remind if the INOP condition persists.	On Realarm Off	On
Reminder Time	Sets the time period for Reminders.	1, 2, or 3 minutes	3 min
No Data Inop	Sets the severity of the No Data from Mon. INOP. **Note —** The No Data Tele INOP on the MX40 is always a hard INOP.	Hard Soft	Hard
ECG Leads Off	Sets the severity for the ECG Leads Off INOP.	Cyan Yellow Red	Yellow
Replace Battery	Sets the severity for the Replace Battery INOP.	Cyan Yellow Red	Yellow
Leadset Unplugged	Adjust the severity level of this technical alarm (INOP).	Cyan Yellow Red	Cyan
No Pulse	Adjust the severity level of this technical alarm (INOP).	Cyan Yellow Red	Cyan
Some ECG AI INOP	Allows for notification whenever the On/Off settings for ECG/Arrhythmia alarms differ from the current Profile.	On Off	On
HR Alarms	Sets heart rate limit alarm type.	Short Yellow Yellow	Short Yellow

Telemetry Setup

Control	Function	Setting Choices	Factory Default
Mute (N/A for MX40)	Toggle adjustable sounds On/Off.	On Off	N/A
Volume at Device (N/A for MX40)	Sets the volume level.	1 - 5 (5 being loudest)	3

Control	Function	Setting Choices	Factory Default
Telemetry Button	Determines the action when the Telemetry Button is pressed.	Nurse Call - generates nurse call alarm that is marked as an event in Alarm Review. Record - generates an automatic recording. Call & Record - Creates both the nurse call alarm and automatically starts a recording. Off	Nurse Call
Standby Duration	Sets the standby duration time when Standby is selected at the PIC iX. **Note —** Standby Duration can also be set at the MX40. The Standby time period may differ between the device and the default setting at the Information Center. The duration is determined by the location of the Standby selection, i.e. placing the MX40 in Standby mode at the device or at the Information Center. When the MX40 comes out of Standby at either location, the device is activated in both locations.	10 minutes 20 minutes 30 minutes 1 hour 2 hours 3 hours 4 hours Infinite	Infinite
Global Resume	When set to On, resumes both the MX40 and patient monitor from Standby.	On Off	Off
Remote Pause	Enables all alarms to be paused at the device for the same configured amount of time that they are paused at the Information Center.	On Off	Off
RF Auto Shutoff	Selects whether the device will shut off after ECG LEADS OFF for longer than 10 minutes and the SpO_2 sensor cable is not connected for longer than 10 minutes.	On Off	Off
SRR Use Model	Selects whether the device will assign to patient monitor or cableless measurement device.	Look for Sensor Look for Monitor	Look for Monitor
SRR Fast Transition	Reduce the delay time when fast switching between the MX40 and the patient monitor	On Off	On

Control	Function	Setting Choices	Factory Default
Allowed Leadset (Not used with MX40. See "Choosing EASI or Standard Lead Placement" on page 74.)	Determines the default lead placement.	Standard EASI	Standard
Screen On Time	Determines how long the MX40 display is active by default.	1 min 2 min 5 min 15 min 30 min	1 min
Default Screen	Sets the default display screen.	2 Waves P (portrait) 1 Wave P (portrait) 2 Waves L (landscape) ChestDiagram	2 Waves P
Wave 1-4	Selects the waveforms that will be sent and stored. Wave 1 and Wave 2 will always be Primary and Secondary Lead respectively.	ECG Pleth Resp	Wave 1 and Wave 2 will always be Primary and Secondary Lead respectively. ECG

ECG Management

Control	Function	Settings	Factory Default
Primary Lead	Sets which lead will default to the Primary Lead for ECG analysis.	1, II, III, aVR, aVF, aVL, V1-6, V7-9, V3R - V5R	II
Secondary Lead	Sets which lead will default to the Secondary Lead for ECG Multi Analysis.	1, II, III, aVR, aVF, aVL, V1-6, V7-9, V3R - V5R	V2
Va Lead	Sets the default Va lead label.	V1-6, V7-9, V3R-V5R	V2
Vb Lead	Sets the default Vb lead label.	V1-6, V7-9, V3R-V5R	V5
Filter	Sets the filter on the ECG wave display.	0.5-40 Hz M 0.05-40 Hz ST	0.5-40 Hz M

Control	Function	Settings	Factory Default
Hexad (Va, Vb)	Sets the lead pairs for derived 12-lead ECG.	Off V1, V3 V1, V4 V1, V5 V2, V4 V2, V5 V3, V5 V3, V6	Off

Trends

This section covers the Trend functionality of the MX40. Trends are patient data collected over time and displayed in tabular or graphic (Option C03) 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 aperiodic measurements, such as SpO_2 or NBP. One hour of tabular trend information is standard on the MX40, with the option available for 24 hours (Option C03).

There are two groups of Trend views, Standard and Cardiac. Standard view displays HR, PVC, SpO_2, Pulse, and Resp. Cardiac view displays all ST values and QT, QTc, and ΔQTC in addition to the Standard view items.

For MX40 WLAN only, p/n 865352, (Release B.06 or later with IIC iX C.0 or later), up to eight hours of numeric data that is collected while the device is not connected to the Information Center automatically uploads once the device reconnects to the Information Center.

Note — All trend information is erased from the Vital Trend window when you discharge or transfer a patient, or if you change to Demonstration Mode. Trend information is not affected by battery replacement and remains stored.

Viewing Vital Trend Information

To view Vital Trend information:

1 Touch the SmartKeys button.

2 From the **SmartKeys** menu, select **Trends**.

To change the time interval:

1 Touch the time bar displayed horizontally across the screen.

2 Select a different time interval.

To change the view:

1 Touch the measurement column on the right.

2 Select **Standard** or **Cardiac**. Your setting choice is retained upon exiting the Trend display.

Note — Tabular values displayed are median values. Values in each column are grouped by the preceding minute, e.g. values in the column labeled 10:01 are from the 10:00 to 10:01 range.

Viewing Graphic Trend Information

If desired, the Graphic Trend view can be expanded and scaled to the MX40 display. Graphic Trend is only available on the MX40 with option C03 enabled.

To view Graphic Trend information:

1 Touch the SmartKeys button.

2 From the **SmartKeys** menu, select **Trends.**

3 Touch the measurement column.

4 Select **Graph Trend**.

To change the View

1 Touch the measurement column on the right.

2 Select **Standard** or **Cardiac**. Your setting choice is retained upon exiting the Trend display.

The time interval is changed as described above. Standard or Cardiac view is selected using the **Trends** menu where you also can toggle the **Optimum Scale: On/Off** setting. The **Trends** menu can also be displayed by touching the parameter column from the **Graph Trend** menu.

Maintenance

This section provides procedures for maintaining the MX40 after installation, including equipment label assignment, cleaning and battery care.

Cleaning

The procedure in this section keeps the MX40 and its accompanying patient cable and accessories (battery adapter tray, rechargeable battery) 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.

Caution

After use, the MX40 and accessories must be cleaned as per the instructions contained herein. Use only the recommended cleaners and disinfectants listed in the table below. Others may cause damage (not covered by warranty), degrade performance, reduce product lifetime, or cause safety hazards.

Note —No calibration needs to be performed on the MX40. For additional test and inspection procedure information, see the MX40 Installation and Service guide.

Note — Sterilization of the MX40 has been qualified using the STERRAD 100NX System. For more information and instruction on sterilizing the MX40, please contact your Steris representative. The alternative Steris V-pro process using hydrogen peroxide vapor is also acceptable.

Note — Single-Patient-Use leadsets are intended to be disposed of when use is complete. They are not to be re-used and are not designed to be cleaned using any of the materials listed below.

Note—The MX40 Battery Adapter Tray requires routine inspection, and will require replacement when visible signs of wear are present, including cracks, bends, crimping, or curling that can prevent disposable batteries from remaining securely in the tray. It is recommended that the MX40 Battery Adapter Tray be replaced every 12 months or sooner when visible wear is recognized.

