Instructions for Use

English

Release 4.0

Philips Telemetry Monitor 5500

PHILIPS

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Copyright

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Rx

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

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FCC Radio Compliance

This device complies with Part 15 and/or Part 95 of the FCC Rules. Operation is subject to the following two conditions: (1) these devices may not cause harmful interference, and (2) these devices must accept any interference received, including interference that may cause undesired operation.

Changes and modifications not expressly approved by Philips Medical Systems can void your authority to operate this equipment under Federal Communications Commission rules.

NOTE

"Harmful interference" is defined in 47 CFR §2.122 by the FCC as follows: Interference which endangers the functioning of a radio navigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radio communication service operating in accordance with the [ITU] Radio Regulations.

Compliance

Uses of the Philips Telemetry Monitor 5500 for purposes other than those intended and expressly stated by the manufacturer, as well as incorrect use, incorrect operation, or modifications made to the system without explicit approval from Philips, may relieve the manufacturer (or his agent) from all or some responsibilities for resultant non-compliance, damage or injury.

Proprietary Information

Document Conventions

In this guide:

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.

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.

NOTE

A Note contains additional information on the product.

Accessing Paper and Electronic Documentation

There are many documents and guides that will help you use and understand your Telemetry Monitor 5500. These documents can be obtained either in paper format through your Philips Sales Representative, or electronically by accessing the Philips Resource Center or Philips InCenter. (Note that access to InCenter requires a Philips InCenter account and password.)

The table below shows a full list of documents associated with the Telemetry Monitor 5500 and where you can find them electronically. The following pages provide step-by-step instructions showing how you can use the Philips Resource Library or Philips InCenter to obtain these documents.

Remember to check the software version/release on the products you are using to ensure that the document you retrieve describes the correct information. Consider searching for "Telemetry Monitor 5500" in the Philips Resource Center or Philips InCenter in case documentation updates and/or addendums have been created after the copyright date of this Instructions for Use.

Document Title (part number)	Philips Resource Center	Philips InCenter
	See "Accessing the Resource Center" on page 8	See "Accessing InCenter" on page 9
Telemetry Monitor 5500 Instructions for Use (453564928311)	✓	
Telemetry Monitor 5500 Cleaning Quick Card (453665005561)	✓	
Telemetry Monitor 5500 Device Quick Card (453564928341)	✓	
Telemetry Monitor 5500 Configuration Guide (453564928361)		✓
Telemetry Monitor 5500 Installation and Service Guide (453564928321)		✓
Telemetry Monitor 5500 Battery Charger Instructions for Use (453564947691)	✓	
Telemetry Monitor 5500 Rechargeable Lithium-Ion Battery Guide (453564928351)		✓
LP PIC iX Release 4.3 Instructions for Use (453665096931)	✓	✓
LP PIC iX 4.x License Activation Guide, Ed 3 (453564943251)		✓

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Document Title (part number)	Philips Resource Center	Philips InCenter
LP PIC iX 4.x Web Installation and Configuration Guide (453564943261)		✓
LP PIC iX Clinical Configuration Guide Release 4.x (453564943141)		✓
Philips Patient Monitoring System Security for Clinical Networks (453564943301)		✓
Protective Carry Pouch for Patient Worn Monitors IFU (453564979631)	✓	
ECG Lead Sets, Cables, Adapter Cables (453564887941)	✓	
SupportTool_Instructions_for_Use_Rev._18.x.x (453665103321)		✓
IntelliVue Network Specification (453564569261)		✓
Application Note - Hexad 12-lead ECG Monitoring Using a 6-wire Lead Set (452299108161)		✓
12-lead ECG for Monitoring and Diagnostic Use Mar 2018 (452299119991)		✓
Assessing Arrhythmia Performance Mar 2021 (452299167561)		✓
Arrhythmia Monitoring ST/AR Algorithm Dec 2020 (452299165051)		✓
QT Interval Monitoring ST/AR Arrhythmia Algorithm Apr 2020 (452299159161)		✓
ST Segment Monitoring ST/AR Algorithm Aug 2022 (452299174601)		✓
Validation of SpO2 measurement accuracy (453665160251)		✓

Training Considerations

- Philips believes that providing our customers with an electronic IFU makes it easier for institutions and clinicians to meet their training obligations. We recognize that the process to define and train the clinical staff that will use the product is not always an easy task.
- Please consider printing a paper copy of the IFU if you think your trained clinicians will want to refer to or need an IFU while using the 5500.

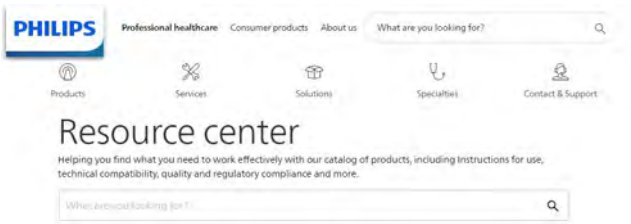
Accessing the Resource Center

To access documents available on the Philips Resource Center, follow these steps:

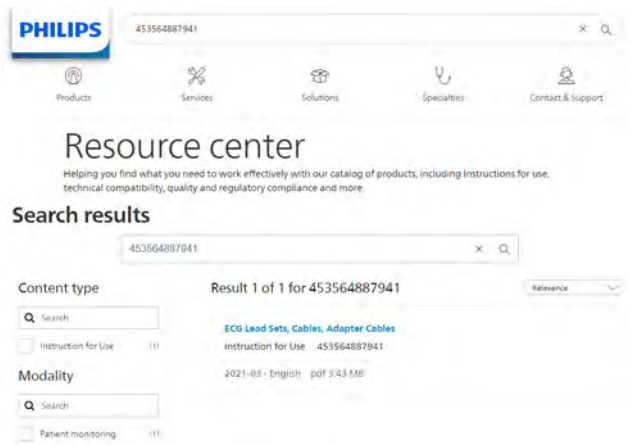
1. Go to the Philips Resource Center website:

http://www.philips.com/ifu OR

2.Type (or cut and paste from the table titled “Accessing Paper and Electronic Documentation” on page 6) the part number or the title of the publication you would like to access in the "what are you looking for?" box. Click the magnifying glass to begin the search.



Above the search results are buttons that allow you to filter the results by Product category, Content type, and/or Language.



3. Click on the linked title to open the publication. Using a PDF reader, you can view the table of contents, search for text, download and print.

If you can't find what you are looking for, there is a **Request documentation** button at the bottom of the **Search results** screen shown above. You can use this button to request any document you are looking for, in paper or electronic format.

Accessing InCenter

Access to InCenter requires a Philips InCenter account and password. Authorized personnel should visit www.incenter@philips.com to request access to InCenter or contact your biomedical engineer.

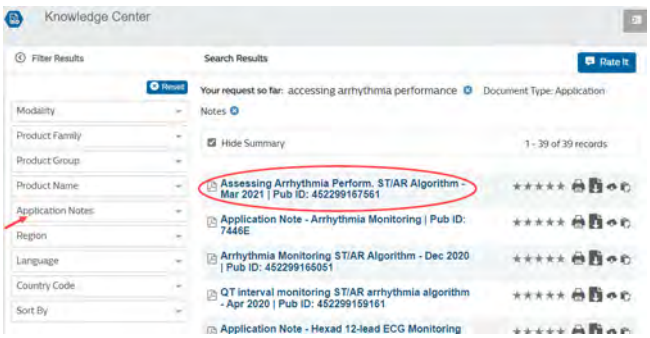
To access documents available on the Philips InCenter, follow these steps:

1. Go to the Philips InCenter website:

https://philips.mizecx.com/cc OR

2. Type (or cut and paste from the table titled “Accessing Paper and Electronic Documentation” on page 6) the part number or the title of the publication you would like to access in the "Start Searching..." box. Click **GO** to search.

3. If the search returns a long list of related publications, you can filter the results. To filter the search results, select one of the options in the boxes to the left. For example, changing "Document Type" to **Instructions for Use** filters the results to publications categorized as Instructions for Use.



4. Click on the linked title to open the publication. Using a PDF reader, you can search for text and print the publication.

Printing History

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

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

First Edition..... June 2025

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1 Introduction

This chapter introduces the Philips Telemetry Monitor 5500 wearable patient monitor, subsequently referred to as "5500" or "the 5500".

The terms "local", "locally", or "device" refer to actions initiated or displayed at the 5500.

1.1 Telemetry Monitor 5500 Models

The 5500 is available in two models:

1. ECG only (SO1)
2. ECG and SpO_2 (SO2)

The following software options are enabled by default:

1. CO1: Enhanced Arrhythmia
2. CO3: Graphic Trends
3. MO2: Respiration

Your facility may choose to keep the software options enabled or disable them. Contact your service team for more information.

1.2 Intended Use/Indications for Use

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.

1.3 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. The Telemetry Monitor 5500 is contraindicated for use with infants and neonates.

1.4 Patient Population

The Telemetry Monitor 5500 is for use with adult and pediatric (child and adolescent(1)). Not for use with infants or neonatal patients.

Clinical judgment must be used to determine when the 5500 should be used on a specific pediatric patient, as it is not possible to assign a precise weight or age to ECG performance.

(1) The US Food and Drug Administration defines pediatric subpopulations as: Children - 2 years to less than 12 years old, and Adolescents - aged 12 through 21.

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The 5500 is patient worn, one patient at a time, and for ambulatory adult and pediatric patients requiring monitoring of multiple physiological parameters.

The 5500 should be used in a non-sterile, reusable, hospital, in-hospital transport, Cardiac telemetry and other post-surgical care settings in General Ward and Medical Surgical settings.

1.5 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.
- Philips FAST technology which provides continuous, automatic or manual SpO_2 measurements.
- Standard, EASI or Hexad ECG lead system selection.
- Impedance-based Respiration measurement.
- 6-lead with two V-leads for diagnosing multiple cardiac abnormalities, including wide-QRS complex tachycardias and acute myocardial ischemia/infarction.
- 24-hour numeric trend upload.
- 10s waveform backfill.
- Local measurement trend/alarm history, graphical trend, trend upload.
- Local alarming for measurements.
- Integrated radio for connection to an Patient Information Center iX (known as PIC iX or Information Center).
- Powered by three AA batteries or a Philips rechargeable lithium ion battery.
- Audio feedback for out-of-range and lost device.
- Battery gauge on device and at the Information Center.
- Alarm suspend and resume from standby at device and the Information Center.
- Protective Carry Pouch with clear front that closes securely.

NOTE

Unlike a traditional bedside monitor which operates on AC power, the 5500 is powered by battery and provides time-limited screen display and local alarming.

1.6 Compatibility

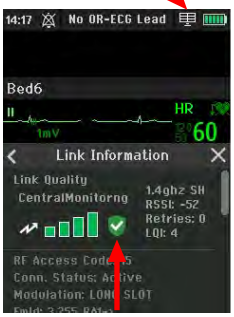
The 5500 is compatible for use with Patient Information Center iX (PIC iX), IntelliVue Support Tool (IVST) Mark2 and the Smart-hopping Wireless Infrastructure (SH). The following table provides a version and encryption compatibility matrix for the 5500, Version 4.0.0.0.

Product	Version	Encryption
PIC iX	≥ 4.2	Yes
	C.03	Yes - without authentication and encryption
IntelliVue Support Tool Mark2	≥ 19.0.0	Yes
1.4 GHz Smart-hopping Infrastructure	SH 1.0	Yes - without authentication and encryption
	SH 2.0	Yes

The 5500 is configured with authentication and encryption enabled by default and can operate with unauthenticated and unencrypted legacy systems, as noted above.

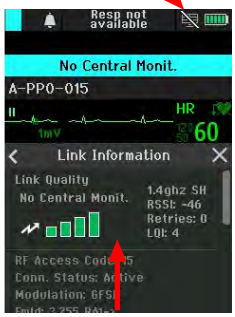
When authentication and encryption is enabled, a green encryption status shield is displayed in the Device Status->**Link Information** menu and the wireless icon is displayed in the Device Status area at the top of the screen, as shown below.

Device is connected to the PIC iX



Encryption status shield (auth/encrpt is enabled)

Device is Not connected to the PIC iX



No encryption status shield (auth/encrpt is disabled)

NOTE

Operating the 5500 without Authentication and Encryption increases the risk of unauthorized access to data and compromising data integrity.

Trend Upload and **Wave Backfill** are features only available when the device displays the green shield (authentication and encryption is enabled) and the device is connected to the PIC iX.

For information about Wave Backfill, see “Backfilling Wave Dropouts” on page 146.

For information about authentication and encryption or your wireless infrastructure, contact your service team.

1.7 Product Safety

This section consolidates the general safety warnings associated with the 5500. These warnings are repeated throughout the book in context where relevant.

WARNING

- **The 5500 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 PIC iX. The 5500 sends ECG and optional pulse oximetry data to the PIC iX, which then 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 5500 regardless of the connection to the PIC iX.**
- **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 PIC iX is not clinically acceptable for certain patients, alternatives must be sought. As the 5500 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 electro-surgical units because such use may interrupt or interfere with the transmission of signals from the 5500 or effect ECG quality.**
- **Always confirm monitor observations with clinical observation of the patient before administering interventions.**
- **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 Service Adapter.**
- **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 OR leads with adapters connected to the 5500, this results in Respiration leads-off condition, and delayed treatment.**

WARNING

- **Do not use the 5500 device, patient cables or accessory cables and sensors if prior visual inspection reveals 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 183. 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 5500 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 team.**
- **If the 5500 displays a SW License Required message, remove the device from service and contact your service team.**
- **Patients should be instructed not to open the battery compartment while the 5500 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 Device Location feature is not intended for use when attempting to locate a patient.**
- **Do not touch device during defib events to avoid the risk of electrical shock.**

CAUTION

- **Philips recommends that when using a Protective Carry Pouch to attach the 5500 to your patient, you consider the placement of the straps because they could present a strangulation hazard.**
- **Do not use pneumatic tube systems to transport this device or the rechargeable lithium ion battery. Damage may result.**
- **Place the 5500 in a Protective Carry Pouch or over clothing, or both, during patient use.**

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1.8 Security Information

Protecting Personal Information

Protecting personal health information is a primary component of a security strategy. The Telemetry Monitor 5500 does not store personal information such as patient name, gender, sex, date of birth etc., rather this information is provided by the PIC iX, when a connection is established. In addition, data at rest is encrypted. Each facility that uses the 5500 must provide the protective means necessary to safeguard personal information consistent with country laws and regulations, and consistent with the facility's policies for managing this information. Protection can only be realized if you implement a comprehensive, multi-layered strategy (including policies, processes, and technologies) to protect information and systems from external and internal threats.

As per its intended use, the 5500 operates in the patient vicinity and contains personal and sensitive patient data. It also includes controls to allow you to adapt the monitor to the patient's care model.

To ensure the patient's safety and protect their personal health information you need a security concept that includes:

- Physical security access measures: access to the 5500 must be limited to authorized users. It is essential that you consider physical security measures to ensure that unauthorized users cannot gain access.
- Operational security measures: for example, ensuring that patients are discharged after monitoring in order to remove their data from the monitor.
- Procedural security measures: for example, assigning only staff with a specific role the right to use the monitors.

In addition, any security concept must consider the requirements of local country laws and regulations.

Always consider data security aspects of the network topology and configuration when connecting the 5500 to shared networks. Your medical facility is responsible for the security of the network, where sensitive patient data from the 5500 may be transferred.

When ending monitoring for a patient, perform a discharge to ensure patient trend data is removed from the 5500.

When a 5500 is returned for repair, disposed of, or removed from your medical facility for other reasons, always ensure that all related patient data and security related information such as networking certificates and custom PINs are removed from the 5500 by ending monitoring for the last patient by resetting the monitor to factory defaults.

NOTE

Log files generated by the 5500 are used for system troubleshooting and do not contain protected health data.

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Philips Product Security Policy Statement

Additional security and privacy information can be found on the Philips Product Security web site at:

http://www.usa.philips.com/healthcare/about/customer-support/product-security

Manufacturer Disclosure Statement for Medical Device Security - MDS2

You can view the Manufacturer Disclosure Statements for Medical Device Security (MDS2) for specific devices at:

http://www.usa.philips.com/healthcare/about/customer-support/product-security

Cybersecurity Requirements and Controls

The Telemetry Monitor 5500 cannot be connected to portable media such as USB drives or CDs. Cybersecurity threats therefore result mainly from network connectivity and may impact safe and secure operation of your network or any devices attached to this network.

The 5500 does not support user accounts, therefore no audit log is collected.

Anytime you are disconnected from the PIC iX, the 5500 automatically activates Monitor Mode. The 5500 reverts to Telemetry Mode when a connection to the PIC iX is re-established. If the 5500 is not connected to the PIC iX, the alarms are only announced locally.

As part of your security concept, you are responsible for establishing controls to protect your network and any networked devices, including the 5500, against such cybersecurity threats. For more information, see the *IntelliVue Network Specification - Guideline for Building Networks for Philips*.

If network authentication is configured, the 5500 uses a Certificate Authority (CA) to establish its identity. The CA plays an important role in the overall network security. You must protect the CA from tampering and physical damage. You must ensure that valid certificates are issued only to trusted devices. Please refer to the *PIC iX 4.x License Activation Guide*.

For additional Security and Privacy recommendations to enable the 5500 to function in a high security environment, consult the *Patient Monitoring System Security for Clinical Networks Release 4.x*

Documentation mentioned above can be found on InCenter. See “Accessing Paper and Electronic Documentation” on page 6

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Network Cybersecurity Measures

Only connect the Telemetry Monitor 5500 to networks that are explicitly intended for that purpose. The monitor is intended to be used for monitoring of, and to generate alarms for, multiple physiological signals of patients. If you connect the monitor to a network, it is therefore highly recommended that you deploy measures for protecting the network against cybersecurity threats. This includes the deployment of firewalls to limit remote access and antivirus protection of standard computer systems.