Perform the following steps to clean the MX40 and accessories:

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

1 Remove the batteries and disconnect the patient cable. Note that disconnecting the patient cable for cleaning is dependent on your hospital's protocol. The connection between the MX40 and the patient cable is rated IPX7 (protected against the effects of temporary immersion in water). Care must be taken to ensure this area of connection is completely dry prior to reconnecting the MX40 with the patient cable. The MX40 and patient cable must be connected correctly and completely in order to maintain the IPX7 rating. The battery compartment of the MX40 has an IPX3 rating (protected against the effects of spraying water).

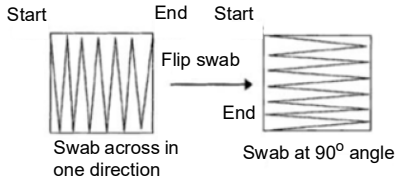
   a. If using disposable AA batteries, remove the battery adapter tray and clean separately. Dispose of AA batteries according to hospital policy.

   b. If using the MX40 rechargeable battery, remove and clean separately.

2 Clean the MX40, rechargeable battery, patient cables, and battery adapter tray before disinfecting.

3 Wipe the MX40, rechargeable battery, and patient cables using a lint-free cloth or cotton swab dampened modestly with one of the approved cleaning or disinfecting agents listed in the table below.

If using a cotton swab to clean or disinfect, swabbing should be unidirectional at a time. Parallel strokes should be used to cover the entire swab area as shown below.



4 Wipe the exterior surfaces of the patient cable using a lint-free cloth or cotton swab dampened modestly with one of the approved cleaning or disinfection agents listed in the table below. If the interior surfaces of the patient cable connector require disinfection, wipe using a lint-free cloth or cotton swab dampened modestly with isopropyl alcohol only. Wipe between and around the MX40 connector pins to remove chemical residue.

5 Wipe the outside surfaces of the battery adapter tray with one of the approved cleaning or disinfecting agents listed in the table below. Wipe the inside surfaces of the battery adapter tray with a lint free cloth dampened modestly with isopropyl alcohol.

6 Follow the manufacturer's instructions with regard to application duration.

7 Remove cleaner residue by wiping the MX40, exterior surfaces of the patient cables, rechargeable battery, and battery tray with a lint-free cloth modestly dampened with distilled water or isopropyl alcohol.

8 Allow to air-dry, or dry with a non-lint producing cloth.

9 Store the MX40 until ready to re-use. Do not insert rechargeable or disposable batteries until ready for use.

Cautions

- Never immerse or soak the MX40, the patient cable, the battery adapter tray, or the rechargeable battery in any liquid solution for cleaning or disinfecting. Damage may result.
- Use of cleaning/disinfecting agents other than isopropyl alcohol inside the patient cable connector and battery adapter tray can result in chemical residue build-up and damage to the contacts. Connecting the patient cable to the MX40 while there is still moisture from cleaning/disinfecting agents other than Isopropyl Alcohol present, and then inserting the rechargeable battery or battery adapter tray and batteries into the MX40 can result in corrosion of the MX40 pins and patient cable contacts.
- Use of brushes with stiff and/or wire bristles on any part or component of the MX40 may cause damage.

Cleaning Materials for the MX40

Cautions

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

Note —The cleaners listed in the following table have been tested and approved by Philips as of the print date of this document.

Note —The listed cleaners are also suitable for cleaning the outside of the patient cable, the rechargeable battery and the outside surface of the battery adapter tray.

Approved Cleaners

Cleaner	Active Ingredient
Isopropyl Alcohol	Isopropyl Alcohol (≥70%)
Hydrogen Peroxide	Hydrogen Peroxide (3%)
Chlorine Bleach	Sodium Hypochlorite (1:10 concentration, mixed < 24 hours)
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%)
Sani-cloth Plus Germicidal Cloths (Red Top)	Isopropyl alcohol (55%) n-Alkyl dimethyl ethyl benzyl ammonium chlorides n-Alkyl dimethyl benzyl ammonium chlorides 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%)
Sani-cloth HB	Quaternary ammonium (1%)
Sani-cloth Plus	Quaternary ammonium (0.25%) 2-Butoxyethanol (1-4%) Isopropyl alcohol (14.85%)
Super Sani-cloth	Quaternary ammonium (<1%) Isopropyl alcohol (55%)
Sani-cloth Bleach Germicidal Disposable Wipes (Orange Top)	Sodium Hypochlorite (0.6%)
Bacillol 25	Ethanol 100 mg/g, Propane-2-ol 90 mg/g Propane-1-ol 60 mg/g

Cleaner	Active Ingredient
Bacillol AF	Propane-1-ol (450 mg/g) Propane-2-ol (250 mg/g) Ethanol (47 mg/g)
Hydrogen Peroxide	Hydrogen peroxide (5%)
Meliseptol	Propane-1-ol, (50 g) Glyoxal (0.08 g)
Alkaspray Ultra	Bis (3-aminopropyl) dodecylamine (0.31 gm) Didecycl dimethyl ammonium chloride (0.16 gm) Benzalkonium chloride (0.03 gm)
Dismozon Plus	Magnesium monoperoxyphthalate hexahydrate (≥90%, ≤100%); Tridecanol, branched, ethoxylated (≥1%, <2.5%); Amines, coco alkyldimethyl, N-oxides(≥1%, <2.5%); (1 packet in 4 liters water, 0.4%)
Biguacid Liquid	ethanol (25 - 30 %) propan-2-ol (35 - 40 %) polyhexamethylene biguanide hydrochloride < 0.1 %
Lysoformin	Formaldehyde (6%) Glutaral (1.8%) (0.75% solution in water)
Descosept pur	Ethanol (45%)
Descogen Liquid	Pentakaliumbis (peroxymonosulfate) bis (sulphate) > 1%

Unsupported Cleaners

The following cleaners have been tested and failed. They should not be used to clean the MX40.

- Caltech-Dispatch 5200
- Cidex OPA
- Gluteraldehyde
- Liquid Soap (antibacterial soap)
- Omnicide
- Sanicloth AF
- Wavicide
- Cidex Formula 7
- Cidex Activated Dialdehyde
- Incidin
- Metricide
- Procide 14
- Virex Tb

Disposing of the MX40

Warning

To avoid contaminating or infecting personnel, the environment or other equipment, make sure you disinfect and decontaminate the MX40 appropriately before disposing of it in accordance with your

country's laws for equipment containing electrical and electronic parts. For disposal of parts and accessories where not otherwise specified, follow local regulations regarding disposal of hospital waste.

You will find detailed disposal information on the following web page:

http://www.healthcare.philips.com/main/about/Sustainability/Recycling/pm.wpd

The Recycling Passports located there contain information on the material content of the equipment, including potentially dangerous materials which must be removed before recycling (for example, batteries and parts containing mercury or magnesium).

Do not dispose of waste electrical and electronic equipment as unsorted municipal waste. Collect it separately, so that it can be safely and properly reused, treated, recycled, or recovered.

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.

Re-assigning an Equipment Label at the IntelliVue Information Center

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.

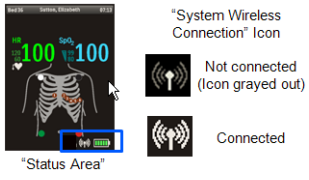
2 Select **All Controls -> Label Assignment**.

3 Enter password (tele).

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**.

Re-assigning an Equipment Label at the Patient Information Center iX

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

1 Enter the **Manage Unit** application (scroll down if necessary).

2 Select **Label Assignment**.

3 Select the entry for both the previously assigned device (on the left) and the entry for the available device (on the right).

4 Select **Replace**.

5 At the MX40, select **Confirm**.

6 At the Information Center iX, select **OK**.

7 Select Refresh to confirm that the device now appears in the **Assigned Devices** column.

8 Confirm that the Equipment Label is now displayed on the MX40.

Charging Lithium-ion Rechargeable Batteries

The li-ion rechargeable battery is recharged using the IntelliVue CL Charging Station. In order to meet the published battery life specifications, the battery should be fully charged before use.

Battery management is very important to ensure that when a fully charged battery is needed, one is available. Recharging a discharged battery can take up to 6.5 hours.

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, and at the Information Center
- 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 **AC Power / Error LED** is

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

The nine **Charger Slot LEDs** show the battery status of the device in their slot and are switched off if a battery is not connected.

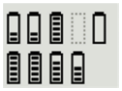
When a battery is put on a charging station slot, confirm that the corresponding LED flashes yellow until the battery's current state has been identified. Then a beep is issued and the LED reflects the battery status as described in the table below.

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

Note — Wiping of battery contacts with an isopropyl 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.



Note — The display on the charging station is product revision dependent. Newer revisions do not have a display.

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 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.

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 Maintenance

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

- EN 60601-1:2006 +A1: 2013, Medical electrical equipment - Part 1: General requirements for basic safety and essential performance

  IEC 60601-1:2005 + A1: 2012

- EN 60601-1:1990 + A1:1993 + A2:1995 + A13:1996, Medical electrical equipment - Part 1: General requirements for basic safety and essential performance

  IEC 60601-1:1988 + A1:1991 + A2:1995

- EN ISO 80601-2-49:2018 Medical electrical equipment - Part2: Particular requirements for Safety
- CAN/CSA C22.2 601.1-M90: Medical Electrical Equipment part 1: General requirements for Safety
- UL 60601-1 Medical Electrical Equipment - General Safety
- EN 60601-1-1:2001 Medical electrical equipment - Part 1-1: General requirements for safety - Collateral standard: Safety requirements for medical electrical systems

  IEC 60601-1-1:2000

- EN 60601-1-2:2007, Medical electrical equipment - Part 1-2: General requirements for basic safety and essential performance - Collateral standard: Electromagnetic compatibility - Requirements and tests

  IEC 60601-1-2:2007

- EN 60601-1-2:2001+ A1:2006, Medical electrical equipment - Part 1-2: General requirements for basic safety and essential performance - Collateral standard: Electromagnetic compatibility - Requirements and tests

  IEC 60601-1-2:2001 +A1:2004

- EN 60601-1-2:2015 Medical electrical equipment - Part 1-2: General requirements for basic safety and essential performance - Collateral Standard: Electromagnetic disturbances - Requirements and tests

  IEC 60601-1-2:2014

- ISO 80601-2-61: 2017 Pulse Oximeters, requirements for SpO2
- EN 80601-2-61:2019 Pulse Oximeters, requirements for SpO2
- EN 60601-1-4: 1996 + A1:1999 Medical electrical equipment - Part 1-4: General requirements for safety - Collateral standard: Programmable electrical medical systems

  IEC 60601-1-4:1996 + A1:1999

- EN 60601-1-6:2007, Medical electrical equipment - Part 1-6: General requirements for basic safety and essential performance - Collateral standard: Usability

  IEC 60601-1-6:2004

- EN 60601-1-8: 2004 +A1: 2006, Medical electrical equipment. General requirements for basic safety and essential performance. Collateral Standard: General requirements, tests and guidance for alarm systems in medical electrical equipment and medical electrical systems

  IEC 60601-1-8: 2003 + A1: 2006

- EN 60601-1-8: 2007

  IEC 60601-1-8: 2006

- EN 60601-2-27: 2006, Medical electrical equipment - Part 2-27: Particular requirements for the safety, including essential performance, of electrocardiographic monitoring equipment

  IEC 60601-2-27: 2005

- EN 60601-2-27: 2011 Medical electrical equipment - Part 2-27: Particular requirements for the safety, including essential performance, of electrocardiographic monitoring equipment

  IEC 60601-2-27: 2011

- EN 60601-2-49: 2001, Medical electrical equipment - Part 2-49: Particular requirements for the safety of multifunction patient monitoring equipment

  IEC 60601-2-49: 2001

- EN 60601-2-49: 2011 Medical electrical equipment - Part 2-49: Particular requirements for the safety of multifunction patient monitoring equipment

  IEC 60602-2-49: 2011

- EN ISO 10993-1:2009 (for leadwires and pouch), Biological evaluation of medical devices - Part 1: Evaluation and testing within a risk management process

- EN 62304:2006, Medical device software - Software life-cycle processes

  IEC 62304:2006
- EN 62366:2008, Medical devices - Application of usability engineering to medical devices

  IEC 62366:2007

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 Information Center by way of a wireless network. When the MX40 is connected to the Information Center, the 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

Authorized Australia Sponsor

Philips Electronics Australia
65 Epping Road
North Ryde NSW, Australia 2113

Patient Population

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

Clinical judgment must be used to determine when the MX40 should be used on a specific pediatric patient, as it is not possible to assign a precise weight or age to ECG performance.

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.

Contraindications

A Contraindication describes a situation, such as patient population, medical reason, or clinical condition, in which a device may not be used because the risk of use clearly outweighs any possible benefit.

There are no contraindications for use of the MX40.

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 Information Center.

The System achieves its Essential Performance exclusively through alarm generation at the Patient 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.

Risk Management Considerations

Warning

The MX40 operates exclusively via a wireless network connection, therefore, it should not be used for primary monitoring in applications where momentary loss of the ECG is unacceptable at the Information Center. It sends ECG and optionally pulse oximetry and respiration data to the Information Center, where the Information Center displays real-time patient data, provides alarm annunciation, data storage and review applications. The ECG waveform data, alarms and optionally SpO_2 and Resp can always be viewed on the MX40 regardless of the connection to the Information Center.

Smart Hopping technology alleviates most of the problems associated with legacy telemetry technologies. Reception problems are less frequent, because Smart Hopping avoids interference and moves to a different access point if the signal strength is too low. The level of radio frequency activity is always fluctuating in the environment. If the level becomes high enough to significantly interfere with transceiver operation, the system responds by moving to another "cleaner" area where there is less activity.

Dropouts

Because the MX40 operates exclusively via a wireless network connection, under certain frequency conditions dropouts can occur. Dropouts result from a weak signal or RF interference, and appear on the waveform when the signal is interrupted. If dropouts are frequent enough to affect the heart rate count, the "Cannot Analyze ECG" or "Cannot Analyze ST" technical alarm occurs. If there are enough dropouts to cause disassociation/reassociation with the Information Center, events in the Clinical Review Applications can reflect loss of data for up to 1 minute in the worst case.

Monitoring Considerations

- Patient should be restricted to the designated coverage area. Monitoring performance will degrade if patients go outside the radius of coverage of the receiving wireless network.
- A patient location strategy is critical to a telemetry system. If a life-threatening event occurs, the clinician must be able to locate the patient quickly. The importance of this increases as the coverage area increases.
- Frequency management is the responsibility of the hospital. Philips Healthcare has no control over the RF environment in the hospital. If interference exists at the operating frequencies of the telemetry equipment, telemetry performance will be affected. Careful selection of frequencies for all wireless devices used within a facility (transceivers, other wireless medical devices, etc.) is important to prevent interference between them.

Caution

IEC/ANSI/AAMI 80001-1:2010

Philips recognizes the importance of a safe and effective network that meets both the business needs of a healthcare facility, IT networking requirements, and the clinical functionality. Philips supports the IEC 80001-1 standard in regards to working as a partner with a healthcare organization in the design, implementation, and management of the Medical IT-Network to properly provision and support not only Philips devices, but all the devices using the network. Applying the principles of risk management to hospital frameworks is highly encouraged.

When operating the MX40 on a Customer Supplied Clinical Network, Philips strongly encourages our customers to perform risk management of their Medical IT-Network infrastructure in accordance with

IEC 80001. Changes may include changes in network configuration, connection of additional items, disconnection of items, update of equipment, or upgrade of equipment.

If the MX40 experiences loss of network connectivity, technical alerts at the Information Center ("No Signal" or "No Data Tele") and at the MX40 ("No Central Monit.") will occur. The MX40 will also automatically revert to local monitor mode which activates display of patient data on the MX40 – however, when in this state, battery life will be shortened.

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, 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.

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.