Network Security Requirements for Connectivity to other Systems

To ensure safe and secure operation of networked data collection applications involving the Telemetry Monitor 5500, you must implement network traffic isolation by using dedicated physical or logical networks (isolated VLANs). Network traffic separation can be achieved by configuration of network infrastructure devices (switches, routers and firewalls) as outlined in the IntelliVue Network Specification. Only devices required by the specific system application should share this dedicated network. To prevent malware from affecting network performance or device operation, always ensure that all networked devices with standard operating systems have virus protection installed and kept up to date.

For managing risks in clinical network deployments, Philips recommends that you apply a formal process such as the IEC 80001 series of standards to address safety, effectiveness, and data and system security.

Network Security Requirements for Connectivity to Philips Systems

You must follow the network configuration instructions of the specific Philips system product. For the Philips Patient Information Center (PIC iX), the IntelliVue Network Specification provides detailed network configuration requirements associated with the safe and secure operation of Philips IntelliVue devices within your hospital network for the purpose of patient monitoring. The IntelliVue Network Specification ensures the configuration and operation of a logical isolated network (LAN or VLAN) for IntelliVue devices (including the 5500) by the configuration of network infrastructure devices (switches, routers, etc.). The document also defines the interconnection of the isolated network with other hospital networks using firewalls as well as the use of antivirus software for computer platforms based on standard operating systems.

Compliance to the IntelliVue Network Specifications is verified by Philips in cooperation with the customer prior to go-live. Contact your Philips sales or service representative for a copy of the IntelliVue Network Specification.

Network Ports, Protocols and Services

Port Usage Category	Port No	Protocol	Inbound	Outbound	Service Name	Description of Service	Optional	Able to Config.	Encrypted
Clinical	24005	UDP	X	X	med-ci	Connect Indication	--	--	PIC iX
Clinical	24009	UDP	X	X	med-label	Label Assignment	--	--	PIC iX
Clinical	24008	UDP	X	X	med-data	Physiological Data	X	--	PIC iX
Clinical	57003	UDP	X	X			X(2)	X	PIC iX
Service	68	UDP	X	--	dhcp	IP Configuration	--	--	DHCP Server
Service	55353	UDP	X	--	mdns	Service Discovery	--	--	IVST

Security Software Updates

All software for the Telemetry Monitor 5500 is completely built and integrated by Philips. There are no separate user-updatable software components from other manufacturers.

Philips authorized software updates for the 5500, including any potential cybersecurity updates, are communicated via the Field Change Order Process which is a component of the Philips Quality System. Field Change Orders are published and available on InCenter at: http://incenter.medical.philips.com/.

The procedure on how to install software updates is described within the Field Change Order or Service Bulletin.

If you have questions about InCenter access, please contact your Philips sales or service representative.

(2) Default

2 Basic Operation

This chapter provides an overview of the Philips Telemetry Monitor 5500 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.

2.1 Getting Started

The 5500 operates with two device modes, Telemetry and Monitoring. Telemetry Mode is when the 5500 is connected to the PIC iX. The volume is set to zero and the display is Off to minimize patient disruption. Monitoring Mode is when the 5500 display is always On, alarms are announced at the device and at the PIC iX, if network connected. To learn more about Device Modes, see “Device Modes” on page 44.

The 5500 arrives with a default set of measurements but requires an equipment label to be configured and the device to be assigned to the PIC iX for physiological alarms to be activated. Your biomedical engineer can create profiles at the PIC iX with measurements defined for Adults and Pediatric patients. When a patient is discharged, alarm limits and measurements will return to the defaults. Admitting and Discharging patients is performed at the PIC iX.

Inspecting the Device

WARNING

Do not use the 5500 device, patient cables or accessory cables and sensors if prior visual inspection reveals damage or the presence of liquid, lint or dust inside.

CAUTION

The AA Battery Door 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 AA Battery Door be replaced every 12 months or when visible wear is recognized. A date code is included on the battery door to help you identify the 12-month time period.

Before you start to take measurements and on a daily basis, carry out the following checks on the 5500:

- Inspect the 5500 for obvious signs of damage.
- Check all external patient cables and accessory cables or sensors for damage.
- Replace any damaged equipment or accessories.

- Check all functions that you need to monitor your patient and ensure that the device is in good working order.

Ensure that the battery has sufficient power for monitoring. If you are using a lithium ion battery, make sure it is fully charged. For both the lithium ion battery and AA batteries, refer to "Battery Charge Status" on page 59 and "Battery Information" on page 49 for more Battery Safety information and instruction.

2.2 Telemetry Monitor 5500 Controls and Indicators

The clinical controls of the 5500 include buttons, display icons, visual and audio indicators.

1. Local Audio Status

2. Alarm Indicator

3. Bed Label / Equipment Label

4. Measurement Area 1

5. Acknowledge Alarms Button

6. SmartKeys Button

7. Information Area

8. Device Status Area

9. Active Alarm Area

10. Patient Demographics

11. Measurement Area 2

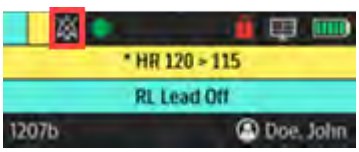
12. Wave 1

13. Wave 2

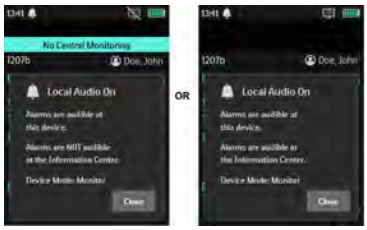
14. Main Screen Button

Audio/Alarm Indicators and Demographics

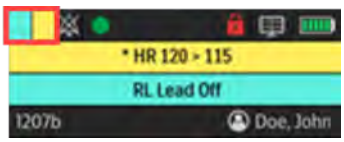
Local Audio Status



The audio status icon indicates whether the device audibly alarms.

Icon	Function	Local Audio icon Popup
 Local Audio On	The Local Audio On bell indicates: • Alarms are audible at this device. • Alarms may or may not be audible at the Information Center. • Device Mode: Monitor	
 Local Audio Off	The Local Audio Off bell indicates: • Alarms are NOT audible at this device. • Alarms are audible at the Information Center. • Device Mode: Telemetry	

Alarm Indicator



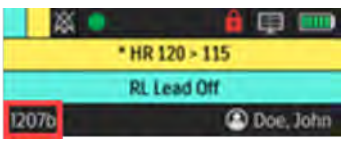
The alarm indicator on the 5500 main screen displays alarm/INOP conditions that have not been acknowledged.

The alarm indicator is divided into two sections and appears in the upper left-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.
- The left section lights continuously for a standard INOP and flashes for INOPs configured as red or yellow alarms.

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

Patient Demographic: Bed / Equipment Label



The left side of the patient demographic area shows the bed label or the equipment label.

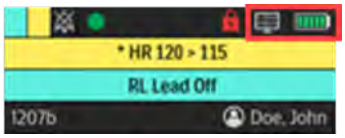
Information Area

Leads Off and Lock status icons are displayed in the Information area. Informational messages also appear here such as **Settings Sync** or **Resp Not Available**.

Touch the information area to show the chest diagram screen.

Icon	Function
 Lead Off indicator example	Lead Off indicators appear here. The color of the circles correspond with the Lead Off INOP text. If all leads are off, you will see the number of circles for the type of lead set you are using. 
 Lock Icon	The Lock symbol appears in the top right of the information area when the 5500 is in a locked state. • The device locks 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 unintended access. • When the display is locked, a red lock icon indicator is displayed after touching the screen. • The display can be unlocked using the SmartKeys menu. Additionally, the 5500 can be configured to require a 6 digit PIN to unlock the device.

Device Status Area

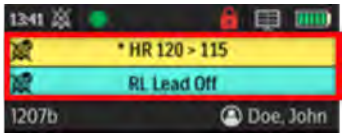


Device information (e.g. wireless and battery information) appears here.

Connection Indicator and Battery Charge Status icons

Icon	Function
	Indicates the device is connected to the PIC iX
	Indicates the device is not connected to the PIC iX
	5 bars, 81-100% battery capacity
	4 bars, 61-80% battery capacity
	3 bars, 41-60% battery capacity
	2 bars, 21-40% battery capacity
	1 green bar, <20% battery capacity
	1 red bar, <Low Battery Threshold

Active Alarm Status



Active alarm status is displayed as banners above the patient's name.

WARNING

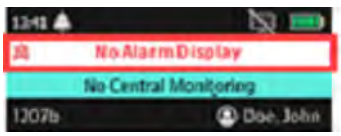
If a "No Alarm Display" message appears after a battery change, physiological alarms are not active. Remove the device from use and contact your service personnel.

- The top banner is for physiological alarms (yellow or red patient alarms) or Alarm Pause status. If alarms are paused, **Alarms Paused** along with a countdown timer displays instead.
- The bottom banner is for cyan, yellow or red technical alarms (INOPs).
- Touching the active alarm status area displays a list of all current active alarms.
- A multiple alarm indicator (up arrow) is displayed when multiple alarm conditions are present. The alarm message rotates every 2 seconds.
- Alarm indicators are provided when the alarm is active and not acknowledged. When acknowledged, the indicator stops flashing.

Alarm Off

When the alarm off icon displays on the physiological alarm banner, the alarm system is not active on the device for all measurements. The alarm off icon has solid cross lines.

As noted in the Warning above, if the **No Alarm Display** message persists, remove the device from use and contact your service team.



Alarm Pause

When the alarms paused icon displays on the physiological alarm banner, the alarm system is not active on the device for all measurements. The alarm pause icon has broken (or dashed) cross lines.

The alarm system will reactivate when the configured time reaches zero. You can resume alarming at any time by unpausing the alarms.

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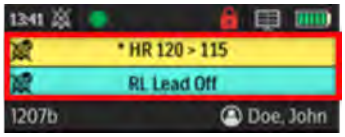
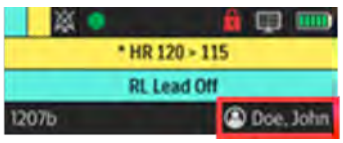
Alarm Acknowledged

When the acknowledge alarm icon displays in either alarm banner, any active alarm is acknowledged and the alarm system no longer audibly announces the alarm. The acknowledge alarm symbol is a bell with solid cross lines and a checkmark in the top right corner.



Patient Demographic: Name



The right side of the patient demographic area displays the Patient Name.

Touching the patient demographic area activates a pop-up window which lists the following information, if available from the PIC iX:

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

Measurement Areas

The measurement areas of the 5500 display are optimized to show available measurement numerics, waveforms, and alarm limits. Each element is a touch object and when you select it, further controls and menus become available. When any measurement is off (or manually turned off), its waves and numerics are removed from the 5500 and the PIC iX. The 5500 stops the measurement and is no longer able to alarm for this measurement.

Measurement Area Display Configurations

The display of your 5500 can operate in one of six available orientations:

- Portrait - Chest diagram and two numerics
- Portrait - Two waveforms and two numerics
- Portrait - One waveform and four numerics
- Portrait - No waveforms and six numerics
- Landscape - Two waveforms and three numerics
- Landscape - Multi-lead ECG waveforms and four ECG numerics

Touching the Main Screen button cycles through the screens. The Chest Diagram screen automatically displays when all of the leads are off.

Measurement Area 1

In the example above and outlined in red, HR has been configured to display in measurement area 1. Relevant alarm limits and the paced status are displayed whenever the HR is displayed.

Paced Mode

1. 2. 3.

1. Pacing algorithm is On.
2. Pacing algorithm is Off.
3. Pacing algorithm is On. Pacing status is unconfirmed.

Measurement Area 2

In the example above and outlined in red, SpO_2 has been configured for measurement area 2. Relevant alarm limits and the signal quality indicator are displayed whenever SpO_2 is displayed.

Waveform Areas

The 5500 includes two areas for waveforms. The following types of waves are available: ECG, Pleth and Resp.

Waveform Area 1

Waveform Area 2

Primary or secondary ECG waveform configuration changes made at the PIC iX change what is displayed on the 5500. But changes made locally at the 5500 do not affect settings at the PIC iX. Selecting Pleth or RESP to display at the PIC iX affects ECG wave storage for future review at the PIC iX.

The Waveform areas are covered by the SmartKeys Menu when you press the SmartKey Menu button.

Acknowledge Alarm, SmartKey Menu, and Main Screen Buttons

The three buttons on the bottom of the screen are always present and allow you to acknowledge active alarms, open the SmartKey menu, and open the Main Screen.

Button	Function
 Acknowledge Alarms button	Touch to acknowledge active alarms and INOPS at the 5500 and at the PIC iX. This switches off the audible alarm indicators and alarm lamps for any active alarms.
 Smartkey Menu button	Touch to open the SmartKey menu. (see next page for a list of available SmartKeys and descriptions)
 Main Screen button	• Touch and hold the Main Screen button for 1.5 seconds to turn the display screen On • Touch again to change the screen view • Touch to resume from Standby • Touch to return to the Main Screen when in a sub-menu • When display is active, touch and hold to lock and turn screen Off (PIC iX connection required)

SmartKeys

The following table lists the SmartKey functions and descriptions. A scroll bar on the display indicates there are more SmartKeys or more menus available. Touch the SmartKey icon to access the function. Grey text indicates the SmartKey is unavailable.

Start SpO_2	**Start SpO2** Starts a manual SpO_2 measurement. This icon is grayed out when the SpO_2 measurement is continuous. "Measurement Overview" on page 135	**Device Mode**	**Device Mode** Opens to change device mode. **Telemetry -** screen and alarm volume "off" * **Monitor -** screen and alarm volume "on"
Standby	**Standby** Selects a standby time. Confirmation required. **Note**: Monitoring and Alarming are not available while the device is in standby.	**Main Setup**	**Main Setup** Opens setup menu for: • Measurement menus • Screen "on" time
ECG: On	**ECG: On** Turns ECG Measurement "on" or "off". Turning ECG "off" requires confirmation.	**Trends**	**Trends** Opens for you to view tabular or graphical trends
Alarms	**Alarms** Reviews alarms, pauses alarms or views alarm volume.	**Print Reports**	**Print Reports*** Prints a preconfigured report at the PIC iX.
Op Modes	**Op Modes** Provides password protected access to Demonstration, Configuration, and Service operation modes.	**Lock: On** **Lock: Off**	**Lock/Unlock** Locks or unlocks the 5500 screen (may require PIN to unlock).

**A connection to the PIC iX is required.*

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2.3 Operating and Navigating

The principal method of operating your 5500 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.

Audible Tones

The 5500 plays audible tones for alarms and other events/tasks. See “Audible Alarm Indicators when in Monitor Mode” on page 68 for alarm specific tones.

The table below shows which audio tone is played at specific events/tasks. When the display for the 5500 is off, the only audio available is the Find Device sound.

When the 5500 measures a weak RSSI (Received Signal Strengh Indicator) below the weak signal threshold, the device will display a **Tele Weak Signal** message. Under good RSSI and link quality conditions, the device will not output any audio tones. If the RF quality is poor enough to cause the 5500 to lose its connection to any access point, the device will emit a hard INOP tone and display a **No Central Monit.** message.

NOTE

Alarm sounds have the highest priority. Sounds coupled with user interface actions (e.g. SpO_2 tone modulation, touch click) and other sounds (e.g. device location) are queued and played on a First In, First Out (FIFO) basis and may be omitted if an alarm sound is being played.

Audio tones for events/tasks

Event/Task	Audio Tone	Volume
Main Screen button touch	Keyboard click sound	Volume: **0** (off) Range: **1** to **5** (on)
SmartKey button touch		
Acknowledge button touch		
Touch screen area		
Self-Test Passed	Self-Test Passed sound	Fixed, cannot be muted
Self-Test Failed	Self-Test Failed sound	
SpO_2 Tone Modulation Volume (Volume is only available when the screen is on)	When enabled, tone modulation indication is only available when operating in Continuous mode and not available when operating in Manual or Auto mode.	Range: **Off**, **1** to **5** (on)

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Event/Task	Audio Tone	Volume
Page/Find Device	If a 5500 device is misplaced, the Find Device feature can be initiated at the Central Station. The misplaced device (with a good battery) will play a continuous two tone sound similar to a "European ambulance sound" for 15 seconds, pauses for 5 seconds and repeats. Once found, the sound must be acknowledged/turned off from the 5500.	Fixed
No Connection to PIC (with a good battery)	No Central Monitoring INOP tone sound at the maximum alarm volume. Monitor screen turns on automatically.	**5**
The 5500 in Telemetry Mode transitions with low battery - off network.	When the 5500 transitions in Telemetry Mode to off network in a low battery state, an optimized alternating double tone beep sound is played until the battery is exhausted. The 5500 display is dim with a low battery icon. No local monitoring is possible.	Fixed, cannot be muted
Physiological alarms and technical alarms - on network	Audio alarms can be silenced by pressing the acknowledge button. See “Alarms Overview” on page 65.	Telemetry mode: **0** Monitor mode: **1**-**5**
Physiological alarms and technical alarms - off network, with a good battery		**5**

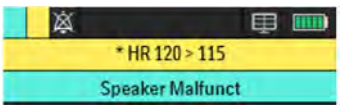
Power-On Self Test and Connectivity

Once battery power is supplied, the 5500 performs a power-on self test to check operational status prior to start-up. Subsequent connection to the PIC iX then occurs. 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 PIC iX and displayed locally.

For ECG Only devices, if an SpO_2 leadset is connected, the message **SPO2 Not Available** temporarily displays to remind the user that there is no SpO_2 functionality available.

WARNING

- **Do not apply any labels or stickers on the right side of the device (the side without the "5500"). A label/sticker or hand may impair audio performance and lead to a change in alarm volume or tone.**
- **Should the 5500 fail its alarm sound test (no sound played) or the Speaker Malfunct or Tele Malfunction INOP is displayed, remove device from use and contact your service team.**



Ensure that your 5500 connects to the PIC iX. You can verify this by confirming the following:

- The bed label appears in the top left corner of the patient demographic area.
- The **No Central Monit.** INOP is no longer displayed and the screen transitions to display the **Audio Off** status message and accompanying icon.
- Device sounds have ceased, and after one minute (configurable) the display is no longer active and the connectivity icon at the top right of the screen is no longer crossed out.

Check that the above actions occur and that you are connected to the PIC iX when in the wireless coverage area. If you are not in range of the PIC iX, 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 5500 and accessories. If damage is detected, remove from use. Replace any damaged equipment or accessories.

NOTE

A successful power-on self test transitions the 5500 to the start-up screen. Selectable background colors can be configured and displayed on the startup screen for assistance with device identification. This can be helpful when devices are in a pooled use setting.

Covering the right side of the device (the side without the "5500"), with a label or hand may impair audio performance and lead to a change in alarm volume or tone. In some cases, the device may report a speaker failure during the power-on self test.

Touch Sensitive Display

The display area of the 5500 is touch sensitive and can be touched with your fingertip or thumb through a Protective Carry 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 lock icon is displayed.

Navigating

Navigation is performed with swipe up and down gestures. A scrollbar appears on the right side of the display to indicate access to additional SmartKeys or other menu options.

Selecting Display Areas

Touch a display area to access the actions linked to that area/element. For example, touch the Patient Demographic area to display the Patient Demographics window, or touch the HR numeric to display the **Setup ECG** menu. Touch the ECG waveform to display the **Wave Selection** menu.

Locking the Display

CAUTION

Consider configuring a 6 digit Unlock PIN (numeric only) to prevent unintended user access to the touch display that could interfere with monitoring operations.

To provide additional protection against patient access to the 5500, 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. You may also lock the display by simply touching and holding the Main Screen button.

To unlock the display, touch and hold the Main Screen button and enter the PIN, if one has been configured. The PIN must be entered every time the configured time of non-use is exceeded.

NOTE

Philips recommends you create PINs that are unique and strong (at least 6-8 digits). PINs should not be shared across other types of hospital devices and should be changed periodically, following hospital policy.

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
Acknowledge Alarm Button	No	No	Yes	No

`

Connecting/Disconnecting the Patient Cable

The Philips FAST patient cable is shown below.

The Masimo SET patient cable is not compatible with Philips FAST devices. If connected, an **Invalid Leadset** INOP displays, along with instructions to connect the proper patient cable.

WARNING

Masimo SET leadsets are not compatible with the Philips FAST devices, replace with a compatible leadset.

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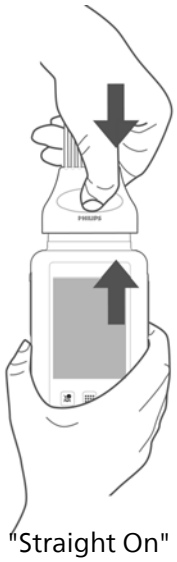
Patient cables are connected to the 5500 as shown in the illustration below.



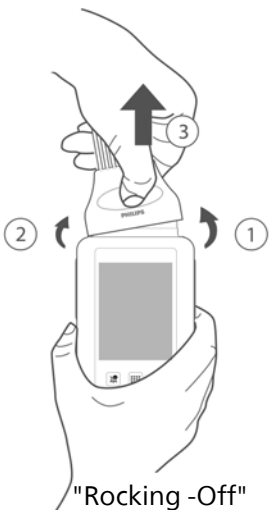
"Straight On"

When connecting to the 5500, there is a slight clicking sound that signifies that the cable is securely connected.

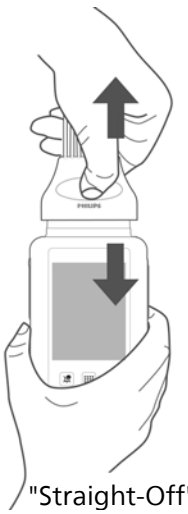
CAUTION

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 5500.

Disconnect the patient cable using a rocking motion or by pulling the cable connector straight off.



"Rocking -Off"



"Straight-Off"

CAUTION

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

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2.4 Device Modes

Telemetry Mode

To minimize patient disruption, the 5500 operates in Telemetry Mode when connected to the PIC iX. In Telemetry Mode, the local volume is set to zero and the display is off. To activate the display at any time, touch and hold the main screen button until the screen appears. All active alarms can be viewed when the display is on, however audible alarm indicators are not annunciated. The Audio Off icon  is displayed. Regardless of the display status, all measurement data is being sent to the PIC iX. Telemetry Mode is only available when connected to the PIC iX.

Monitor Mode

You may find the use of Monitor 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 5500 and at the PIC iX if network connected. The Audio On icon  is displayed. Be aware that when the display is on and alarms are audible, battery consumption will increase.

To use Monitor Mode:

1. Touch the Device Mode SmartKey button.
2. Choose **Monitor**.

NOTE

- Anytime you are disconnected from the PIC iX, the 5500 automatically activates Monitor Mode. The 5500 reverts to Telemetry Mode when a connection to the PIC iX is re-established. If the 5500 is not connected to the PIC iX, alarms are only announced locally. For additional information regarding battery status during Monitor Mode, see “Battery Charge Status” on page 59.
- A confirmation sound is made when switching from Telemetry mode to Monitor mode.

2.5 Standby Behavior

WARNING

Standby suspends patient monitoring and physiological alarming. Reconnect the 5500 to your patient and resume from standby when monitoring and alarming is necessary. Failure to resume monitoring could cause serious injury or a missed cardiac arrest.

Standby suspends patient monitoring and physiological alarming. All waves and numerics disappear from the 5500 and the PIC iX, but all alarm settings and patient data is retained. When the 5500 is resumed from Standby, either at the PIC ix or at the device itself, the measurement waveform and numeric settings at the 5500 revert to their default settings.

CAUTION

When using the Standby feature, monitoring and physiological alarming is unavailable and therefore the patient requires close personal surveillance.

The device will automatically resume monitoring from standby in any of these states:

- If the standby duration ends.
- If a **Tele Battery Low** INOP condition occurs.
- If a physiological signal is detected.

NOTE

The 5500 must be connected to the patient in order for automatic resume from standby to work.

When the 5500 is placed in Standby, either at the PIC iX or at the device, the measurement waveform and numeric settings at the 5500 revert to their default settings. The Standby time period may differ between the device and the default setting at the PIC iX. The duration is determined by the location of the Standby selection, i.e. placing the 5500 in Standby mode at the device or at the PIC iX. When the 5500 comes out of Standby at either location, the device is activated in both locations.

If a **Tele Battery Low** INOP condition occurs during a **Standby** or **Transmitter Off** state, the 5500 will attempt to resume from Standby and reconnect to the PIC iX to transmit the INOP condition. This requires the device to be in the coverage area in order to reconnect to the PIC iX and transmit the INOP condition. This may result in the 5500 resuming from Standby sooner than anticipated, but this behavior prevents battery exhaustion while not connected to the PIC iX.

The 5500 will automatically start looking for any continuous valid physiological signal after 10 minutes. If a continuous physiological signal is detected, the 5500 will automatically resume monitoring and alarming and attempt to reconnect to the
PIC iX. If standby is the desired state, disconnect the ECG leads and/or SpO_2 sensor from the patient and select standby again.

To manually resume monitoring from standby:

1. Touch the blue Main Screen button, or
2. Disconnect/reconnect the IntelliVue Patient Monitor Adapter Cable.

2.6 Radio Frequency (RF) Auto Shutoff Behavior

RF Auto Shutoff is a configuration setting enabled or disabled for individual clinical units, the default is disabled but your facility may enable this feature. Contact your service team for more information.

If **RF Auto Shutoff** is enabled at the PIC iX, wave data, alarm detection, monitoring, and connection to the PIC iX shuts off after the combination of 10 minutes of a Leads Off and no continuous SpO_2 measurement or a **Leadset Unplugged** INOP. There is no local audio alarm sound when **RF Auto Shutoff** is enabled. A **Transmitter Off** INOP is displayed at the PIC iX.

To resume communication with the PIC iX, reconnect the 5500 patient cable. When operating in SpO_2 Only operation mode, the setting for this configuration choice is not used. The connection to the PIC iX continues, regardless of measurement frequency, that is, continuously, manually, or automatically.

WARNING

If you receive a Transmitter Off technical alarm you must reconnect the patient cable and ECG Leads to your patient when monitoring and alarming is necessary. Failure to resume monitoring could cause serious injury or a missed cardiac arrest.

The following table summarizes the **RF Auto Shutoff** behavior when it is enabled and when the 5500 meets certain conditions.

If one or more of these conditions are met...	RF Auto Shutoff behavior
At least one lead of ECG is being measured.	5500 will not auto shutoff
SpO_2 measurement mode is set to **Continuous**.	
The 5500 is in SpO_2 Only operation mode. The **ECG/Arrh AlarmsOff** INOP is displayed.	
The 5500 is in a low or replace battery state displaying one of the following INOPs: **Tele Battery Low**, **Replace Battery** or **Tele Batt Empty**	
No ECG or SpO_2 data has been measured for 10 minutes: A **Leadset Unplugged** INOP is displayed. or SpO_2 measurement mode is set to Manual or Auto AND an **ECG Leads Off** INOP is displayed	The 5500 shuts off and disconnects and a Transmitter Off INOP occurs at the PIC iX.

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2.7 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 or using the **Main Setup** SmartKey . 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.

Device Controls at the 5500

The following table lists the available local device controls that affect the PIC iX, the 5500, or both.

5500 only and reflected at PIC iX: The control is available at the 5500 only. The effect of the control will be reflected at the PIC iX.

5500 only and not reflected at PIC iX: The control is available at the 5500 only and is not reflected at the PIC iX.

Both: The control is available and will synchronize at both the PIC iX and the 5500.

Control Setting	Affects PIC iX / 5500	Control Setting	Affects PIC iX / 5500
Acknowledge Alarms	Both	SpO_2 Manual Measurement	Both
Relearn Arrhy	Both	SpO_2 Measurement (On or Off)	Both
Adjust size (for ECG)	5500 only and not reflected at PIC iX	SpO_2 Mode	Both
Change Wave	5500 only and not reflected at PIC iX	**Adjust size** (for RESP)	5500 only and reflected at PIC iX
Lead Placement	5500 only and reflected at PIC iX	Standby/Resume	Both
ECG (On or Off)	5500 only and reflected at PIC iX	Standby Duration	*
Pause Alarms	Both if configured	**Screen On Time**	5500 only and not reflected at PIC iX
Pulse (On or Off)	Both	**Print Reports**	5500 only and reflected at PIC iX

For a list of the device controls at the PIC iX, see “Multiple Device Assignment at the PIC iX” on page 146.

*For Standby Duration control information, see “Standby Behavior” on page 44.

Waveform Settings at the 5500

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 PIC iX.
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 PIC iX.

NOTE

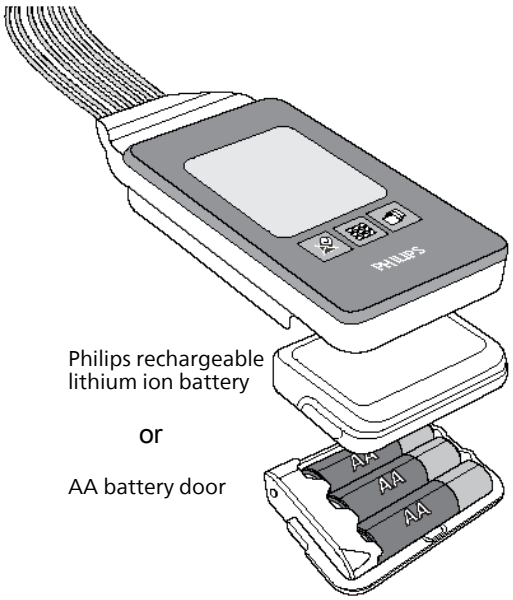
Primary or secondary ECG waveform configuration changes made at the PIC iX change what is displayed on the 5500. But changes made locally at the 5500 do not affect settings at the PIC iX. Selecting Pleth or RESP to display at the PIC iX affects ECG wave storage for future review at the PIC iX.

2.8 Battery Information

This section provides battery safety information, insertion and removal, etc. For maintenance, see “Battery Maintenance” on page 164.

The 5500 uses two types of batteries:

- Philips lithium ion rechargeable battery, or
- Three AA batteries affixed via the AA battery door



Battery Safety Information

WARNING

- **Loss of monitoring will occur when the battery is exhausted. Charge battery or replace battery promptly when a battery alarm is displayed.**
- **Use the Philips Rechargeable lithium ion battery or 3 Duracell MN1500 batteries, size AA, 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 5500 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 5500 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.**
- **The battery compartment door must be closed during defibrillation.**

Battery Safety Information

WARNING

- **Disposable batteries should be removed from the 5500 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, and/or battery life performance.**
- **Do not store AA batteries in the 5500 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 door 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 or batteries loaded into the AA Battery tray on your person, e.g. in clothing pockets.**
- **Use of batteries with terminal voltage >1.6V may cause damage to the device.**

Lithium Ion Rechargeable Battery Care

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

Activity	When to Perform
Perform a visual inspection.	Before inserting a battery in the 5500.
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.

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Activity	When to Perform
Discontinue using the battery.	When any of the following INOPs are displayed on the 5500: **Service Batt Now** **!!!Service Batt Now** **Tele Battery Temp** **Tele Remove** **Note** When the above INOPs occur, the **Tele Battery Low** INOP is suppressed.

Rechargeable batteries are charged using the Philips Telemetry Monitor Battery Charger. For information on charging station use, see “Battery Maintenance” on page 164.

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 rechargeable lithium ion battery shall have a minimum shelf life ≥7 months without the need to be recharged.

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 capacity.

Inserting/Removing Batteries

WARNING

Arrhythmia relearning is initiated whenever the 5500 loses power 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 5500 for an extended period of time.**
- **The AA Battery Door 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 AA Battery Door be replaced every 12 months or when visible wear is recognized. A date code is included on the battery door to help you identify the 12-month time period.**

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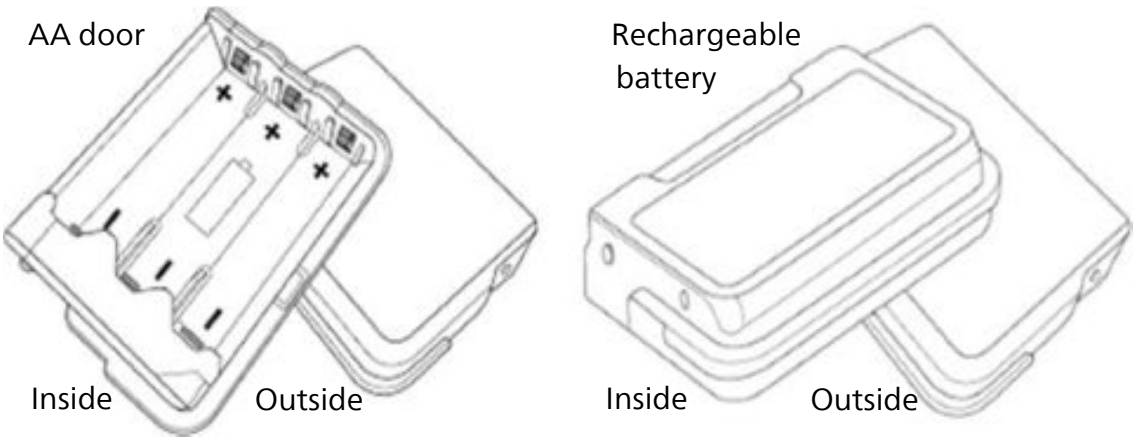
The battery compartment located on the back of the 5500 is accessible by opening the compartment door from the bottom. It accommodates three AA 1.5V alkaline batteries or the Philips rechargeable lithium ion battery. Only these battery choices should be used.



NOTE

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

Battery Authentication

The 5500 authenticates the AA battery door or lithium ion battery when it is inserted on/in the device. If authentication fails, the 5500 will not monitor, communicate to the PIC iX, IntelliVue Support Tool Mark2, or Focal Point. The following incompatibility message will be displayed on the 5500.

Inserting Batteries

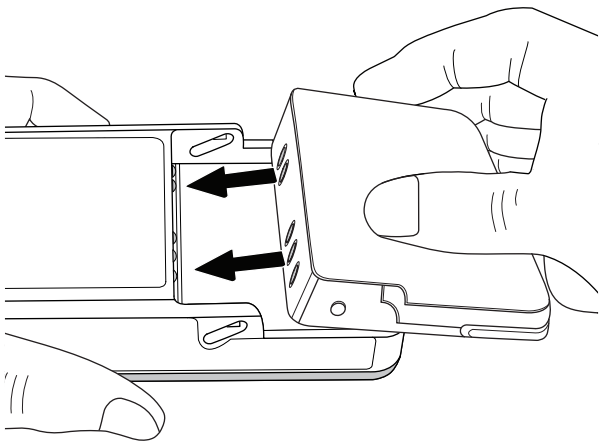
AA Battery Insertion

Insert AA batteries into the 5500 using the following procedure:

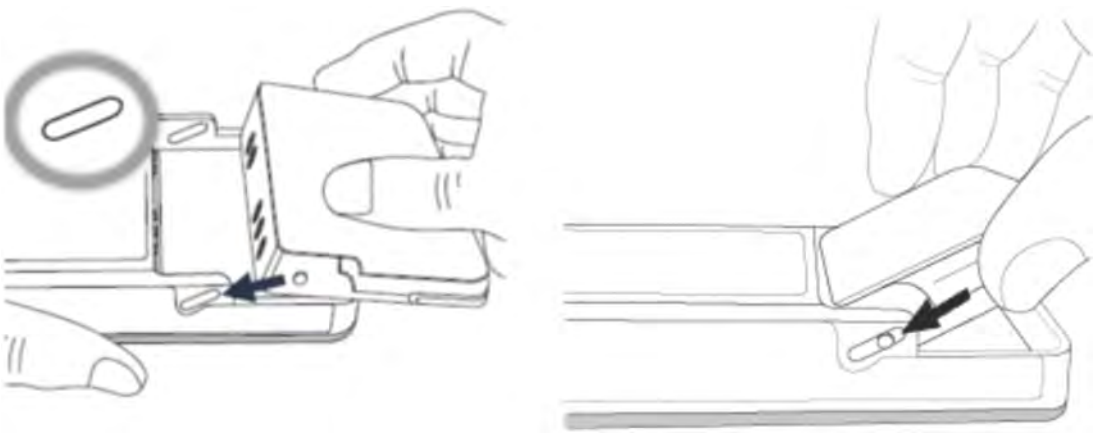
NOTE

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

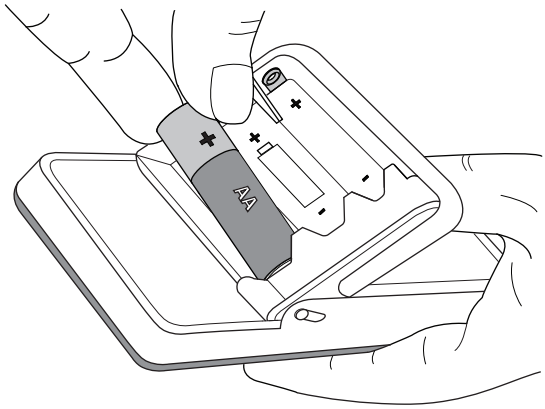
1. To attach the AA Battery Door, first orient it so that its five gold connector pins are aligned with the five gold pins in the battery compartment on the 5500.