Note — For cellphone frequencies 810-930 MHz at 28 V/m, increased ECG waveform noise is observed that impacts ST performance. The MX40 can tolerate RF interference power to 7 V/m and maintain ECG noise in compliance with IEC 60601-2-27 and AAMI EC13, and a typical cellphone RF power is expected to be less than 5 V/m. A technical alarm for ST or Invalid Parameter is presented with excessive ECG noise. Field strength is measured at 3 meter distance per standard.

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 radio frequency (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.

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 emissions	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 **4th Edition:** ±8 kV contact ±15 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%.
Power frequency (50/ 60 Hz) magnetic field IEC 61000-4-8	3 A/m **4th Edition:** 30 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 6 Vrms in ISM bands	3 VRMS	Recommended separation distance: $d = 1.2\sqrt{P}$
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2.7 GHz	3 V/m See Note under "Electromagnetic Compatibility" on page 174	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
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 defibrillation. This does not affect patient or equipment safety. Do not expose the equipment to x-ray or strong magnetic fields (MRI). The MX40 is not for use during electrosurgery.

Restart Time

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

Battery Specifications

Battery Life

Note —Battery life specifications are stated with a 95% confidence level that the average run time will be at least this long assuming a random sample of the population with a Student's t-distribution.

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 (Display Off)	Battery Life (1.4GHz p/n 865350)	Battery Life (2.4GHz p/n 865351)
ECG only	37.0 hours	33.0 hours
ECG/SpO_2 FAST Continuous (ECG operation available.)	22.0 hours (time to No Signal INOP)	20.0 hours (time to No Signal INOP)
ECG/SpO_2 FAST Continuous (Continuous SpO_2 operation available)	10.0 hours (time to No SpO2T, Batt Low INOP)	10.0 hours (time to No SpO2T, Batt Low INOP)
ECG/SpO_2 Masimo Continuous (ECG operation available.)	20.0 hours (time to No Signal INOP)	18.0 hours (time to No Signal INOP)
ECG/SpO_2 Masimo Continuous (Continuous SpO_2 operation available)	9.0 hours (time to No SpO2T, Batt Low INOP)	8.0 hours (time to No SpO2T, Batt Low INOP)
ECG/SpO_2 FAST Auto (5 min.) (ECG operation available.)	35.0 hours (time to No Signal INOP)	30.0 hours (time to No Signal INOP)
ECG/SpO_2 FAST Auto (5 min.) (SpO_2 operation available)	18.0 hours (time to No SpO2T, Batt Low INOP)	16.0 hours (time to No SpO2T, Batt Low INOP)
ECG/SpO_2 Masimo Auto (ECG operation available.)	30.0 hours (time to No Signal INOP)	28.0 hours (time to No Signal INOP)
ECG/SpO_2 Masimo Auto (SpO_2 operation available)	15.0 hours (time to No SpO2T, Batt Low INOP)	14.0 hours (time to No SpO2T, Batt Low INOP)

Telemetry Mode Networked (Display Off)	Battery Life (1.4GHz p/n 865350)	Battery Life (2.4GHz p/n 865351)
ECG/SpO_2 Manual (FAST & Masimo)	In this mode battery life is dependent on the usage rate and will range between the ECG Only battery life and the ECG/SpO2 Continuous battery life.	

Monitor Mode Networked (Display On)	Battery Life (1.4GHz p/n 865350)	Battery Life (2.4GHz p/n 865351)
ECG Only	10.5 hours	9.5 hours
ECG/SpO_2 FAST Continuous	5.3 hours	2.5 hours
ECG/SpO_2 Masimo Continuous	4.3 hours	3.5 hours
ECG/SpO_2 Manual (FAST & Masimo)	In this mode battery life is dependent on the usage rate and will range between the ECG Only battery life and the ECG/SpO2 Continuous battery life.	

Monitor Mode Non-networked (Display On)	Battery Life (1.4GHz p/n 865350)	Battery Life (2.4GHz p/n 865351)
ECG only	6.8 hours	6.0 hours
ECG/SpO_2 FAST Continuous	4.7 hours	4.0 hours
ECG/SpO_2 Masimo Continuous	4.0 hours	3.0 hours
ECG/SpO_2 Manual (FAST & Masimo)	In this mode battery life is dependent on the usage rate and will range between the ECG Only battery life and the ECG/SpO2 Continuous battery life.	

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

Telemetry Mode Networked (Display Off)	Battery Life (1.4GHz p/n 865350)	Battery Life (2.4GHz p/n 865351)	Battery Life (WLAN p/n 865352)
ECG Only	30.0 hours	28.0 hours	28.0 hours
ECG/SpO_2 FAST Continuous (ECG operation available)	15.6 hours (time to No Signal INOP)	14.0 hours (time to No Signal INOP)	15.0 hours (time to No Signal INOP)

Telemetry Mode Networked (Display Off)	Battery Life (1.4GHz p/n 865350)	Battery Life (2.4GHz p/n 865351)	Battery Life (WLAN p/n 865352)
ECG/SpO_2 FAST Continuous (Continuous SpO_2 operation available)	12.0 hours (time to No SpO2T, Batt Low INOP)	11.0 hours (time to No SpO2T, Batt Low INOP)	12.0 hours (time to No SpO2T, Batt Low INOP)
ECG/SpO_2 Masimo Continuous (ECG operation available)	12.5 hours (time to No Signal INOP)	11.0 hours (time to No Signal INOP)	12.5 hours (time to No Signal INOP)
ECG/SpO_2 Masimo Continuous (Continuous SpO_2 operation available)	10.0 hours (time to No SpO2T, Batt Low INOP)	9.0 hours (time to No SpO2T, Batt Low INOP)	10.0 hours (time to No SpO2T, Batt Low INOP)
ECG/SpO_2 FAST Auto (5 min.) (ECG operation available)	28.0 hours (time to No Signal INOP)	26.0 hours (time to No Signal INOP)	27.0 hours (time to No Signal INOP)
ECG/SpO_2 FAST Auto (5 min.) (SpO_2 operation available)	15.0 hours (time to No SpO2T, Batt Low INOP)	14.0 hours (time to No SpO2T, Batt Low INOP)	15.0 hours (time to No SpO2T, Batt Low INOP)
ECG/SpO_2 Masimo Auto (5 min.) (ECG operation available)	24.0 hours (time to No Signal INOP)	22.0 hours (time to No Signal INOP)	24.0 hours (time to No Signal INOP)
ECG/SpO_2 Masimo Auto (5 min.) (SpO_2 operation available)	13.0 hours (time to No SpO2T, Batt Low INOP)	12.0 hours (time to No SpO2T, Batt Low INOP)	13.0 hours (time to No SpO2T, Batt Low INOP)
ECG/SpO_2 Manual (FAST & Masimo)	In this mode battery life is dependent on the usage rate and will range between the ECG Only battery life and the ECG/SpO2 Continuous battery life.		

Monitor Mode Networked (Display On)	Battery Life (1.4GHz p/n 865350)	Battery Life (2.4GHz p/n 865351)	Battery Life (WLAN p/n 865352)
ECG Only	10.0 hours	9.0 hours	10.0 hours
ECG/SpO_2 FAST Continuous	8.0 hours	7.0 hours	8.0 hours
ECG/SpO_2 Masimo Continuous	7.0 hours	6.0 hours	7.0 hours
ECG/SpO_2 Manual (FAST & Masimo)	In this mode battery life is dependent on the usage rate and will range between the ECG Only battery life and the ECG/SpO2 Continuous battery life.		

Monitor Mode Non-networked (Display On)	Battery Life (1.4GHz p/n 865350)	Battery Life (2.4GHz p/n 865351)	Battery Life (WLAN p/n 865352)
ECG Only	9.0 hours	8.0 hours	9.0 hours
ECG/SpO_2 FAST Continuous	8.0 hours	7.0 hours	8.0 hours
ECG/SpO_2 Masimo Continuous	7.0 hours	6.0 hours	7.0 hours
ECG/SpO_2 Manual (FAST & Masimo)	In this mode battery life is dependent on the usage rate and will range between the ECG Only battery life and the ECG/SpO2 Continuous battery life.		