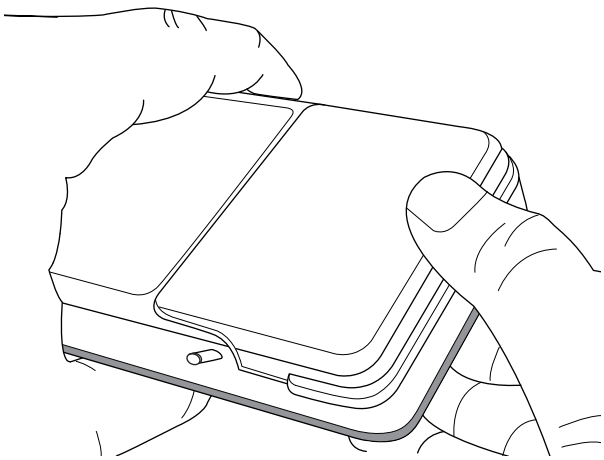
2. Align the notches on each side of the AA Battery door with the edge of the 5500 case near the slots, and slide the AA Battery door toward the slots until the notches engage.



3. Insert three Duracell AA 1.5V Alkaline batteries, matching the polarity with the - and + indications inside the door. Ensure to insert the - end in first.



4. Close the AA Battery Door. Make sure you hear the battery door "click" closed. Look for gaps that might indicate the door didn't close.



5. Watch for the start-up screen on the front of the 5500 to illuminate.

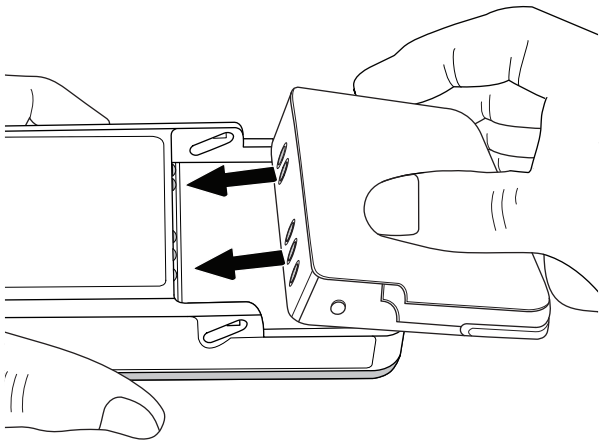
NOTE

All batteries are inserted with the + polarity in the same direction.

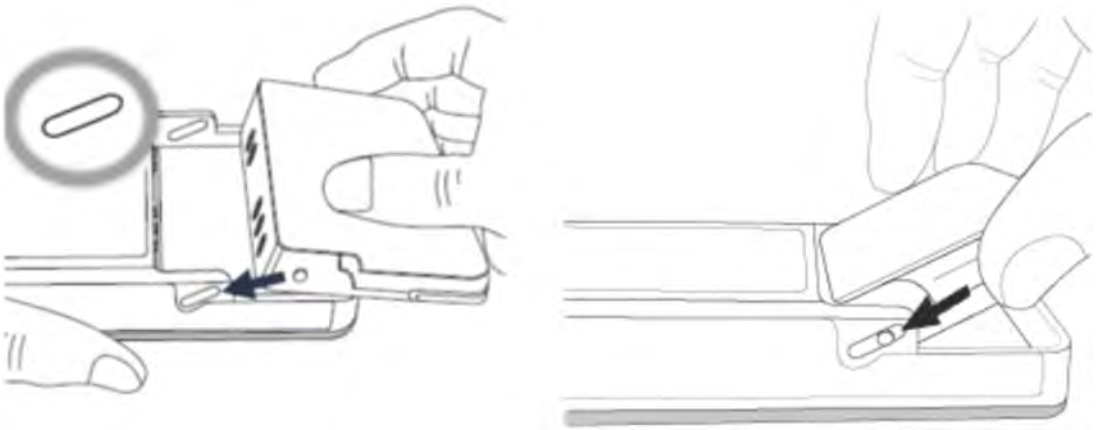
Lithium Ion Battery Insertion

Insert the Philips rechargeable lithium ion battery into the 5500 using the following procedure:

1. To attach the rechargeable battery, first orient it so that its five gold connector pins are aligned with the five gold pins in the battery compartment on the 5500.



2. Align the notches on each side of the rechargeable battery with the edge of the 5500 case near the slots, and slide the rechargeable battery toward the slots until the notches engage.



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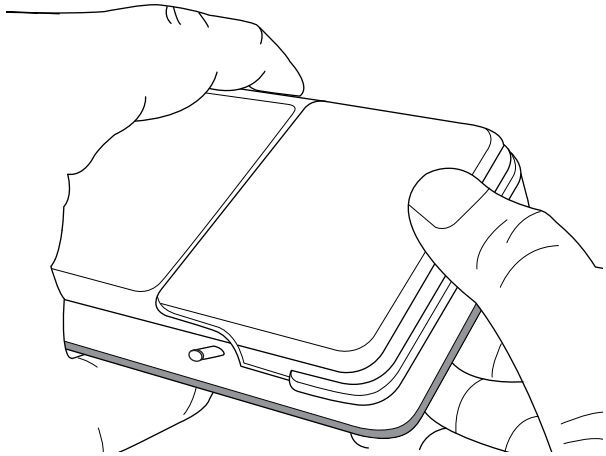
3. Secure the rechargeable battery in the battery compartment. Make sure you hear the battery "click" closed. Look for gaps that might indicate the battery didn't close.



4. Watch for the start-up screen on the front of the 5500 to illuminate.

Removing the Batteries

AA and Lithium Ion Battery Removal

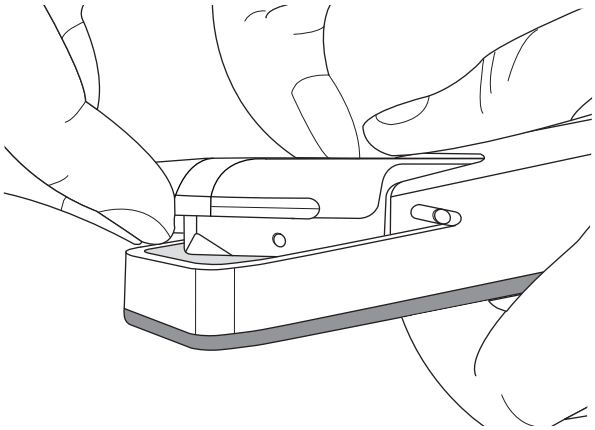
Batteries should be removed when the 5500 is not in use or is being stored.

CAUTION

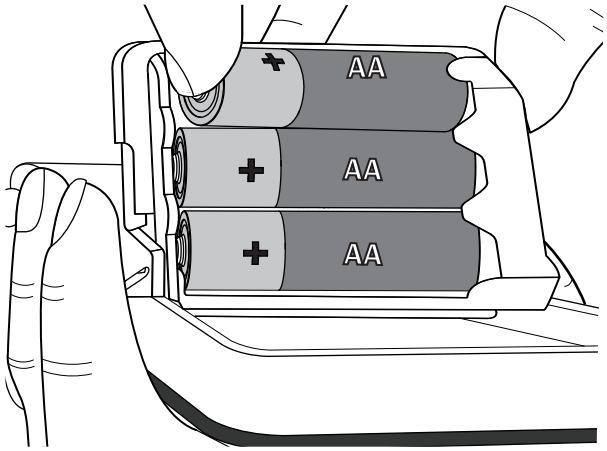
- **Be careful not to short circuit the batteries. Batteries can get hot when shorted. Short circuits are caused when a piece of metal touches both the positive and negative terminals simultaneously. More than a momentary short circuit will generally reduce the battery life. In case of a short circuit, discard the batteries, or just the shorted one if the batteries are new.**
- **Failure to remove the rechargeable battery from the 5500 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 5500.**

Remove batteries from the 5500 using the following procedure:

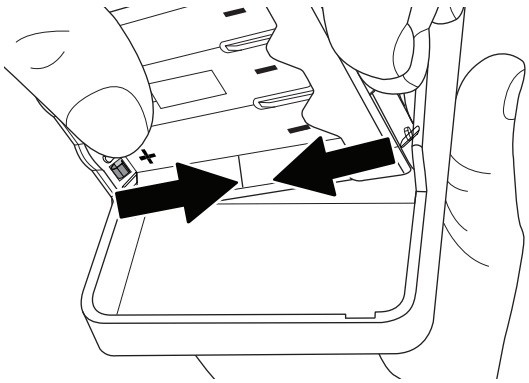
1. Open the AA battery door or lithium ion battery by lifting up on the grip feature on the bottom side.



2. If using AA batteries, push in towards the right side, on the (+) to dislodge from the door.



3. When needed (e.g. for cleaning or replacement) remove the AA battery door or the lithium ion battery from the 5500 by pinching and pulling from one side to the other to dislodge the door from the hinges.



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

After the 5500 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, indicating that the battery status is unknown.

In order to guarantee overall device performance, certain functionality is disabled when the battery charge reaches critical levels.

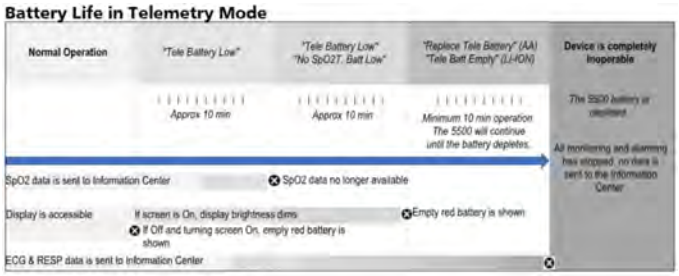
When monitoring SpO_2 and the battery reaches a low battery state, the **Tele Battery Low** INOP is displayed for approximately 10 minutes. After this time period, **No SpO2T, Batt Low** and **Tele Battery Low** are displayed for an additional 10 minutes (approximate). If you need to continue to monitor SpO_2, replace your batteries during the initial **Tele Battery Low** period. Once the time period has elapsed, or the 5500 has dropped off the network, a third INOP is displayed - **Replace Tele Batt** (or **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 **Replace Tele Batt** (or **Tele Batt Empty**) period, the 5500 will continue to send ECG monitoring information to the PIC iX for as long as possible. Once battery power is completely depleted,  monitoring will stop completely and two INOPs are displayed at the PIC iX **Replace Tele Batt** (or **Tele Batt Empty**) and **No Data Tele**.

WARNING

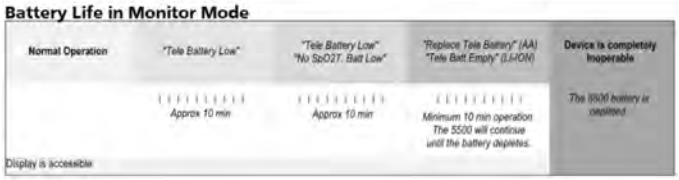
Failure to replace battery power in a timely manner will cause monitoring and physiological alarms to cease.

The diagrams below are for the 5500 operating in Telemetry and Monitor Modes, 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.

Battery Life in Telemetry Mode



Battery Life in Monitor Mode



NOTE

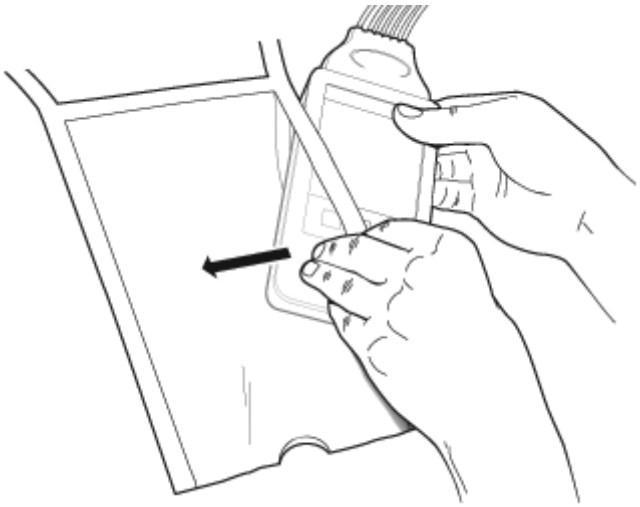
If the **Tele Battery Low** INOP occurs and then the 5500 disconnects from the network, the behavior and timing described in the diagram above does not apply. The screen activates to show a large red battery icon , and the device plays an escalating double beep sound to indicate that it is disconnected from the network. Alarm and SpO_2 monitoring are no longer available locally. The 5500 will attempt to reconnect to the PIC iX to transmit the battery INOP condition.

2.9 Protective Carry Pouch

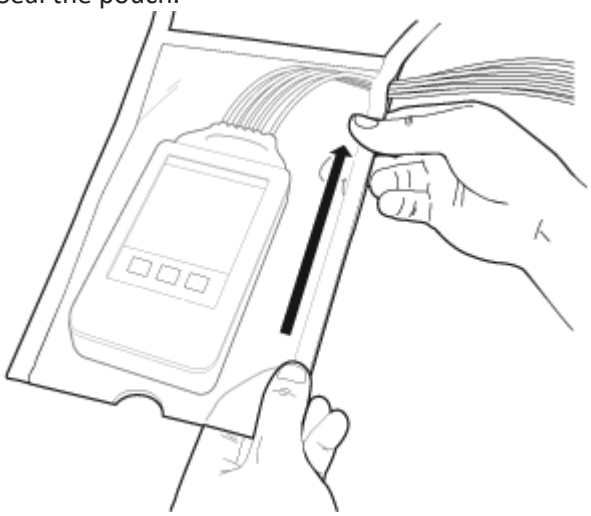
During normal use, the 5500 should be worn over clothing, in a pocket or, preferably, in a pouch. The Protective Carry Pouch with clear front is an appropriate means for holding the 5500. For ordering information, see “Accessories” on page 197.

Securing the Pouch

1. See the *Protective Carry Pouch for Patient Worn Monitors, Instructions for Use* for more information. Documentation can be found on InCenter. See “Accessing Paper and Electronic Documentation” on page 6.
2. Insert the 5500 into the pouch with lead wires and SpO_2 sensor cable, if used, exiting from the side opening of the pouch. Pinch the Velcro® closure 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, in a crossbody style.

5. Check that the patient is comfortable wearing the pouch with the 5500.

CAUTION

- **The pouch is designed to be used exclusively with the 5500. 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 5500 to your patient, consider your patient's condition and be careful about placement of the straps, as the straps could present a strangulation hazard.**

2.10 Showering

WARNING

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

CAUTION

- **Because the touchscreen display is sensitive to water impact, the display should be locked when showering.**
- **The 5500 can be used to monitor a patient in the shower, but only when placed inside a protective carrying pouch with its drain hole at the bottom, and its side opening securely sealed around patient cables. The pouch must be secured on the patient as described above. The combination of the 5500 and the protective carry pouch will withstand showering for no longer than 10 minutes, otherwise carry pouch water ingress protection could be compromised.**
- **The 5500 should not be used for monitoring if the battery compartment is wet. Remove the batteries and wipe the compartment dry before continued monitoring use.**

Drying the 5500 after Showering

After showering, perform the following steps to continue monitoring:

1. Remove the battery door, rechargeable battery or disposable batteries.
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 5500 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 and close the battery door.

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Accidental Liquid Exposure

If the 5500 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/disinfection (see “Cleaning” on page 155) as needed.

2.11 Device Shut Down

To shut down the 5500, open the door to the battery compartment.

2.12 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 5500 is in use.

NOTE

Pausing alarms at the PIC iX activates the 5500 display. Patients should be notified that this is normal operation and not cause for any concern.

3 Alarms

This chapter provides alarm information that applies to the Telemetry Monitor 5500. Measurement-specific alarm information is discussed in the sections on individual measurements. A listing of Informational Messages and their associated conditions is also provided.

3.1 Alarms Overview

The 5500 generates two different types of alarms: physiological and technical (INOPs).

Once alarm settings are communicated to the 5500 from the PIC iX, alarms are available locally on the 5500 regardless of network connection to the PIC iX. Alarm settings are as configured by the PIC iX. Changes to physiological alarm settings can only be made at the PIC iX. Audible alarm indicators are annunciated only when operating in Monitor Mode or when the 5500 is not networked connected.

Physiological and Technical Alarms

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).

For the full list of physiological alarms, see “Physiological Alarms” on page 72.

Technical Alarms (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, **ECG 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. All monitors in a unit should have the same severity configured. The following INOPs can also be configured as red or yellow INOPs to provide a severity indication:

- **ECG Leads Off**
- **Leadset Unplugged**
- **SpO2T No Pulse**
- **Replace Tele Batt** (when using disposable batteries)
- **Tele Batt Empty** (when using the rechargeable battery)

For the full list of technical alarms (INOPS), see “Technical Alarms (INOPs)” on page 77.

NOTE

The 5500 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 delay is the sum of the alarm delay configured for the specific measurement plus the system alarm delay. For additional alarm disclosure information, see “Measurement Specifications” on page 173.

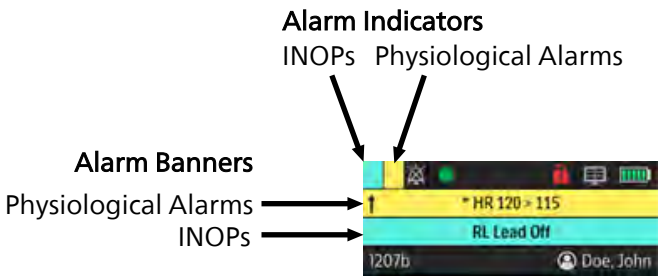
Visual Alarm Indicators

When the 5500 is operating in Telemetry Mode, its display is inactive for a majority of the time because alarms are being annunciated on the PIC iX.

WARNING

In Telemetry mode, you must activate the screen to view any alarms at the 5500. Upon activating the screen, the alarm volume is set to zero.

The following image shows an unacknowledged physiological alarm and INOP as they appear in portrait view:



Alarm Banner

A text alarm banner appears in the alarm status area at the top of the screen indicating the source of the alarm. The background color of the alarm banner 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 banner matches 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 banner; !!! for red INOPs and !! for yellow INOPs. If more than one alarm is present, there is an upward facing arrow symbol on the left side of the banner. Active alarm/INOP banners rotate every 2 seconds.

The 5500 uses the enhanced alarm text format, for example **** <SpO2 Label> xx < yy**.

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Alarm Indicator

An alarm indicator on the 5500's main screen communicates alarm/INOP conditions that have not been acknowledged. The alarm indicator is divided into two sections on the screen and appears in the upper left 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.

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 a measurement in an alarm flashes when the screen is on.

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 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 a medium priority yellow alarm tone.

Rule 3: When there is more than one highest priority 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 Monitor 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 5500 volume setting is zero or when operating in Telemetry Mode. Audible alarm indicators become active as soon as the 5500 is no longer connected to the PIC iX.**
- **When switching alarms off or pausing alarms, be aware of the following:**
  - **No audible or visual alarms, patient or physiological, are announced at the 5500.**
  - **No audible or visual alarms, patient or physiological, are announced at the PIC iX.**
  - **Technical alarms are only announced visually at the 5500 and PIC iX.**

There are two choices for audible alarm sounds, Traditional and ISO/IEC Standard Audible Alarms.

Traditional Audible Alarms

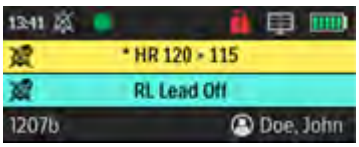
- Red alarms and red INOPs: A high pitched sound is repeated every two seconds.
- Two-star yellow alarms and yellow INOPs: A lower pitched sound is repeated every four seconds.
- One-star yellow alarms (short yellow alarms): The audible indicator is the same as for yellow alarms, but of shorter duration.
- 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 acknowledge alarm button.  This switches off the audible alarm indicators and alarm lamps for any active alarms. The acknowledge alarm icon (a crossed out bell containing a check mark) next to the alarm text indicates that the alarm was acknowledged at the 5500 or PIC iX. An acknowledge alarm icon in the banner 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 the acknowledge alarm icon beside it, except for 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 5500 is connected to the PIC iX. Red alarms are latched at the PIC iX and the audible alarm indicator and message will continue until 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 from the 5500, if enabled in the configuration. Depending on your 5500 configuration, alarms are paused for one, two or three minutes.

To Pause All Alarms

Select the **Alarms** SmartKey and then select **Pause Alarms**. **Pause Alarms** is grayed out on the device if not enabled in the configuration. A timer on the display shows the remaining pause time.

While Alarms are Paused

- In the alarm banner, the 5500 displays the message ALARMS PAUSED with a countdown timer e.g. 1:28, together with the alarms paused 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.

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- INOP messages are shown but no INOP tones are sounded.

  The only exceptions are 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 correct the INOP condition first before you can switch the alarm tones off again.

WARNING

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

Restarting Paused Alarms

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

Alarm Limits

The alarm limits you set at the PIC iX determine the conditions that trigger yellow and red alarms. By setting a high alarm limit to the maximum, and a low alarm limit to the minimum, you will effectively turn off the alarm. For example, if you set the high SpO_2 alarm limit to the maximum of 100, and the low SpO_2 alarm limit to the minimum of 0, no high/low alarms will activate. In this case, the alarms off symbol will not be 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 Active Alarms

You can see which alarms and INOPs are currently active by touching the banner. Touching the active alarm status area displays a list of all current active alarms.

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To see the previous alarms and INOPs in one place, select the **Alarms** SmartKey  and then touch **Review Alarms**.

All alarms and INOPs are erased from the Alarm Messages window when you discharge or transfer a patient, or if you change to **Demo** Mode. Alarm data survives power cycling, e.g. battery change.

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 5500 is not connected to the PIC iX, will appear in the Review Alarms window, however, they are not communicated to the PIC iX.

Alarm Reminders

The 5500 provides alarm reminders. If **Alarm Reminder** is configured on for your device, you will get an audible reminder of alarm conditions that remain active after you have acknowledged the alarm. This reminder may take the form of a repetition of the alarm tone for a limited time (alarm reminder is set to **On** (bold font) or an unlimited repetition of the alarm tone, ReAlarm is the same as a new alarm). The frequency of the reminder can be 1, 2 or 3 minutes. These settings are configured at the PIC iX in configuration mode.

Latching Alarms

The alarm latching setting for your 5500 defines how the alarm indicators behave when you do not acknowledge them. The alarm latching setting is a configuration setting at the PIC iX.

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 acknowledge alarm button.

Alarm Latching Behavior

Red & Yellow Measurement Alarms		Non-latching Alarms	Visual and Audible Latching
Alarm has not been acknowledged.	Alarm condition still present.	Alarm tone on. Alarm message. Flashing numerics.	Alarm tone on. Alarm message. Flashing numerics.
	Alarm condition no longer present.	All audible and visual alarm indicators automatically stop.	Alarm tone on. Alarm message. Flashing numerics.

Red & Yellow Measurement Alarms		Non-latching Alarms	Visual and Audible Latching
Alarm has been acknowledged.	Alarm condition still present.	Alarm tone off. Alarm message with an acknowledge icon. Flashing numeric. Audible alarm reminder (if configured)	Alarm tone off. Alarm message with an acknowledge icon. Flashing numeric. 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 5500 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 monitor restores the latest alarm settings from the PIC iX. When the 5500 is in standby and a patient is discharged at PIC iX, the device remains in standby.

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 team.

3.2 Physiological Alarms

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

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 5500 provides physiological alarms based on the settings at the PIC iX. Alarming is not active on the 5500 until it is configured via an active association with the PIC iX.

NOTE

- Alarm tones are always available at the PIC iX. On the 5500 they are only audible in Monitor Mode.
- The physiological alarm messages displayed on the 5500 use an extended text format.

In the following table, physiological alarms are listed alphabetically:

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)	numeric flashes, short yellow alarm tone, yellow alarm indicator, yellow alarm banner if screen is on, short yellow alarm tone if audio is on
***** Apnea x:yy** ***** Apnea >10 min**	Resp	Respiration has stopped for longer than the configured Apnea time, enhanced text display *** Apnea yy.xx, yy=minutes, xx=seconds. If Apnea time is >10min, the alarm message displayed is *** Apnea >10min.	numeric flashes, red alarm indicator, red alarm tone
***** Asystole**	ECG	No beat detected for a period > the asystole threshold (2.5 to 4.0 seconds)	numeric flashes, red alarm indicator, red 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 (low SpO2 limit -10), this is adjustable 50 to 99.	numeric flashes, red alarm indicator, red alarm tone
*** End AFIB**	ECG	Atrial fibrillation no longer detected for the Afib end delay time (For adult patient category only)	yellow alarm indicator, short yellow alarm tone
*** End Irregular HR**	ECG	Irregular HR rhythm no longer detected for the irregular HR end delay time	yellow alarm indicator, short yellow alarm tone
*** /** HR xx > yy**	ECG	Heart Rate > the high HR limit	numeric flashes, yellow alarm indicator, yellow 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 Cardiotach (Arrhythmia Off) is selected.
*** /** HR xx < yy**	ECG	Heart Rate < the low HR limit	numeric flashes, yellow alarm indicator, yellow 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 Cardiotach (Arrhythmia Off) is selected.
*** 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 indicator, short yellow alarm tone

Alarm Message	From	Condition	Indication
*** 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 indicator, short yellow alarm tone
*** Multiform PVCs**	ECG/Arrhythmia	The occurrence of two differently shaped beats labeled as **V** within the last 60 beats AND each occurring at least once within the last 300 beats	numeric flashes, yellow alarm indicator, short yellow 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 indicator, short yellow alarm tone
*** 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 indicator, short yellow alarm tone
*** 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 indicator, short yellow alarm tone
*** Pair PVCs**	ECG/Arrhythmia	Two consecutive beats labeled as **V** between two beats not labeled as **V**	numeric flashes, yellow alarm indicator, short yellow alarm tone
*** 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 indicator, short yellow alarm tone
**** Pulse yyy > xxx**	SpO_2/Pulse	Pulse rate higher than Pulse High alarm limit.	numeric flashes, yellow alarm indicator, yellow alarm tone
**** Pulse yyy < xxx**	SpO_2/Pulse	Pulse rate lower than Pulse Low alarm limit.	numeric flashes, yellow alarm indicator, yellow alarm tone
*** PVCs/min xxx > yyy**	ECG/Arrhythmia	Within 1 minute, the number of beats labeled as **V** > the PVCs/min limit	numeric flashes, yellow alarm indicator, short yellow alarm tone
**** QTc xxx > yyy**	ECG/QT	QTc value has exceeded the QTc high limit for more than 5 minutes	numeric flashes, yellow alarm indicator, yellow alarm tone
**** ΔQTc xxx > yyy**	ECG/QT	ΔQTc value has exceeded the ΔQTc high limit for more than 5 minutes	numeric flashes, yellow alarm indicator, yellow 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 < 333 ms and < 1/3 of the average R-R interval followed by a compensatory pause > 1.25 times 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 indicator, short yellow alarm tone
**** RR yyy > xxx**	RESP	The respiration rate has exceeded the high alarm limit.	numeric flashes, yellow alarm indicator, yellow alarm tone
**** RR yyy < xxx**	RESP	The respiration rate has dropped below the low alarm limit.	numeric flashes, yellow alarm indicator, yellow 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 indicator, short yellow alarm tone
**** <SpO2 Label> xx>yy**	SpO_2	The arterial oxygen saturation has exceeded the high alarm limit.	numeric flashes, yellow alarm indicator, yellow alarm tone
**** <SpO2 Label> xx<yy**	SpO_2	The arterial oxygen saturation has fallen below the low alarm limit.	numeric flashes, yellow alarm indicator, yellow 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 indicator, yellow alarm tone
****STE <n>,<n>**	ECG/ST	Two contiguous leads <n> and <n> have exceeded elevation for more than 60 seconds.	numeric flashes, yellow alarm indicator, yellow alarm tone
**** ST-<n> xx > yy**	ECG/ST	The lead <n> has exceeded elevation for more than 60 seconds. Lead is not contiguous with any other lead.	numeric flashes, yellow alarm indicator, yellow alarm tone
**** ST-<n> xx < yy**	ECG/ST	The lead <n> has exceeded depression limits for more than 60 seconds. Lead is not contiguous with any other lead.	numeric flashes, yellow alarm indicator, yellow 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 indicator, short yellow alarm tone
***Vent Bigeminy**	ECG/Arrhythmia	A dominant rhythm of beats labeled as **N, V, N, V, N**	numeric flashes, yellow alarm indicator, short yellow alarm tone

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Alarm Message	From	Condition	Indication
***** Vent Fib/Tach**	ECG	Fibrillatory wave (sinusoidal wave between 2 – 10 Hz) for 4 consecutive seconds.	numeric flashes, red alarm indicator, red 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 indicator, short yellow alarm tone
*** Vent Trigeminy**	ECG/Arrhythmia	A dominant rhythm of beats labeled as **N, N, V, N, N, V, N, N**	numeric flashes, yellow alarm indicator, short yellow alarm tone
***** 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 indicator, red alarm tone
*****xBrady xxx < yyy**	ECG	Pulse rate < the Brady (pulse) limit.	numeric flashes, red alarm indicator, red alarm tone
*****xBrady/P xxx < yyy**	SpO_2/Pulse	Pulse rate < the extreme bradycardia alarm limit. xxx denotes the lowest measured value; yyy is the extreme bradycardia limit.	numeric flashes, red alarm indicator, red alarm tone
*****xTachy xxx > yyy**	ECG	Pulse rate > the Tachy (pulse) limit.	numeric flashes, red alarm indicator, red alarm tone
*****xTachy/P xxx > yyy**	SpO_2	Pulse rate > the extreme Tachycardia alarm limit. xxx denotes the highest measured value; yyy is the extreme tachycardia limit.	numeric flashes, red alarm indicator, red alarm tone

3.3 Technical Alarms (INOPs)

Technical Alarms, or INOPs (inoperative conditions), are sourced at the 5500, the ST/AR algorithm, or the PIC iX. 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** - A Severe INOP is a technical defect which could cause harm to the patient's health. During a Severe INOP, monitoring and alarm generation are disabled. The 5500 only provides a visual alarm indicator, but an audible tone is played at the PIC iX. A Severe INOP must be acknowledged by a clinician.
  If alarms are paused and a Severe INOP occurs, alarms will reactivate (or unpause) to annunciate the Severe INOP condition. After the Severe INOP has been resolved, the alarms will remain unpaused.
- **Hard** - A Hard INOP is a technical defect or signal condition which disables the parameter algorithm that derives numerical values. During a Hard INOP, monitoring and alarm generation are disabled. The 5500 only provides a visual alarm indicator, but an audible tone is played at the PIC iX.
- **Soft** - A Soft INOP is a signal condition or measurement state which makes the result of a parameter algorithm questionable. During a Soft INOP, monitoring and alarm generation remain active. The 5500 and PIC iX provide a visual alarm indicator, but no audible tones are played at the PIC iX.
- **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.

WARNING

Acknowledging the <SpO2 Label> No Sensor technical alarm turns off the SpO_2 measurement on the 5500 and at the PIC iX when operating in Continuous mode. It does not turn the measurement off when operating in Auto or Manual mode.

In the following table, technical alarms are listed with their priority, the condition that triggers the alarm, and what to do when the alarm occurs:

Alarm Text	Priority	Condition	What to do
<ECG Lead>Lead Off Source - Telemetry Monitor 5500	Hard	Single lead is off. If primary lead is MCL, lead will be identified as V/C in INOP text.	Re-attach ECG lead to patient.
<SpO2 Label> Equip Malf Numeric is replaced by -?- Source - Telemetry Monitor 5500	Hard	Malfunction in the SpO_2 equipment.	Contact your service team.

Alarm Text	Priority	Condition	What to do
<SpO2 Label> Erratic (Philips FAST only) Numeric is replaced by -?- Source - Telemetry Monitor 5500	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> Interference Numeric is replaced by -?- Source - Telemetry Monitor 5500	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 - Telemetry Monitor 5500	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 Philips FAST only, this INOP may also be configured to display as a Red or Yellow Technical Alarm. Numeric is replaced by -?- Source - Telemetry Monitor 5500	Cyan, Red or Yellow or Hard Technical Alarm	Pulse is too weak or not detectable. The **<SpO2 Label> No Pulse** INOP is delayed (up to 35 sec) in presentation in manual and auto mode. No Pulse can be escalated from cyan to yellow or Red. The No Pulse INOP is a transient event and may present other INOP states for this condition, Invalid Data (-?-).	Check SpO_2 sensor connection to patient.
<SpO2 Label> No Sensor **WARNING! Silencing this technical alarm turns off the SpO2 measurement on the 5500 and at the PIC iX when operating in Continuous mode. It does not turn the measurement off when operating in Auto or Manual mode.** Numeric is replaced by -?- Source - Telemetry Monitor 5500	Hard	No sensor attached to SpO_2 device.	Attach SpO_2 sensor.
<SpO2 Label> NoisySignal Numeric is replaced by -?- Source - Telemetry Monitor 5500	Hard	Excessive patient movement or electrical interference is causing irregular pulse patterns	Reduce movement or electrical noise sources.
<SpO2 Label> Poor Signal Numeric is replaced by -?- Source - Telemetry Monitor 5500	Soft	Although a measurement may be possible, its accuracy may be reduced due to poor signal quality.	Apply the sensor according to the manufacturer instructions. Relocate the sensor to a different site on the patient.