Note —Use of the short-range radio can reduce battery life by 35%.

Note —The battery capacity of re-chargeable batteries degrades over time and number of recharge cycles. Toward the end of its useful life, the battery capacity may be reduced by 30%. If this reduced battery life is unacceptable based on your use model, Philips recommends replacing the rechargeable battery sooner.

Nominal Current

Operating Mode	Nominal Current (p/n 865350)	Nominal Current (p/n 865351)	Nominal Current (p/n 865352)
ECG Only (Display inactive)	51.5 mA @ 3.6V	51 mA @ 3.6V	51.5 mA @ 4.1V
ECG/SpO_2 FAST Continuous (Display inactive)	120 mA @ 3.6V	116 mA @ 3.6V	120 mA @ 4.1V
ECG Only Masimo (Display inactive)	51.5 mA @ 3.6V	51 mA @ 3.6V	51.5 mA @ 4.1V
ECG/SpO_2 Masimo Continuous (Display inactive)	122 mA @ 3.6V	118 mA @ 3.6V	123 mA @ 4.1V

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 SpO2. • With 3 AA batteries, includes SpO2 and all hardware options • With lithium-ion battery, includes SpO2 and all hardware options	 1.4 GHz - 223 g (7.8 oz) 2.4 GHz - 223 g (7.8 oz) 1.4 GHz - 298 g (10.5 oz) 2.4 GHz - 298 g (10.5 oz) 1.4 GHz - 289 g (10.2 oz) 2.4 GHz - 289 g (10.2 oz) 2.4 GHz/5.6 GHz WLAN - 206 g (7.3 oz)
Display • Type • View Area • Resolution • Backlight • ECG Display Sector Size (height) ECG or Pleth Display Sweep Speed RESP 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 or Pleth data (portrait), 10mm/s with 5.76 sec of viewable ECG or Pleth data (landscape), or 25mm/s with 1.73 sec of viewable ECG or Pleth data (portrait), 25mm/s with 2.30 sec of viewable ECG or Pleth data (landscape) • 2.5mm/s with 17.28 sec of viewable RESP data (portrait), 2.5mm/s with 23.04 sec of viewable RESP data (landscape)
Alarm Signal Sound Pressure Level (also applies to IntelliVue Information Center, Release N.)	40dB(A) - 70dB(A)

MX40 1.4 GHz Smart-Hopping Radio

Parameter	Specification
Frequency Ranges	Bands: 1395-1400 MHz and 1427-1432 MHz Channel Spacing: 1.6 MHz
RF Output Power	12.5 dBm ±1.5 dB (12.6 mW to 25 mW, nominal 17.8mW) into antenna load. Calibrated into 50 Ohms.
Radio Frequency Accuracy during normal operation	$<^{+}60/^{-}100$ KHz relative to channel frequency, includes temperature compensation and aging effects
Modulation Type	GFSK (1M40Q7D)
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 Smart-Hopping 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 -15 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
Radio 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, RSS-210, 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 Healthcare 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 Canadian 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 or the Information Center depending on use model.
RF Output Power	-1.5 to -4.5 dBm +2/-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)

MX40 2.4GHz/5.6GHz WLAN Radio

The MX40 2.4GHz/5.6GHz WLAN Radio conforms to the 802.11 a/b/g/n standard operating in the 2.4GHz and 5.6GHz ISM bands.

Note — For the MX40 WLAN device, Part Number 865352, use of the MX40's Short-range Radio is only supported when operating with 802.11a (5.6GHz band).

The Radio characteristics are defined below.

WLAN Radio RF Specs	Specification
802.11b	
Technology	IEEE 802.11b
Frequency Range	2.4 to 2.4835GHz
Transmitter Power	10 to 15 dBm into antenna load (RMS power)
Modulation	CCK (Complementary Code Keying)
Occupied Bandwidth, 99%	<-22 MHz
802.11g, 802.11ng	
Technology	IEEE 802.11g, 802.11ng
Frequency Range	2.4 to 2.4835GHz
Transmitter Power	9.5 to 15 dBm into antenna load (RMS power)
Occupied Bandwidth, 99%	<-22 MHz
Modulation Type	OFDM (Orthogonal Frequency Division Multiplex)

WLAN Radio RF Specs	Specification
Frequency Bands (802.11 b/g/n)	FCC, RSS-210, ETSI Japan{ARIB},China, AS/NZS: 2.400 – 2.4835GHz
Out of Band Emissions (802.11 b/g/n)	Meets ETSI, RSS-210, FCC, ARIB, AS/NZS standards
802.11a, 802.11na	
Technology	IEEE 802.11a, 802.11na
Frequency Power	5.15 to 5.825GHz
Transmitter Power	7 to 15 dBm into Antenna load (RMS power)
Occupied Bandwidth	≤ 19 MHz (802.11a, 802.11na) ≤ 37 MHz (802.11na bonded channel)
Modulation	DSSS: OFDM (Orthogonal Frequency Division Multiplex)
Frequency Bands (802.11a, 802.11na)	FCC, RSS-210: 5.15 ~ 5.25GHz, 5.25 ~ 5.35GHz, 5.42 ~ 5.725GHz, 5.725 ~ 5.825GHz (excluding 5.6 ~5.65GH ETSI, AS/NZS: 5.15~ 5.35GHz, 5.47 ~ 5.725Ghz Japan, ARIB: 5.150 – 5.250GHz, 5.25 – 5.35GHz, 5.470 – 5.725GHz, China: 5.725 ~5.825GHz
Out of Band Emissions (802.11a, 802.11na)	Meets ETSI, RSS-210, FCC, ARIB, AS/NZS standards

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 Healthcare may cause harmful radio frequency interference and void your authority to operate this equipment.

- The maximum antenna gain permitted (for devices in the 5250-5350 MHz and 5470-5725 MHz bands) complies with the e.i.r.p. limits as stated in RSS-210.
- The maximum antenna gain permitted (for devices in the 5725-5825 MHz bands) complies with the e.i.r.p. limits specified for point-to-point operation as stated in RSS-210.
- The device for band 5150-5250 MHz is only for indoor usage to reduce potential for harmful interference to co-channel mobile satellite systems.

Caution

High power radars are allocated as primary users of 5250-5350 MHz and 5650-5850 MHz. These radars could cause interference and/or damage to LE-LAN devices.

Environmental Specifications

Parameter	Specification
Temperature	
Operating	0 to 37° C (32 to 99° F)
Storage and Transportation	-30° C to 50° C (-22° F to 122° F) without batteries 12° C to 35° C (53.6° F to 95°F) with Single-Patient-Use leadsets
Humidity	
Operating	< 95% RH at 37° C (98.6° F) non-condensing ≥ 15% RH low limit
Storage and Transportation	< 90% RH at 50° C (122° F) without batteries ≥ 15% RH low limit
Altitude	
Operating & Non-operating (includes Transportation)	3,000 m (9,842 ft)
Barometric Pressure	72kPa (537 mmHg)
Water Resistance	MX40 Battery Compartment - IPX3 (protected against spraying water) MX40 Electronics Compartment - IPX7 (protected against immersion, up to 1m depth) MX40 Patient Cable when not attached to the MX40 (all connections) - IPX3 (protected against spraying water) MX40 to MX40 Patient Cable Connection (when patient cable is securely attached) - IPX7 (protected against immersion, up to 1m depth)

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 = Vector a-i Channel #2 = Vector a-s Channel #3 = Vector e-s
6 electrodes	Channel #1= II Channel #2 = III Channel #3 = MCLa Channel #4 = MCLb
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 (Active RL-drive is used for best CMRR performance.)
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.
Lead Off Detection (auxiliary current)	Lead off detection uses DC current to patient of 40µA maximum per lead. Total patient auxiliary current < 10µA.
Active Right Leg (RL) Drive (auxiliary current)	Active RL-drive improves CMRR performance with a typical DC operating point at 1.1 volts and patient auxiliary current limited to < 10µA for all conditions.