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Alarm Text	Priority	Condition	What to do
<SpO2 Label> Pulse? (Philips FAST only) Numeric is replaced by -?- Source - Telemetry Monitor 5500	Hard	The detectable pulsations of the SpO_2 signal are outside the specified pulse rate range.	Check connection to patient. Avoid excessive motion at the measurement site.
<SpO2 Label>Searching Source - Telemetry Monitor 5500	Soft	The patient signal is analyzed, but a valid numeric is not available yet.	Wait for the measurement to complete.
<SpO2 Label>Sensor Malf Numeric is replaced by -?- Source - Telemetry Monitor 5500	Hard	Malfunction of the SpO_2 sensor/ adapter cable.	Replace sensor and/or adapter cable.
<SpO2 Label>Sensor Off Numeric is replaced by -?- **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 instructions. If the condition persists, relocate the sensor to a different site on the patient.
<SpO2 Label> Unkn.Sensor Numeric is replaced by -?- Source - Telemetry Monitor 5500	Hard	The connected SpO_2 sensor and/ or adapter cable is not supported by the hardware version.	Use specified sensor and/or adapter cable.
Cannot Analyze ECG Numeric is replaced by -?- Source - Telemetry Monitor 5500 and PIC iX	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.
Check Touchscreen	Hard	Check the touchscreen for damage, deformation, spillage, drops, permanent press/touch or unspecified operation. Check for electromagnetic interference.	Restart the 5500. If the INOP persists, contact your service team.

Alarm Text	Priority	Condition	What to do
Chk PulseT Limits Numeric is replaced by -?- Source - Telemetry Monitor 5500	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 = > 30bpm - < 300.
ECG Leads Off **Note:** This INOP may also be configured to display as a Red or Yellow Technical Alarm. Numeric is replaced by -?- Source - Telemetry Monitor 5500	Cyan, Red or Yellow or Hard Technical Alarm	Multiple leads are off and no fallback lead available. The Leads Off escalation is delayed by 3 seconds to allow the 5500 to determine if the leadset is unplugged, the effective delay to the PIC iX is 4 seconds. The 5500 shows **ECG Leads Off** as cyan until it is escalated to a higher level (if configured) or is replaced by the **Leadset Unplugged** INOP. Escalation only occurs after the 5500 has determined it has connected to an ECG source prior to **ECG Leads Off**. On power-up multi-lead is off and cyan, until the configured escalation occurs.	Re-attach ECG leads to patient.
ECG/Arrh AlarmsOff Source - Telemetry Monitor 5500	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.
Invalid Leadset Numeric is replaced by -?- Source - Telemetry Monitor 5500	Hard	A Masimo SET leadset is attached to the 5500 with Philips FAST or an SpO_2 Only adapter cable is connected to an ECG Only device.	Replace with compatible leadset.
Leadset Unplugged **Note:** The message will initially display for up to 3 seconds as **ECG Leads Off** at the 5500 and at the PIC iX. Numeric is replaced by -?- Source - Telemetry Monitor 5500	Cyan, Red or Yellow or Hard Technical Alarm	Patient cable has been unplugged from the 5500. The 5500 shows the **ECG Leads Off** INOP as cyan until it is escalated to a higher level (if configured) or is replaced by the **Leadset Unplugged** INOP.	Re-attach the patient cable. Replace the leadset.
No Alarm Display Source - Telemetry Monitor 5500	Soft	No local alarming at the 5500, networked or non-networked.	Remove the device from use and contact your service team.

Alarm Text	Priority	Condition	What to do
No Central Monit. (appears at Telemetry Monitor 5500 only) Source - Telemetry Monitor 5500	Hard	The 5500 is out of range of the network. Patient Sector at the PIC iX is in Standby. The 5500 is not assigned to a bed at the PIC iX. The 5500 is configured for authentication/encryption and is connected to a Smart-hopping 1.0 network, which does not support authentication/ encryption; **No Central Monit.** is the INOP and **Unsupported Network** is displayed in the Information Area.	Return the 5500 to the coverage area. Select Resume at the PIC iX. Ensure proper equipment assignment in the Manage Patient application at the PIC iX. Contact your Service Team.
No Data Tele (appears at PIC iX only)	Hard Latched	The 5500 is out of range of the network and has no signal to the PIC iX.	Replace battery if the 5500 is out of power or Replace 5500 if bootup self-check fails or Move 5500 to the coverage area, replace it if it continues to fail.
!!No SpO2T, Batt Low	Yellow	Battery power is too low to support SpO_2 measurement.	Insert fresh AA batteries or recharged lithium ion battery to continue monitoring SpO_2.
Replace Tele Batt(Cyan) **!!Repl. Tele Batt** (Yellow) **!!!Repl. Tele Batt** (Red) **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. Source - Telemetry Monitor 5500	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 Numeric is replaced by -?- Source - Telemetry Monitor 5500	Hard	Malfunction in the Resp equipment. The 5500 requires calibration.	Contact your service team.

Alarm Text	Priority	Condition	What to do
Resp Leads Off **Note:** OR leadsets cannot be used to monitor Resp with the 5500 . Numeric is replaced by -?- Source - Telemetry Monitor 5500	Hard	Resp lead off. Adapter cable is connected to 5500 or OR-ECG leadset is connected.	Re-attach lead to patient. Do not use OR-ECG leadset. Remove adapter cable, wait 3 seconds until **Leadset Unplugged** INOP is generated. Replace adapter cable and answer popup question. If you answer **Yes**, then Respiration will not be measured. If you answer **No**, Respiration measurements are possible and you will receive an informational message reminding you not to connect an OR-ECG leadset.
!!!Serv. Batt Now **Note:** When the above INOP occurs, the **Tele Battery Low** INOP is suppressed. Source - Telemetry Monitor 5500	Red	The battery has reached the end of its lifetime and is no longer able to be charged and will not power the 5500.	Replace the Lithium ion battery. Dispose of old battery properly. **WARNING! This battery cannot be used to monitor patients.**
Service Batt Now	Hard	This battery has reached the charge cycle maximum limit but is < 10% above the threshold or the age of the battery is between the age threshold minus 1 month and the age threshold.	Order another rechargeable lithium ion battery now.
Service Batt Soon **Note:** When the above INOP occurs, the Tele Battery Low INOP is suppressed. Source - Telemetry Monitor 5500	Soft	The lithium ion battery has < 25 charge cycles remaining before reaching the charge cycle maximum limit or the age is between age threshold minus 2 months and the age threshold minus 1 month.	Be aware that the lithium ion battery will soon need replacement. Order a new rechargeable lithium ion battery.
Some ECG AlarmsOff	Soft	Some ECG alarms have been turned off at the PIC iX for your patient. Dependent on changes to patient alarm settings that differ from unit settings.	This INOP is removed upon discharge or when the default alarm settings are manually reset.
Speaker Malfunct Source - Telemetry Monitor 5500	Soft	The 5500 Power-on Self Test detected a speaker malfunction.	Remove the 5500 from use. Contact your service team.

Alarm Text	Priority	Condition	What to do
Tele Batt Empty **Note:** This INOP may also be configured to display as a Red or Yellow Technical Alarm. Source - Telemetry Monitor 5500	Cyan, Red or Yellow or Hard Technical Alarm, Latched	The 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 when this INOP is present.
Tele Battery Low	Hard or Soft based on the **Replace Battery** INOP configuration setting (cyan = soft, red or yellow = hard).	There is < 20 minutes of monitoring time remaining (AA batteries). The 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.
Tele Battery Temp **Note:** When the above INOP occurs, the Tele Battery Low INOP is suppressed. Source - Telemetry Monitor 5500	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 - Telemetry Monitor 5500	Hard	The 5500 has an internal malfunction or self-test failure or an incompatible Hardware/ Software upgrade.	Remove the 5500 from use. Contact your service team.
Tele Remove **Note:** When the above INOP occurs all other battery related INOPs are suppressed. Source - Telemetry Monitor 5500	Severe, 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 Weak Signal Source - Telemetry Monitor 5500	Soft	Patient is at out of range of the radio coverage area. The 5500 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 5500. Contact your service team. The AP covering the specific area is suspect. Contact your service team.

Alarm Text	Priority	Condition	What to do
Transmitter Off (Only appears at the PIC iX) **NOTICE! The 5500 only shuts off the RF signal, but remains active and will be off the network. When the 5500 screen is on the 'No Central Monit', 'ECG leads Off' INOPS are displayed until the condition is removed.** Source - Telemetry Monitor 5500	Hard	RF Auto Shut off after 10 minutes of All Leads Off and SpO_2 not in continuous mode or No Leadset for devices with ECG and SpO_2. The 5500 must be within the RF coverage area.	Reattach ECG leads to patient.
Unsupported LAN (also see **No Central Monit.** INOP above)	Hard	The 5500 is configured for authentication/encryption and connected to a Smart-hopping 1.0 network, which does not support this feature.	See the 5500 Installation and Service guide for instructions on turning Authentication and Encryption off or use a supported network.

3.4 Informational Messages

The following table lists the informational text messages that may appear in the status area of the 5500 display.

Informational Text	Condition	What to Do...
Audio OFF at Device	Whenever the screen turns on (at power up or returning from Standby) or you transition from monitor to telemetry mode, this status message at top of screen appears.	Clears automatically after 30 seconds or when connected to the PIC iX.
Check Revisions	The revision of the PIC iX that the Telemetry Monitor 5500 is trying to connect to is not supported.	Connect only to supported revisions of the PIC iX.
Certificate Expired	The certificate installed on the device is expired.	Address the condition and start the enrollment process again.
Config (flashing text)	The 5500 is operating in Configuration Mode.	Cleared when the 5500 is changed to a different operating mode.
Demo (flashing text)	The 5500 is operating in Demo Mode	Cleared when the 5500 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.

Informational Text	Condition	What to Do...
Device not enrolled	The encryption credentials are not installed on the device. The informational text maybe followed by one of the following messages specifying where in the process the error occurred: **SCEP server IP unknown** **Wrong password or server error** **SCEP server error** **Check Date** **Enrollment canceled**	Address the condition and start the enrollment process again.
Incompatible Option	Philips FAST device is configured with wrong option.	Cleared automatically after temporary display.
No OR-ECG Lead	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 the 5500.
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.	Replace device with a model that includes ECG and SpO_2.
Secure connect. not available	The certificate installed on the device is expired.	Address the condition and start the enrollment process again.
	The DTLS handshake failed during enrollment.	Address the condition and start the enrollment process again.
	The device is removed from the sector.	Assign the device back to the sector or power cycle the device. Or in case of transfer, wait for it to complete.
	Device goes off network.	Return device to the network.

Informational Text	Condition	What to Do...
Service (flashing text)	The 5500 is operating in Service Mode	Cleared when the 5500 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. **Note**: There is no patient data displayed on the 5500 and PIC iX when the 5500 is in Service mode. The text "Service" will be displayed at the PIC iX sector.
Settings Sync'd	The 5500 is returned to use and settings are synchronized to reflect any changes that may have occurred at the PIC iX.	Cleared after setting synchronization is complete. The message displays for a minimum of 30 seconds, depending on the number of settings changes.
SpO_2 not available (displayed temporarily during power up on ECG Only devices)	SpO_2 sensor is connected to the 5500 but the device does not have the SpO_2 option enabled/available.	Replace device with a model that includes ECG and SpO_2.
SpO2 meas. started	A manual Start SpO_2 measurement was started while another measurement was occurring.	Message is cleared when measurement is complete.
SpO2 meas. complete	A manual SpO_2 measurement was initiated. Message is displayed when measurement is complete.	Message is cleared when a new measurement is started.
Switch to Philips FAST Leadset	An incorrect leadset is connected to a Philips FAST device.	Cleared automatically after connecting a Philips leadset.
Unsupported Network	The 5500 is configured for authentication/ encryption and connected to a Smart-hopping 1.0 network, which does not support this feature.	See the 5500 Installation and Service guide for instructions on turning Authentication and Encryption off or use a supported network.

4 ECG and Arrhythmia

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

4.1 ECG Safety Information

WARNING

- **The 5500 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 PIC iX. The 5500 sends ECG and optional pulse oximetry data to the PIC iX, which then 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 5500 regardless of the connection to the PIC iX.**
- **A noisy ECG signal makes it difficult to accurately detect and/or classify beats thus affecting event detection and alarm generation.**
- **An incorrect heart rate can be displayed if pace pulse detection is not working correctly. Check paced patient and ECG wave presentation carefully.**
- **INOP/Technical alarms occur whenever the ECG signal cannot be properly analyzed due to noise or inoperative conditions (such as ECG leads off). Since the INOP/Technical alarm indicates that the effectiveness of the arrhythmia monitoring for the patient is compromised, a quick response to these conditions is important to prevent missed alarms.**
- **Always confirm the 5500 and PIC iX 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 ST/AR Arrhythmia Algorithm* application note. Documentation can be found on InCenter. See "Accessing Paper and Electronic Documentation" on page 6.**
- **To avoid patient injury, assure that the patient cable is not positioned where leads could become entangled around the patient, or cause choking, strangulation, or inhibit circulation in extremities.**
- **Avoid contact between the patient lead wires and power cords or electrical outlets, while connected to the patient to avoid electrical shock.**
- **Every lead must be secured to an electrode on the patient. Conductive parts of electrodes must not contact earth or other conductive parts.**

WARNING

- **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 5500.**
- **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.**
- **For paced patients, you must set Paced Mode to On. If it is incorrectly set to Off, the monitor could mistake a pace pulse for a QRS and fail to alarm during asystole.**
- **If Paced Mode is On for a patient without a pacemaker, the algorithm's effectiveness in detecting ventricular beats may be reduced and may result in not receiving some PVC alarms.**

CAUTION

- **To protect the 5500 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 copies of Application Notes referenced in this documentation, see "Accessing Paper and Electronic Documentation" on page 6.

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For Paced Patients

WARNING

- **The output power of the 5500 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 5500 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 5500. See the *Patient Information Center iX 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.

4.2 Measuring ECG

The electrocardiogram (ECG) measures the electrical activity of the heart and displays it on the 5500 and the PIC iX 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 lead sets in varying lead placements are used. Standard lead, Hexad and EASI lead placements can be used with the 5500.

The Heart Rate calculation resides in the arrhythmia algorithm on the 5500. Arrhythmia analysis is either Cardiotach, Basic, or Enhanced, depending on the product configuration.

ECG Settings at the 5500

Setting	Description
Alarm Limits (View only)	Heart Rate alarm limits can be viewed locally at the 5500. Limits set at the PIC iX are reflected at the 5500 when connected on the network.
Primary (used for arrhythmia analysis only) (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) (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 (View only)	On, Off, Unconfirmed
Adjust Size	Set ECG gain to x1/2, x1, x2, x4 on the device.
Arrhythmia	Initiate an Arrhythmia Relearn; View Arrhythmia Alarm Limits; Turn Arrhythmia Annotation on or off.
Lead Placement	Set EASI, Standard when using a 5 lead cable.
ECG	Set ECG on or off **CAUTION! Turning ECG off from the SmartKey or ECG Menu requires confirmation. All ECG activity will be turned off and the Arrhythmia alarms will be unavailable. The ECG/ARRH Alarms Off INOP will be displayed.**
New Lead Setup	When IntelliVue Patient Monitor lead sets are in use, select 3-wire, or 5-wire.
Va Lead (6-lead only) (View only)	Shows position of Va, or Ca, electrodes. Choices are V1-V9, v3R, V4R, V5R. Configured at PIC iX.
Vb Lead (6-lead only) (View only)	Shows position of Vb, or Cb, electrodes. Choices are V1-V9, v3R, V4R, V5R. Configured at PIC iX.
Change Numeric	Select measurement 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 5500. When a battery change occurs, ECG monitoring resumes if the SpO_2 Only adapter accessory is no longer attached.
- When the 5500 is powered-on with no adapter or leadset attached, the leadset selected is the last attached leadset. If there was never one connected or after factory reset, the default is 5-wire. The New Lead menu selection is greyed out if no combined ECG/SpO2 adapter is connected.

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4.3 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 5500 and in this section for guidance. Additional lead placement information is available in the *Online Help* at the PIC iX.

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 “Network Risk Management for the 5500” on page 168.

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

Possible causes of noisy ECG signals include poor skin prep, dried electrode gel, detached electrodes, broken lead wires, muscle artifact, baseline wander, respiration artifact, or interference from equipment.

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

NOTE

Philips does not recommend using ether or pure alcohol, because they dry the skin and increase the resistance.

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.
   - 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. Touch firmly around the adhesive edge toward the center.
4. Attach the patient cable to the 5500. An ECG waveform and numeric appear on the monitor display.

4.4 Selecting the Primary and Secondary ECG Leads

When multi-lead analysis is used, the 5500 uses the primary and secondary lead selected at the PIC iX to compute HR and to analyze and detect cardiac arrhythmias. They are also available for recordings and for display on the PIC iX.

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 PIC iX 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

4.5 Checking Paced Status

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

NOTE

Paced status is set at the PIC iX and can only be changed at the PIC iX.

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**:

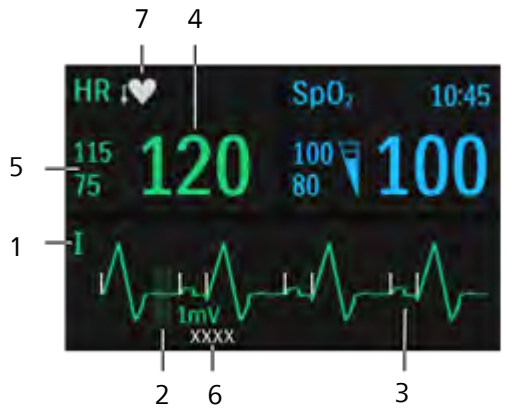
- The pacer algorithm is switched on. This means that pacemaker pulses are not counted as extra QRS complexes.
- The pacer spikes are shown in white.
- The paced symbol with a ? is displayed.

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 or 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.**
- **If the Paced Mode is On for a patient without a pacemaker, the algorithm's effectiveness in detecting ventricular beats may be reduced and may result in not receiving some PVC alarms.**

4.6 Understanding the ECG Display

Your display may be configured to look slightly different.



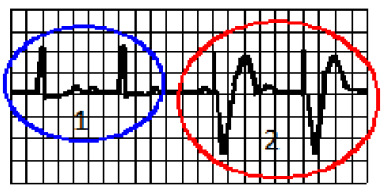
Number	Description	Number	Description
1	Lead label of the displayed wave	5	Current heart rate alarm limits
2	1 mV calibration bar	6	EASI/Hexad lead placement label (located here when active).
3	Pacer spikes	7	Paced status
4	Current heart rate		

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

Pacer spikes: The pacer spikes are shown in white.