ECG Performance Disclosure/Specifications

Parameter	Specification
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. 4.1. 2. 1 (f) is 10 seconds. For a rate drop 80 bpm to 40 bpm the average time is 7 seconds.
Heart Rate Numeric (range, resolution and accuracy)	Range: 15 bpm to 300 bpm (Adult, Pedi) Resolution: 1bpm, accuracy ± 1% of the range Beat Detection Sensitivity: ≥ 200 µV peak Meets AAMI EC-13
Heart Rate Averaging Method	Three different methods are used: • Normally, heart rate is computed by averaging the12 most recent R-R intervals. • For runs of PVCs, up to 8 R-R intervals are averaged to compute the HR. • If each of three consecutive R-R intervals is greater than 1200 ms (that is, rate is less than 50 bpm) for adult and pediatric patients, then the four most recent R-R intervals are averaged to compute the HR.
Heart Rate Meter Response Time to Irregular Rhythm	Provides correct heart rates (60, 80, 90, 120 bpm) using test waveforms as indicated in ANSI/AAMI EC13 Sec. 4.1.2.1(e). All QRS are counted with test waveforms within HR accuracy defined above.
Time to Alarm for Tachycardia	The ranges of time to alarm using test waveforms as indicated in ANSI/AAMI EC13 Sec. 4. 1. 2. 1 (g) are 4 to 5 seconds.
Pacemaker Pulse Rejection Capability	Rejects pace pulses using test waveforms as indicated in ANSI/AAMI EC13 Sec. 4. 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 4.2.7 recommended minimum range and accuracy. Heart rate range is 15 - 300b/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 4.2.8.1 standard. Lower alarm limit is 15 -295. Upper alarm limit is 20 - 300.

Parameter	Specification
Resolution of Alarm Limit Settings	Meets the ANSI/AAMI EC13 Section 4.2.8.2 standard. Adult: ±5 bpm above 40 bpm and ±1 bpm below 40 bpm Pediatric: ±5 bpm above 50 bpm and ±1 bpm below 50 bpm
Alarm Limit Accuracy	Meets the ANSI/AAMI EC13 Section 4.2.8.3 standard. Error less than ± 10% or ± 5b/min
Time to Alarm for Cardiac Standstill	Meets the ANSI/AAMI EC13 Section 4.2.8.4 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 4.2.8.5 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 4.2.8.6 standard: maximum alarm time <10 seconds, using the test waveforms as indicated.
Alarm Silencing	The time required for reactivation of a latched, silenced/acknowledged alarm is 3 minutes.
ECG Waveform Display Time Base Accuracy	0.8%. Meets the ANSI/AAMI EC13 Section 4.2.9.6 standard: maximum error = ± 10%.
Channel Width	40 mm. Meets the ANSI/AAMI EC13 Section 4.2.9.7(a) standard: minimum = 30mm.
Aspect Ratio	0.4s/mV. Meets the ANSI/AAMI EC13 Section 4.2.9.7(b) standard: 0.4s/mV.
Input Signal Reproduction Accuracy: Overall Error	-2.9%. Meets the ANSI/AAMI EC13 Section 4.2.9.8(a) standard: maximum = ± 20%.
Frequency Response Sinusoidal	0.67 to 40 Hz (3 db down). Meets the ANSI/ AAMI EC13 Section 4.2.9.8(b) standard: 0.67 to 40 Hz (3 db down).
Frequency Response Triangular	0 to 25% reduction. Meets the ANSI/AAMI EC13 Section 4.2.9.8(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 4.2.9.8(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 4.2.9. 12 standard: minimum = 0.2 mV RTI.
Tall T-Wave Rejection Capability	Meets AAMI standard: 0.5 - 40 BW: HR of 80 bpm at all T-wave amplitudes 0.05 - 40 BW: HR of 80 bpm at all T-wave amplitudes.

Distributed Alarm System Delay Specification

For complete Distributed Alarms System Delay information and specifications, see the *Patient Information Center iX Instructions for Use*.

Respiration

Parameter	Specification
Leads Used for Measurement	RA, LL (standard) or I, A (EASI)
Range	Adult/Pedi: 0 to 120 rpm
Bandwidth	0.3Hz to 2.5Hz (-6dB)
Noise	Less than 25 mOhm (rms) referred to the input
Calibration Signal	Signal: 1 Ohm p-p; Accuracy: ± 20%
Respiration Rate Resolution	1 rpm
Respiration Accuracy	± 1 rpm for 0-120 rpm
Auxiliary Current, Respiration Excitation Signal	< 470 µA rms @48KHz, sinusoidal waveform

Respiration Alarm

Alarm	Range	Delay
High	Adult/Pediatric: 10 to 100 rpm	≤ 15 seconds
Low	Adult/Pediatric: 0 to 95 rpm	for limits from 0 to 20 rpm: max. 4 seconds for limits above 20 rpm: max. 15 seconds
Apnea Alarm	10 to 40 seconds	Incremental delay 5 seconds max.

FAST SpO_2

Parameter	Specification
SpO_2 Measurement Range (Calibration and Display)	0 to 100%
SpO_2 Accuracy	See table below and "Performance Specification Details for Philips Sensors" on page 114.
SpO_2 Resolution	1%
SpO_2 Numerics - Averaging	5 - 20 seconds (default = 10 seconds) The effect of SpO_2 pulse oximetry on data averaging is internally controllable by the MX40, 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	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 80601-2-61.
Emitted Light Energy	≤ 15 mW

Masimo SET SpO_2

Parameter	Specification
SpO_2 Measurement Range (Calibration and Display)	0 to 100%
SpO_2 Accuracy	See "Performance Specification Details for Masimo SET Sensors" on page 118.
SpO_2 Resolution	1%
SpO_2 Numerics - Averaging	5 - 20 seconds (default = 10 seconds)

Parameter	Specification
SpO_2 & Pulse Numerics - Update Rate	Typical numeric update rate is once per second.
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 questionable, 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	Range: 25 to 240 bpm Accuracy with no motion: 3 bpm Accuracy with motion: 5 bpm Resolution: 1 bpm
Display of SpO_2 numerics	SpO_2 values are displayed as xxx % SpO_2 to meet ISO 80601-2-61.
Emitted Light Energy	≤ 15 mW

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, SpO2 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

Miscellaneous

Order Number	Description
989803174131	MX40 Lithium-ion battery, pkg 3
989803176201	MX40 Lithium-ion battery, pkg 1
989803174891	MX40 AA Battery adapter, pkg 3
989803134771	Skin Preparation Sheets, 10 preps/ sheet, pkg 10

ECG Accessories

Electrodes

Order Number	Description
M4612A	Solid gel ECG electrode disp. 5/pouch 300/case
M4613A	Solid gel ECG electrode disp. 30/pouch 300/case
40493D	Adult foam ECG electrode, disp. 300/ case
40493E	Adult foam 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")
989803171901	ECG 3 lead grabber IEC .85m (35")
989803171911	ECG 3 lead grabber IEC + SpO_2 .85m (35")
989803171821	ECG 5 lead snap AAMI .85m (35")
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")
989803171931	ECG 5 lead grabber IEC .85m (35")
989803171951	ECG 5 lead grabber IEC + SpO_2 .85m (35")
989803171861	ECG 6 lead grabber AAMI .85m (35")
989803171871	ECG 6 lead grabber AAMI + SpO_2 .85m (35")
989803171961	ECG 6 lead grabber IEC .85m (35")
989803171971	ECG 6 lead grabber IEC + SpO_2 .85m (35")
989803202411	ECG 5 lead grabber AAMI + SpO_2 (Masimo)
989803202421	ECG 5 lead grabber IEC + SpO_2 (Masimo)

MX40 Single-Patient-Use Cables

Order Number	Description
989803172031	ECG 5 lead grabber AAMI .85m (35")
989803172051	ECG 5 lead grabber + SpO_2 AAMI .85m (35")
989803172131	ECG 5 lead grabber IEC .85m (35")
989803172151	ECG 5 lead grabber + SpO_2 IEC .85m (35")
989803173121	ECG 3 lead AAMI, Bedside
989803173141	ECG 3 lead AAMI, Telemetry
989803173151	ECG 5 lead AAMI, Telemetry
989803174201	ECG 3 lead IEC, Bedside
989803174211	ECG 5 lead IEC, Bedside
989803197511	ECG 6 lead AAMI, Bedside (Requires Pigtail Adapter)
989803197521	ECG 6 lead IEC, Bedside (Requires Pigtail Adapter)

Reusable Leadsets and Cables for Use with IntelliVue Patient Monitors

Order Number	Description
989803199071	SpO_2 Adapter Cable (FAST) 6 lead + FAST SpO_2
989803199091	SpO_2 Adapter Cable (FAST) 5 lead + FAST SpO_2
989803199101	SpO_2 Adapter Cable (FAST) 3 lead + FAST SpO_2
989803202381	SpO_2 Adapter Cable (Masimo) 5 lead + Masimo SpO_2
989803204291	SpO_2 Adapter Cable (Masimo) 6 lead + Masimo SpO_2
989803199081	SpO_2 -Only Adapter Cable (FAST)
989803202391	SpO_2 -Only Adapter Cable (Masimo)
All above leadsets require the MX40 to IntelliVue Adapter Cable, and the use of the 3 lead, 5 lead, and 6 lead Detachable Shield when showering. For support of Resp measurement the 989803199071 adapter cable must be used.	

SpO_2 Accessories

The following SpO_2 accessories are approved for use with MX40 devices equipped with the S02 (FAST SpO_2) and S04 (Masimo SET SpO_2) options. Sensors are device specific.

Philips FAST SpO_2 Technology (S02)

Philips Reusable Sensors

Product Number	Description	Accuracy A_{rms} (%)- no motion (70-100%)	Comments
M1191B	Adult sensor (2 m cable), for patients over 50 kg. Any finger, except thumb.	2.0	No adapter cable required.
M1191BL	M1191B with longer cable (3 m)	2.0	
M1192A	Small adult, pediatric sensor (1.5 m cable) for patients between 15 kg and 50 kg. Any finger except thumb.	2.0	
M1194A	Ear sensor (1.5 m cable) for patients over 40 kg.	3.0	
M1195A	Infant sensor (1.5 m cable) for patients between 4 kg and 15 kg. Any finger except thumb.	3.0	
M1196A	Adult clip sensor (3 m cable) for patients over 40 kg. Any finger except thumb.	3.0	
M1196S	Adult clip sensor (2 m cable) for patients over 40 kg. Any finger except thumb.	3.0	
M1191T	Adult sensor (0.45 m cable), for patients over 50 kg. Any finger, except thumb.	3.0	Requires M1943A (1 m) or M1943AL (3 m) adapter cable.
M1196T	Adult clip sensor (0.9 m cable) for patients over 40 kg. Any finger except thumb.	3.0	

Philips Disposable Sensors

Product Number	Description	Accuracy A_{rms} (%)- no motion (70-100%)	Comments
M1131A	Adult/Pediatric finger sensor, 0.45 m cable (patient size > 20 kg)	3.0	.
M1132A	Infant finger or toe sensor, 0.9 m cable (patient size 3 - 10 kg)	2.0	
M1133A	Adult/Infant/Neonatal, 0.9 m cable Foot or hand for neonates < 3 kg Big toe or thumb for patients between 10 kg and 20 kg Any finger except thumb for patients > 40 kg	2.0	Requires M1943A (1 m) or M1943AL (3 m) adapter cable.
M1134A	Adult/Infant/Neonatal, 0.9 m cable Foot or hand for neonates < 3 kg Big toe or thumb for patients between 10 kg and 20 kg Any finger except thumb for patients > 40 kg	2.0	

Nellcor Sensors

Nellcor sensors must be ordered from Nellcor/Covidien.

Product Number	Description	Accuracy A_{rms} (%)- no motion (70-100%)	Comments
OxiMax MAXA	Adult finger sensor (patient size > 30 kg)	3.0	Requires M1943A or M1943AL adapter cable.
OxiMax MAXAL	OxiMax MAXA with long cable	3.0	
OxiMax MAXP	Pediatric foot/hand sensor (patient size 10 50 kg)	3.0	
OxiMax MAXI	Infant foot/hand sensor (patient size 3 20 kg)	3.0	
OxiMax MAXN	Adult finger or neonatal foot/hand sensor (patient size > 40 kg or < 3 kg)	3.0	
Oxisensor II D-25	Adult sensor (patient size > 30 kg)	3.0	
Oxisensor II D-20	Pediatric sensor (patient size 10 - 50 kg)	3.0	
Oxisensor II I-20	Infant sensor (patient size 3 - 20 kg)	3.0	
Oxisensor II N-25	Neonatal sensor (patient size < 3 kg or > 40 kg)	3.0	
Oxicliq A	See OxiMax MAXA	3.0	Use M1943A or M1943AL adapter cable together with OC-3 adapter cable.
Oxicliq P	See OxiMax MAXP	3.0	
Oxicliq I	See OxiMax MAXI	3.0	
Oxicliq N	See OxiMax MAXN	3.0	

Extension Cables and Adapter Cables for Philips and Nellcor Sensors

Product Number	Description	Comments
M1941A	Extension cable (2 m)	For use with Philips reusable sensors (M1191B, M1192A, M1194A) and M1943A adapter cable.
M1943A	Adapter cable (1.1 m cable)	Adapter cable for Philips/Nellcor disposable sensors.
M1943AL	Adapter cable (3 m cable)	
OC-3	Adapter Cable for Oxicliq sensors	Available from Nellcor / Covidien only.

Masimo LNCS Reusable Sensors

Masimo sensors must be ordered from Masimo.

Product Number	Description	Accuracy A_{rms} (%)- no motion (70-100%)
LNCS DCI	Adult Finger Sensor (> 30 kg)	2.0
LNCS DCIP	Pediatric Finger Sensor (10 - 50 kg)	2.0
LNCS Y-I	Multi-Site Sensor (> 1kg)	3.0
LNCS TC-I	Ear Sensor (> 30 kg)	3.5

Masimo LNCS Disposable Adhesive Sensors

Masimo sensors must be ordered from Masimo.

Product Number	Description	Accuracy A_{rms} (%)- no motion (70-100%)
LNCS Adtx	Adult Finger Sensor, 18 inch/45 cm (> 30 kg)	2.0
LNCS Adtx-3	Adult Finger Sensor, 3 feet/90 cm (> 30 kg)	2.0
LNCS Pdtx	Pediatric Finger Sensor, 18 inch/45 cm (10 50 kg)	2.0
LNCS Pdtx-3	Pediatric Finger Sensor, 3 feet/90 cm (10 50 kg)	2.0
LNCS Inf	Infant Toe Sensor, 18 inch/45 cm (3 - 20 kg)	2.0
LNCS Inf-3	Infant Toe Sensor, 3 feet/90 cm (3 - 20 kg)	2.0
LNCS Neo	Neonatal Foot Sensor, 18 inch/45 cm (< 3 kg) or Adult Finger Sensor 18 inch/45 cm (> 40 kg)	2.0
LNCS Neo-3	Neonatal Foot Sensor, 3 feet/90 cm (< 3 kg) or Adult Finger Sensor, 3 feet/90 cm (> 40 kg)	2.0

Adapter Cable for Masimo Sensors

Product Number	Description	Philips Part Number
LNC MP10	LNCS MP Series Patient Cable (3.0 m) Adapter Cable for Masimo LNCS Sensors	989803148221

Masimo SET SpO_2 Technology (S04)

Masimo Reusable Sensors

Masimo sensors must be ordered from Masimo

Product Name	Description	Accuracy A_{rms} (%)- no motion (70-100%)
LNC Sensors		
LNCS DCI	Adult Finger Sensor (>30 kg)	2.0
LNCS DCIP	Pediatric Finger Sensor (10-50 kg)	2.0
LNCS TC-I	Adult Ear Lobe Sensor (>30 kg)	3.5
LNCS Y-I	Multi-Site Sensor (>1 kg)	2.0
LNCS-TF-I	Adult Forehead Sensor (>30 kg)	2.0
LNCS DB-I	Adult Finger Sensor (>30 kg)	2.0
M-LNC Sensors		
M-LNCS DC-I	Adult Finger Sensor (>30 kg)	2.0
M-LNCS DCI-P	Pediatric Finger Sensor (10-50 kg)	2.0
M-LNCS TC-I	Adult Ear Lobe Sensor (>30 kg)	3.5
M-LNCS Y-I	Multi-Site Sensor (>1 kg)	2.0
M-LNCS TF-I	Adult Forehead Sensor (>30 kg)	2.0
M-LNCS DB-I	Adult Finger Sensor (>30 kg)	2.0

RD SET Sensors		
RD SET DCI	Adult Finger Sensor (>30 kg)	2.0
RD SET DCIP	Pediatric Finger Sensor (10-50 kg)	2.0
RD SET TC-I	Adult Ear Lobe Sensor (>30 kg)	3.5

Masimo Disposable Sensors

Masimo sensors must be ordered from Masimo.