4.7 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.

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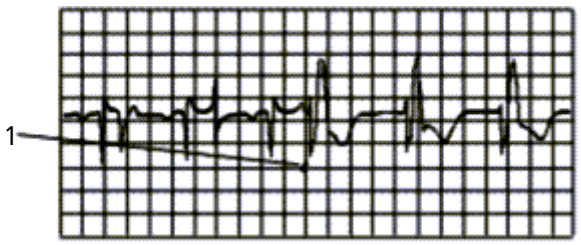
- Avoid fusion and pseudofusion beats. Fusion beats happen when an intrinsically conducted beat and a paced triggered beat occur simultaneously. Depending on the relative timing between the intrinsic beat and the paced beat, the QRS morphology can vary widely. Pseudofusion beats happen when an ineffective 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 intrinsic rate if appropriate.
- For AV pacing, change the AV delay of the pacemaker to avoid pseudofusion beats if appropriate.

Optimizing Lead Selection for Paced Patients

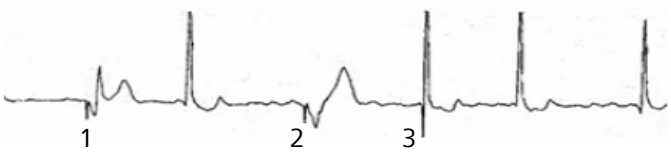
Some unipolar pacemakers display pace pulses with repolarization tails. These tails may be counted as QRSs in the event of cardiac arrest or other arrhythmias.

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

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4.8 Changing the Size of the ECG Wave

If any of the displayed ECG waves on the 5500 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 5500. 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:

- ► Touch the **HR** measurement.
- ► In the **Setup ECG** menu, scroll to the second page and select **Adjust Size**.
- ► 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
- ► Touch the **ECG wave**.
- ► Select the required adjustment factor from the list.

4.9 Choosing EASI or Standard Lead Placement

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

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

NOTE

- When changing lead placement, the 5-wire patient cable must be attached to the 5500.
- When there is a change in lead placement selection, the new selection is retained after battery changes. The default lead placement resumes upon discharge.

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.

For electrode placement diagrams, see “5-Wire Placement (Standard)” on page 103.

4.10 Derived 12-lead ECG

Hexad

When operating with the PIC 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*. Documentation can be found on InCenter. See "Accessing Paper and Electronic Documentation" on page 6.

WARNING

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.

4.11 ECG Configuration

The 5500 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 5500 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 (AAMI)		Electrode (IEC)	
Type	**Color**	**Label/Location**	**Color**	**Label/Location**
3-wire	Black	**LA**	Yellow	**L**
	White	**RA**	Red	**R**
	Red	**LL**	Green	**F**
5-wire	Black	**LA**	Yellow	**L**
(Standard)	White	**RA**	Red	**R**
	Red	**LL**	Green	**F**
	Brown	**V**	White	**C**
	Green	**RL**	Black	**N**
5-wire (EASI)	Black	**S**	Yellow	**S**
	White	**I**	Red	**I**
	Red	**A**	Green	**A**
	Brown	**E**	White	**E**
	Green	**RL**	Black	**N**
6-wire	Black	**LA**	Yellow	**L**
	White	**RA**	Red	**R**
	Red	**LL**	Green	**F**
	Brown	**Va**	White	**Ca**
	Green	**RL**	Black	**N**
	Brown/White	**Vb**	White/Blue	**Cb**

Arrhythmia analysis resides in the arrhythmia algorithm on the 5500. Arrhythmia analysis can be turned on or off. Arrhythmia analysis is either Cardiotach, Basic or Enhanced (optional).

4.12 ECG Leads Monitored

Depending on the patient cable connected to the 5500, a different set of viewable leads is available at the 5500 and the PIC iX. The 5500 can source up to four raw ECG waves to the PIC iX.

If you are using...	these leads can be selected at the 5500 and the PIC iX
3-wire	**I, II, III**
	Sourced (raw) waves are received as:
	Channel 1 = I, II, or III
	Factory Default is II.

If you are using...	these leads can be selected at the 5500 and the PIC iX
5-wire (Standard lead placement)	**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 lead placement)	**I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6**. With EASI lead placement, 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 PIC iX, although you can view and perform ST analysis on all 12 EASI derived leads.
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 PIC iX. When unassigned, the chest leads use the defaults. **Notes:** • 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 PIC iX, the second chest lead (Vb) is not available for monitoring.

If you are using...	these leads can be selected at the 5500 and the PIC iX
6-wire (Hexad lead placement)	**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, can be selected at the PIC iX, and consists of V1/V3, V1/V4, V1/V5, V2/V4, V2/V5, V3/V5, and V3/V6.

Multi-Lead ECG Screen

To view all available leads on the 5500:

Touch the ECG wave and select **Multi-Lead View** or cycle through the Main Screen key until you see the Multi-Lead View option. You can view up to 12 ECG waves (EASI or Hexad) by swiping. Additional ECG numerics are visible including **ST**, **QTc** and **ΔQTc**.

SpO_2, Pulse and Respiration measurements are not visible in this screen. All alarms/INOPs will continue to display.

NOTE

The Multi-Lead Screen is not available when the leadset is unplugged, there is a 3-wire leadset in use or if SpO_2 Only adapter cable is used.

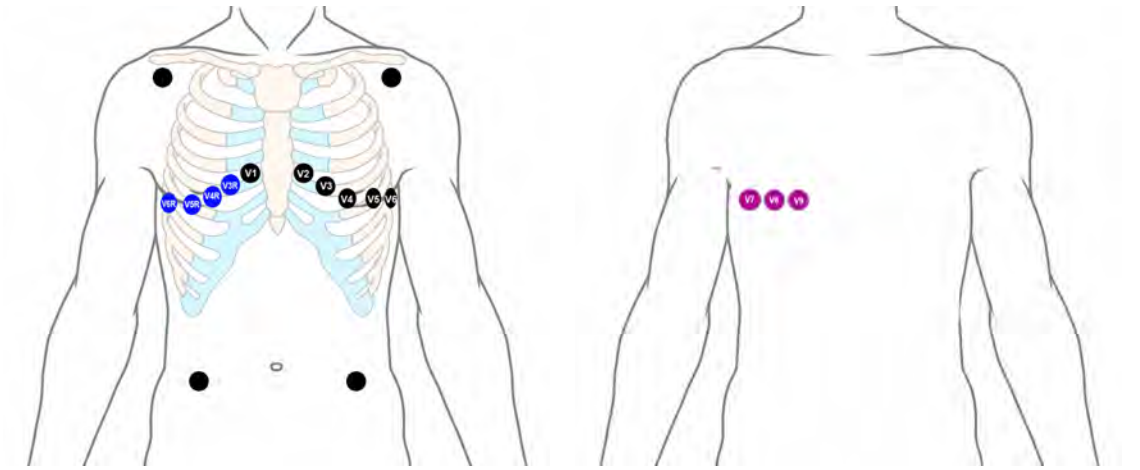
4.13 Reconstructed Leads

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

ECG Lead			Clinical Calculations in terms of electrodes
3-wire	5-wire Standard	6-wire	
-	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

4.14 Chest Electrode Placement



Upper Body Front **Upper Body Back**

- 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
- V7 on posterior chest at the left posterior axillary line in the fifth intercostal space
- V8 on posterior chest, level with V7 at the left midscapular line
- V9 on posterior chest, level with V7 at the left spinal border

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

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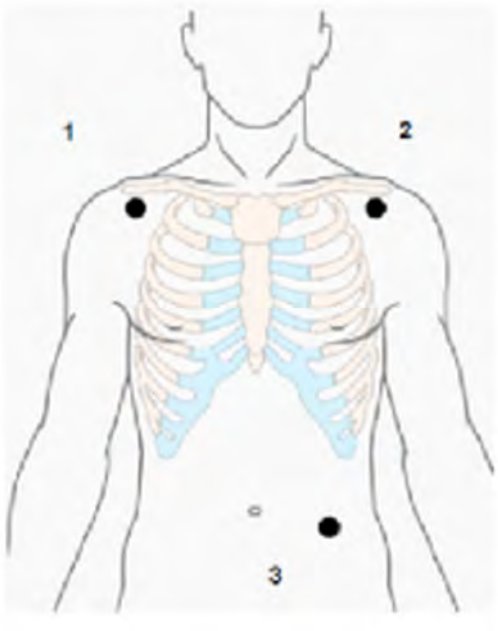
To locate the fourth intercostal space:

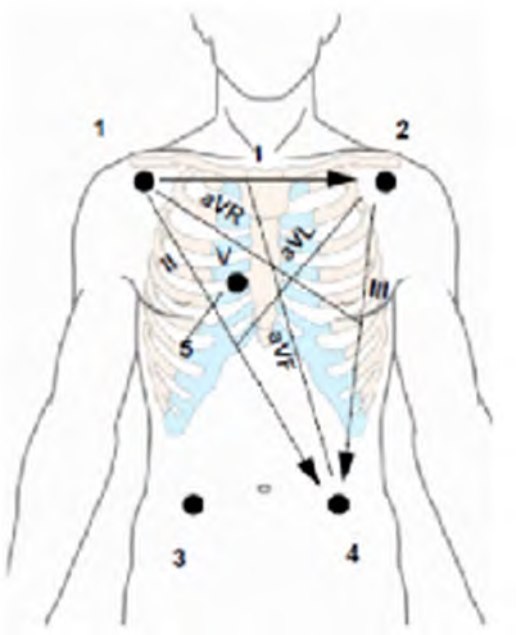
- Locate the second intercostal space by first palpating the Angle of Louis (the little bony protuberance where the body of the sternum joins the manubrium). This rise in the sternum is where the second rib is attached, and the space below this is the second intercostal space.
- Palpate and count down the chest until you locate the fourth intercostal space.

4.15 3-Wire Placement



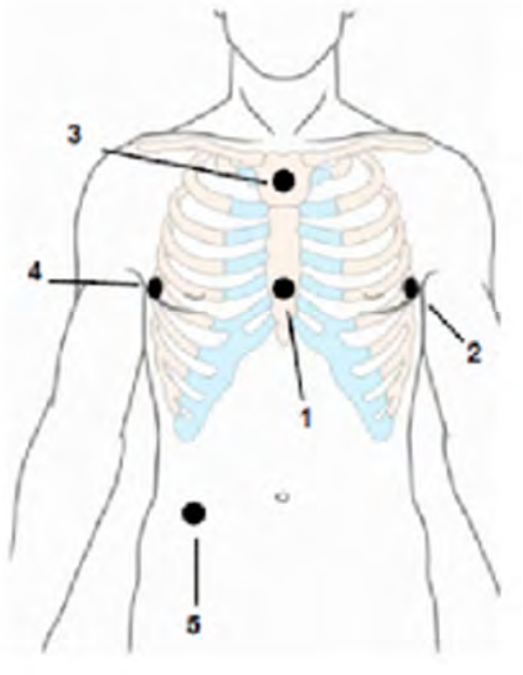
1. RA - directly below the clavicle and near the right shoulder
2. LA - directly below the clavicle and near the left shoulder
3. LL - on the left lower abdomen

4.16 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

4.17 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.

4.18 6-Wire Placement

For a 6-wire placement use the positions from the 5-wire 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 wire - is at the V2 position.

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

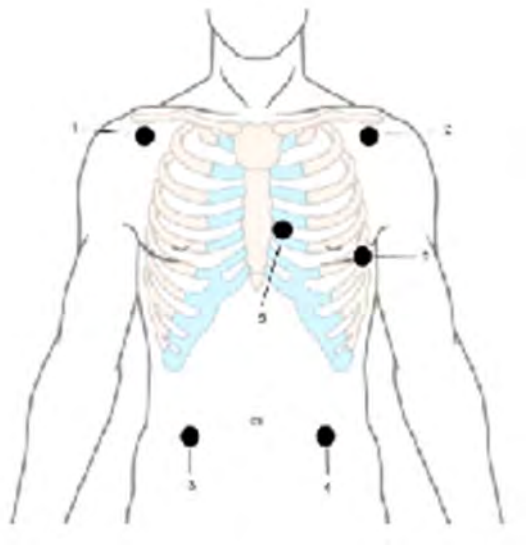
The lead placement for the Va and Vb lead labels must be appropriate. If your unit uses other precordial leads for Va and Vb, they may be assigned in Unit Settings at the PIC iX as defaults for your whole unit, or you may need to assign the new positions on a per-patient basis in the Patient Window at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

Selecting Positions of Va and Vb Chest Leads

The two chest leads for the 6-wire 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 PIC iX, so that the chest leads will be correctly labeled.

4.19 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 PIC 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 positions of your V leads depend on the selected Hexad pair at the PIC iX.
   - 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

- With Hexad lead placement, V leads are chosen in pairs at the PIC iX.
- Hexad pairs are pre-defined, can be selected at the PIC iX, and consists of V1/V3, V1/V4, V1/V5, V2/V4, V2/V5, V3/V5, and V3/V6.

4.20 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 arrhythmias of adult, pediatric, and neonatal(3) (not telemetry) patients to gain information for treatment, to monitor adequacy of treatment, or to exclude causes of symptoms.

The intended for use for the ST/AR arrhythmia algorithm is to monitor adult and pediatric patient's ECG for heart rate, ventricular arrhythmias, atrial fibrillation (for adult patients) and produce events and alarms for one or two ECG leads. The ST/AR arrhythmia algorithm can monitor both paced and non-paced patients.

About Arrhythmia Monitoring

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

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. The selected patient category determines how the ECG signal will be processed by the ST/AR algorithm. During arrhythmia analysis, the 5500 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.

(3) The Telemetry Monitor 5500 is intended for use with pediatric and adult patients only.

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Choosing an ECG Lead for Arrhythmia Monitoring

A major goal of the QRS detection algorithm in the monitoring device is to avoid P-waves, T-waves, atrial fibrillatory waves, atrial flutter waves, or noise from being detected as QRS complexes during complete heart block or asystole.

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.
- 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 intrinsic rate if appropriate.
- For AV pacing, change the AV delay of the pacemaker to avoid pseudofusion beats if appropriate.

NOTE

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. Therefore, for optimal performance and to prevent false alarms such as pause or asystole, it is important that the leads selected for monitoring are optimized.

Ectopic beats:

- PVCs wider and different shape from normal beats.
- PVCs not too tall or too small compared to the normal beat.

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 R-wave beats. 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 5500 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 (V) or Paced beats (P).

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 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 5500.

- 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 5500.

To check your enabled settings, touch the **Device Status** area and then the **Device Info** menu option. See the Options listed. C01 indicates that you have Enhanced Arrhythmia.

Cardiotach Alarms	Additional Alarms with Basic Arrhythmia Option	Additional Alarms with Enhanced Arrhythmia Option
***Asystole	***VTach	*Afib
***Ventricular Fibrillation/ Tachycardia	*Pacer Not Capture	*End Afib
***Extreme Bradycardia	*Pacer Not Pacing	*SVT
***Extreme Tachycardia	*PVCs/min HIGH (PVC > limit/min)	*Missed Beat
**High heart rate		*Pause
**Low heart rate		*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

QRS Detection Threshold

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. You may want to manually adjust the minimum QRS detection threshold if the monitor miscounts the heart rate. If the ECG morphology changes, you may need to readjust the QRS detection threshold. A major goal of the QRS detection algorithm is to avoid P-waves, T-waves, atrial fibrillatory waves, atrial flutter waves, or noise from being detected as QRS complexes during complete heart block or asystole. 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, or the minimum detection threshold set by the user. Any peak smaller than this value is not detected. 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. For detailed instructions on these operations, see the *PIC iX Instructions for Use.*

CAUTION

- **False or missed alarms can occur if the QRS detection threshold is inappropriately set for the patient.**

Using ECG Alarms

At the PIC iX, 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 PIC iX 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 PIC iX 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, Irregular HR (IHR), Missed Beat, PVCs/min High, Pacer Not Capture, Pacer Not Pacing, and **Afib**.

Alarms that have been turned off at the PIC iX will appear as off in the Arrhythmia menu of the 5500, but they are not accessible, nor can you change limits locally. The monitor displays the INOP message **Some ECG Alarms Off**, if configured, when more alarms are switched **Off** than configured in your active profile.

Yellow Arrhythmia Alarms

Yellow arrhythmia alarms are short yellow alarms specific to arrhythmia-related patient conditions. Depending on your PIC iX 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:

- Touch **HR** to open the **Setup ECG** menu.
- Select **Arrhythmia**.

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

WARNING

- **Always check beat labels to ensure that the algorithm is labeling the beats correctly.**
- **If beats are not classified correctly, check that the ECG is optimized for arrhythmia monitoring. You may need to select a different lead(s) or change the electrodes or electrode position if there is excessive noise, unstable voltage, low amplitude, or large P-wave or T-waves.**

To return to the normal ECG primary lead display:

► Select **Annotate Arrhy**.

► Change to **Off**.

► Exit from the **Setup ECG** menu.