Product Name	Description	Accuracy A_{rms} (%)- no motion (70-100%)
LNC Sensors		
LNCS Adtx	Adult Finger Sensor (>30 kg)	2.0
LNCS Adtx-3	Adult Finger Sensor (>30 kg)	2.0
LNCS Pdtx	Pediatric Finger Sensor (10-50 kg)	2.0
LNCS Pdtx-3	Pediatric Finger Sensor (10-50 kg)	2.0
LNCS Inf	Infant Great Toe Sensor (3-20 kg)	2.0
LNCS Inf-3	Infant Great Toe Sensor (3-20 kg)	2.0
LNCS Inf-L	Infant Great Toe Sensor (3-20 kg)	2.0
LNCS Neo	Neonate Foot/Finger Sensor (<3 kg/>40 kg)	2.0
LNCS Neo-3	Neonate Foot/Finger Sensor (<3 kg/>40 kg)	2.0
LNCS Neo-L	Neonate Hand or Foot/Finger or Toe Sensor (<3 kg/>40 kg)	2.0
LNCS Trauma	Adult Finger Sensor (>30 kg)	2.0
LNCS Newborn Infant/Pediatric	Infant/Pediatric Great Toe/Finger Sensor (3-10 kg/10-30 kg)	3.0
LNCS E1	Adult/Pediatric Ear (>30 kg)	2.0
M-LNC Sensors		2.0
M-LNCS Adtx	Adult Finger Sensor, 18 inch/45 cm (>30 kg)	2.0
M-LNCS Adtx-3	Adult Finger Sensor, 3 feet/90 cm (>30 kg)	2.0
M-LNCS Pdtx	Pediatric Finger Sensor, 18 inch/45 cm (10-50 kg)	2.0
M-LNCS Pdtx-3	Pediatric Finger Sensor, 3 feet/90 cm (10-50 kg)	2.0
M-LNCS Inf	Infant Great Toe Sensor, 18 inch/45 cm (3-20 kg)	2.0

M-LNCS Inf-3	Infant Great Toe Sensor, 3 feet/90 cm (3-20 kg)	2.0
M-LNCS Inf-L	Infant Thumb/Great Toe Sensor (3-20 kg)	2.0
M-LNCS Neo	Neonatal/Adult Foot/Finger Sensor, 18 inch/45 cm (<3 kg/>40 kg)	2.0
M-LNCS Neo-3	Neonatal/Adult Foot/Finger Sensor, 3 feet/90 cm (<3 kg/>40 kg)	2.0
M-LNCS Neo-L	Neonatal Hand/Foot Sensor (<3 kg) Finger/Toe (>40 kg)	2.0
M-LNCS Trauma	Adult Finger Sensor (>30 kg)	2.0
M-LNCS Newborn Infant/Pediatrics	Infant/Pediatric Great Toe/Finger Sensor (3-10 kg/10-30 kg)	3.0
M-LNCS Blue	Neonatal/Infant/Pediatric Great Toe/Thumb Sensor for patients with congenital cyanotic cardiac lesions (2.5-30 kg)	3.3
M-LNCS E-1	Adult/Pediatric Disposable Ear Sensor (>30 kg)	2.0
RD SET Sensors		
RD SET Adt	Adult Finger Sensor (>30 kg)	2.0
RD SET Pdt	Pediatric Finger Sensor (10-50 kg)	2.0
RD SET Inf	Infant Great Toe Sensor (3-20 kg)	2.0
RD SET Neo	Neonatal/Adult Foot/Finger Sensor (<3 kg/>40 kg)	2.0
RD SET Trauma	Adult Finger Sensor (>30 kg)	2.0
RD SET Newborn Infant/Pediatric	Infant/Pediatric Great Toe/Finger Sensor (3-10 kg/10-30 kg)	2.0

Masimo ReSposable Sensors

Masimo sensors must be ordered from Masimo.

Product Name	**Description**	**Accuracy A_{rms} (%)- no motion (70-100%)**
LNC and M-LNC Sensors		2.0
LNCS S-ROS 3U	Universal Finger Sensor (SpO2)	2.0
M-LNCS S-ROS 3U	Universal Finger Sensor (SpO2)	2.0
S-DOS 25	Adult Finger Sensor (SpO2) (>30 kg)	2.0
S-DOS 20	Pediatric Finger Sensor (SpO2) (10–50 kg)	2.0

S-DOS 25L	Adult/Neonatal Finger/Foot Sensor (SpO2) (>30 kg/<3 kg)	2.0
S-DOS 20L	Infant Finger Sensor (SpO2) (3–30 kg)	2.0
S-DOS 30L	Large Adult Finger Sensor (SpO2) (>40 kg)	2.0

Masimo Compatible Sensor Adapter Cables

Product Number	Description	Philips Part Number
LNC MP4	Masimo SET to LNCS, Patient Cable, Straight, 4 feet/1.22 m	---
LNC MP10	Masimo SET to LNCS, Patient Cable, Straight, 10 feet/3.04 m	989803148221
M-LNC MP4	Masimo SET to M-LNCS, Patient Cable, Straight, 4 feet/1.22 m	---
M-LNC MP10	Masimo SET to M-LNCS, Patient Cable, Straight, 10 feet/3.04 m	---
RD SET MP05	Masimo SET to RD SET, Patient Cable, Straight, 5 feet/1.52 m	---
RD SET MP12	Masimo SET to RD SET, Patient Cable, Straight, 12 feet/3.66 m	---

15 Accessories

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 *Patient Information Center iX Release C.02 Configuration Guide*, p/n 453564677041.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	Off
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
Leadset Unplugged - Severity	Cyan
No Pulse - Severity **Caution** When using Masimo SET SpO2, do not configure to red/yellow severity.	Cyan
Alarms On	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	
R-On-T PVCs	On	
V.Bigeminy	On	

Arrhythmia Settings	Factory Defaults	
	Adult	Pedi
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	
Minimum QRS Threshold	150 µV (MX40 C.01/ PIC iX < C.03) 300 µV (MX40 C.01/ PIC iX C.03 or later)	150 µV (MX40 C.01/ PIC iX < C.03) 300 µV (MX40 C.01/ PIC iX C.03 or later)

Configuration Default Settings at the MX40

Setting	Factory Default
Touch Tone Volume	0 - 10 **4**
Default Screen	1 Wave (Portrait) **2 Waves (Portrait)** 2 Waves (Landscape) 0 Waves, 6 Numerics (Portrait) Chest Diagram
Screen Color	**B.04 and Earlier** **B.05 and later** **Blue** **Blue** Gray Green Green Purple Pink* Orange* Purple* Aqua* Yellow* (*only display in Standby Mode)
Alarm Sounds	**Traditional** ISO
Unit Defaults	Confirm to restore to unit default settings

Standby Time Duration	**Infinite** 10 minutes 20 minutes 30 minutes 1 hour 2 hours 3 hours 4 hours 6 hours 8 hours
Lock On Start	**Off** On
Lock Password	**Off** On

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