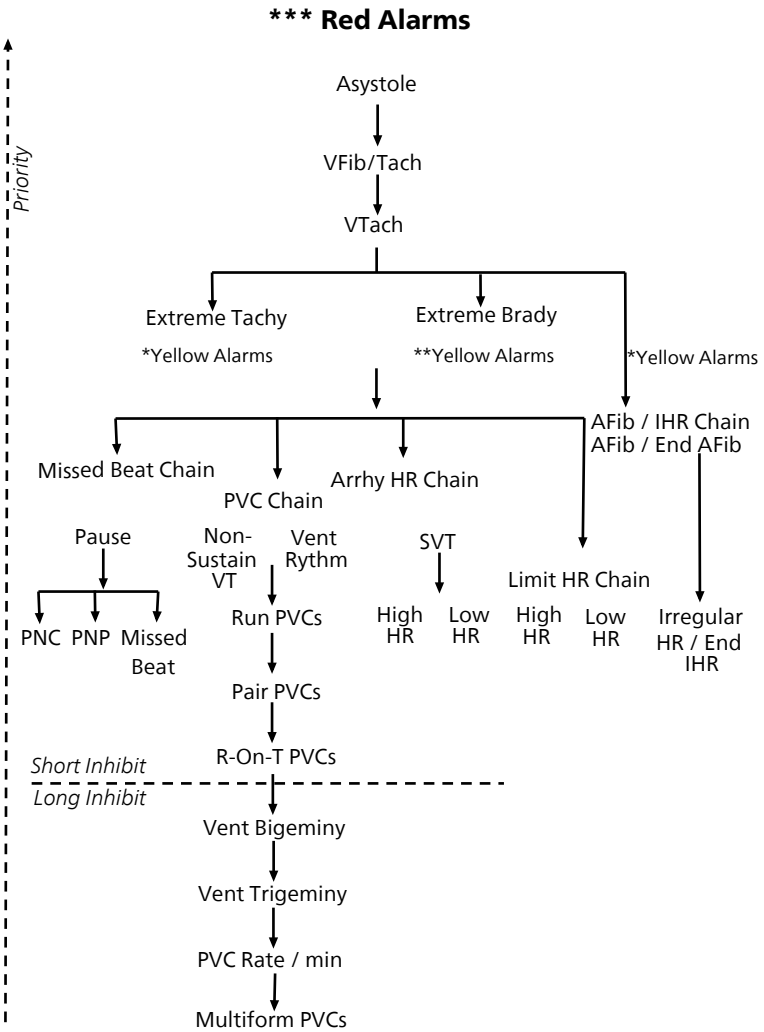
Arrhythmia Beat Labels

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., **ECG Leads Off**)	**I**
M	Pause or Missed Beat	**M**

Enhanced Arrhythmia Chain

To prevent the confusion of redundant alarms or the activation of less important alarms while acknowledging serious alarms, the arrhythmia system sets alarm priorities through an alarm chaining system. 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 an 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.

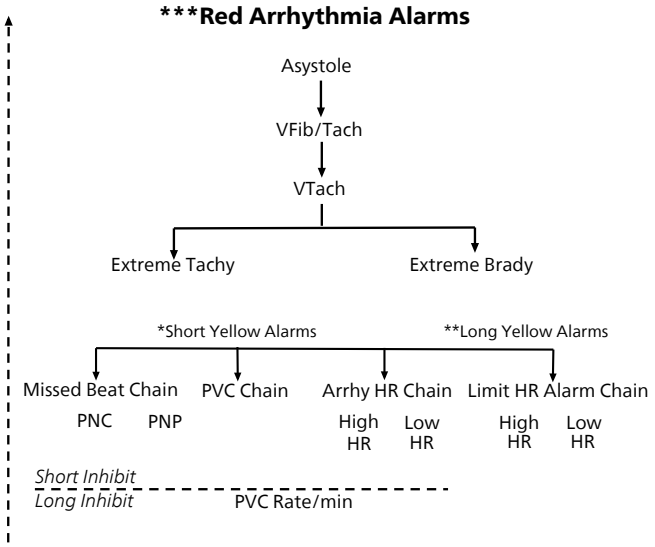


Fig. 1: Basic Arrhythmia Chain

NOTE

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

Monitoring during Leads Off

WARNING

INOP/Technical alarms occur whenever the ECG signal cannot be properly analyzed due to noise or inoperative conditions (such as ECG Leads Off). Since the INOP/Technical alarm indicates that the effectiveness of the arrhythmia monitoring for the patient is compromised, a quick response to these conditions is important to prevent missed alarms.

ECG Fallback and Extended monitoring states are supported for the 5500 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.

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Multi-lead 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 5500 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).

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.

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- The **ECG Lead** or **Lead Label** is changed manually, or when Fallback occurs. See “ECG Fallback” on page 114.
- A **Leads Off** INOP condition (that has been active for >60 seconds) ends.
- When the 5500 re-associates with the PIC iX.

Multi-lead Analysis

If multi-lead analysis is selected, the arrhythmia system begins learning on *both* leads whenever:

- ECG monitoring is initiated.
- The **Relearn Arrhy** control is activated.
- There has been an **ECG Leads Off** INOP condition (that has been active for >60 seconds) for both leads, and the condition ends in either lead.

Multi-lead 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.
- An **ECG 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.

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 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:

- **Respond to the INOP message. For example, re-connect the electrode(s).**
- **Ensure that the arrhythmia algorithm is labeling beats correctly.**

Initiating Arrhythmia Relearning Manually

- ► Touch the **HR** numeric.
- ► Scroll to the next page.
- ► Touch **Arrhythmia**.
- ► Touch **Relearn Arrhy**.
- While the monitor is learning, the beat label **L** may show at the device if the **Annotate** wave is on.
- Next, the monitor determines the dominant rhythm. The beats are labeled **N**, and the rhythm status message changes to **Learning Rhythm**. After relearning is complete, you should check the delayed arrhythmia wave to ensure that the algorithm is labeling the beats correctly. If beats are 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.

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 112.

Automatic Arrhythmia Relearn

Arrhythmia relearning is initiated automatically whenever:

- ECG monitoring is switched on.
- The ECG Lead or Lead Label of the primary/secondary lead is changed manually, or when fallback occurs.
- An **ECG Leads Off** INOP condition (that has been active for > 60 seconds) ends. If you are monitoring multi-lead arrhythmia and there is a change in one lead only, relearning happens only in the affected lead. During this learning phase, the system will continue monitoring using the other lead. Therefore, the delayed arrhythmia wave is not labeled **L** and there is no **Learning ECG rhythm** status message. In addition, alarm timeout periods are maintained, stored arrhythmia templates are maintained for the operative lead, and all alarms switched on are active.

4.21 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

The clinical significance of the ST level change information should be determined by a physician.

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.**
- **if the patient's primary lead has a biphasic QRS complex and you adjusted the ISO/J point setting to manual.**

You should consider switching ST monitoring off if the above mentioned conditions are present.

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.

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CAUTION

- **Artifactual ST segment depression or elevation may occur if the isoelectric point or the ST point is incorrectly set. Always ensure that ST measurement points are appropriate for your patient.**
- **If using ST analysis, the ST measurement points need to be adjusted when you start monitoring, if the patient's heart rate or ECG morphology changes significantly, or changing ECG lead placement (Standard/EASI), as this may affect the size of the QT interval and thus the placement of the ST point. Artifactual ST segment depression or elevation may occur if the isoelectric point or the ST point is incorrectly set. Always ensure that ST measurement points are appropriate for your patient.**

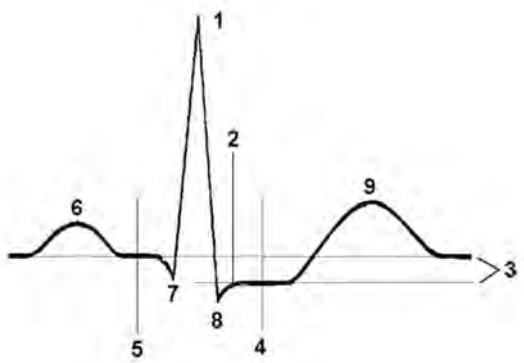
The Measurements

Overview

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 ST measurements from the PIC iX.

When ST analysis is on, ST offset can be measured automatically with present J-point values. You can also manually adjust all ST measurement points.

When using Manual Mode detection for the primary lead, the R-wave should be tall, not clipped, or biphasic. ST measurements are done automatically but can be adjusted manually. To ensure accurate data, you may need to readjust the ST measurement points if the patient's heart rate or ECG morphology changes significantly.

There are three measurement cursors, when using manual ST measurements:

- The ISO measurement cursor positions the isoelectric point in relation to the R-wave peak.
- The J-point cursor positions the J-point in relation to the R-wave peak.
  The purpose of the J-point is to correctly position the ST measurement point.
- The ST measurement cursor positions the ST point a fixed distance from the J-point.

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 PIC iX:

- ► Select the **Measurements ST** page.
- ► Click the **I/O ST** or **I/O STE Analysis** button to toggle **ST** or **STE Analysis** on or off as appropriate.

Displayed ST Data

ST data displays as values in the Patient Sector and Patient Window at the PIC iX. A positive value indicates ST segment elevation; a negative value indicates ST segment depression. You can view ST data at the 5500 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 5500.

Displayed STE Data

STE data can only be displayed at the PIC 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*. Documentation can be found on InCenter. See “Accessing Paper and Electronic Documentation” on page 6.

ST Index

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

HEXAD ST Analysis

When operating with the PIC 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 PIC iX. 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 PIC iX, however its limits are set during configuration and not adjustable on a 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.

4.22 ST/AR QT/QTc Interval Monitoring

Intended Use

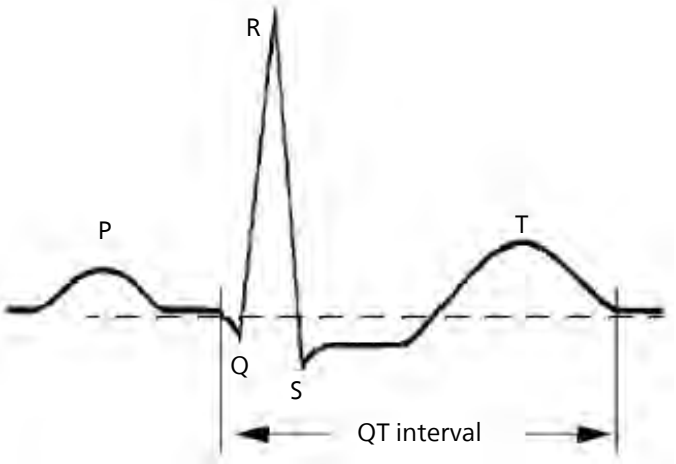
The intended use of the ST/AR QT/QTc analysis algorithm is for use by the physician in the risk assessment process indicated for pediatric and adult patients with and without symptoms of arrhythmia. QT measurement is intended to be used by qualified healthcare professionals in hospital or clinical environments. 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 ST/AR Arrhythmia Algorithm Application Note* and in the *PIC iX Instructions for Use*. See "Accessing Paper and Electronic Documentation" on page 6.

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.

What is QT Interval Monitoring?

QT interval monitoring can assist in the detection of prolonged QT interval syndrome. The QT interval in an ECG lead is the time interval from the onset of the earliest deflection in the QRS complex to the end of the T wave. For patients being monitored by an IntelliVue Telemetry System device, the PIC iX measures the QT values once every 15 seconds.



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

Indications for use of QT Interval Monitoring

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

Limitations for use of QT Interval Monitoring

Conditions that can cause difficulty for continuous QT interval monitoring are:

Flat T-wave

T-wave amplitude in some ECGs may be too low for identification of the end of the T-wave. For reliable **QT** interval monitoring, select a lead with sufficient T-wave amplitude.

U-wave

A discrete and separate U-wave is not considered as part of the **QT** interval. U-waves often overlap the T-wave and the midpoint of the overlap is taken as the end of the T-wave. The ST/AR **QT** interval algorithm will usually measure the end of the T-wave correctly in the presence of a U-wave. However, if the presence of a U-wave causes the algorithm to produce erroneous measurements, select a lead without a predominant U-wave.

High heart rate

When the heart rate is high, the P-wave of the subsequent P-QRS-T complex may approach the end of the T-wave and produce an effect similar to that of a U-wave. The midpoint will be taken as the end of the T-wave. If the heart rate is above 150 bpm for adults or 180 bpm for pediatric and neonatal(4) patients, no measurement will be made. If a P-wave causes the algorithm to produce erroneous measurements, select a lead without a predominant P-wave. If the heart rate is extremely high (over 150 bpm for adults and over 180 bpm for pediatrics) **QT** will not be measured.

Wide QRS complex

Increases in QRS duration contribute to a long **QTc** interval. Patients with left or right bundle branch block, Wolff-Parkinson-White or hypertrophy may have widened QRS durations. If the QRS changes considerably from the learned normal, the beats may be incorrectly labeled as ventricular beats causing them to be excluded from the **QT** analysis. If a long **QTc** is observed, it should be verified to ensure that it is not caused by QRS widening.

Atrial fibrillation and atrial flutter

Patients with atrial fibrillation or atrial flutter often do not have clear T-waves because of the interference due to atrial activity. In addition, the marked variation of rate usually makes correction more problematic. **QTc** interval measurements are difficult to interpret. Some of these problems may be reduced by choosing leads with no visible flutter activity.

(4) The Telemetry Monitor 5500 is intended for use with pediatric and adult patients only.

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Leads used for QT interval measurement

The apparent end of T-wave varies from lead to lead. The biggest problem comes from small T-waves and from respiratory variation in the morphology. If a single lead is being used for patient monitoring, it is advisable to choose a lead with a large T-wave and no terminal inversion.

Prolonged PR intervals

With rapid heart rates typical in neonatal[(5)] and young pediatric patients, the P-wave and T-wave may overlap. Some extreme cases of prolonged PR intervals may result in the P-wave occurring before the end of the T-wave. In such cases, the end of the T-wave should still be measurable. If a P-wave is causing the algorithm to produce erroneous measurements, select a lead without a predominant P-wave.

Arrhythmia algorithm accuracy

To reject beats that should not be measured, beat labeling from the arrhythmia algorithm is used in the **QT** interval algorithm. Incorrect beat labeling by the arrhythmia algorithm can influence the accuracy of the **QT** interval measurement algorithm. To obtain accurate **QT** interval measurement, factors that affect the arrhythmia monitoring performance should be corrected. Because normal beats followed by ventricular beats are not included in the analysis, no QT interval measurement will be generated in the presence of a bigeminy rhythm if the premature beat's R-R interval is 20% less than the average R-R interval.

QT interval monitoring cannot be performed if the beats are predominantly labeled as **V** or **P**. Normal or atrial paced beats and beats with similar morphology are averaged to form a representative waveform for further processing. If the heart rate is extremely high (over 150 bpm for adults and over 180 bpm for pediatrics and neonates[(5)]) **QT** will not be measured. When the heart rate changes, it can take several minutes for the **QT** interval to stabilize. For reliable **QTc** calculation it is important to avoid a region where the heart rate is changing.

For **QT** interval monitoring to be effective, basic or enhanced arrhythmia monitoring should be turned on. If the algorithm cannot form a representative waveform, for example because the morphology of the beats is too varied, a **Cannot Analyze QT** INOP will be generated after one minute. Because of the different algorithm approaches, a **QT**/**QTc** measurement from a diagnostic 12-lead program may differ from the realtime measurement on the monitor.

Selecting the QT Leads

QT and **QTc** interval values can vary between different leads or QT interval analysis can be performed on all leads, the primary lead or on a single lead. The **QT** and **QTc** interval values should be checked and validated when choosing a different lead for monitoring or if the monitoring mode has changed. When **QT** interval monitoring is initiated, the baseline will be automatically set after the active leads have been stable for five minutes and there is a valid **QT** measurement. You can select a new baseline anytime during **QT** interval monitoring. If you set a new baseline the previous baseline is discarded. As the **ΔQTc** alarm is based on the difference between the baseline and the current value, setting an inappropriate new baseline may prevent a **ΔQTc** alarm from being generated. The baseline should be checked and validated. Discharging a patient clears the baseline.

(5) The Telemetry Monitor 5500 is intended for use with pediatric and adult patients only.

Turning QT Analysis On and Off at the PIC iX

For telemetry-monitored patients, you can turn QT Analysis on or off by clicking **I/O QT Analysis** from the **QT** measurement page, at the PIC iX, as appropriate. When the QT measurement is on, the current values for **QT**, **QTc**, **ΔQTc** and **QT-HR** display as well as the lead labels indicating the leads used to calculate the baseline and current values. Turning QT analysis off does not clear the baseline value. This allows you to turn QT analysis off during prolonged arrhythmias, such as bigeminy, without losing the baseline.

Using a consistent formula for measuring the QTc is recommended within the hospital.

There are two QT yellow alarms (**): **QTc High** and **ΔQTc High**. The **QTc High** alarm occurs if the value exceeds the set alarm limit for longer than 5 minutes. The **ΔQTc High** alarm occurs when the difference between the current value and the baseline value exceeds the set limit for longer than 5 minutes.

To turn QT alarms on or off:

Select **QTc High Alarm** or **ΔQTc High Alarm** from the **QT** page at the PIC iX.

Setting QT Alarm Limits at the PIC iX

Set the high alarm limits based on your assessment of the patient's clinical condition, unit protocols, physician orders or medication specified limits.

To set the **QTc** or **ΔQTc** alarm limits:

1. Select **QTc High Limit** or **ΔQTc High Limit** from the **QT** page as appropriate. A pop-up with limit values displays.
2. Use the up and down arrows to scroll through the limit values then select a value on the list.

Viewing QT data at the 5500

Once the measurement is turned on at the PIC iX, you can choose to view QT data at the 5500:

- Touch any numeric.
- Select **Change Numeric** (it may be necessary to scroll down).
- Select **QT**.

Only **QTc** and **ΔQTc** measurements are available for viewing.

QT measurement definition and display location:

Measurement	Display Location	Measurement Definition
QT	PiC iX	QT interval in milliseconds (ms). The QT interval is the time between the beginning of the Q-wave and the end of the T-wave.
QT-HR	PiC iX	The heart rate used to calculate QTc.

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Measurement	Display Location	Measurement Definition
QTc	5500	QTc represents the heart rate corrected QT interval. By default, the telemetry monitor uses the Bazett correction formula to correct the QT interval for heart rate. Your system may be set up to use the Fridericia correction formula.
ΔQTc	5500	The difference between the current QTc value and the QTc baseline value.

5 Monitoring Pulse Rate

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

5.1 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.

The pulse numeric is displayed at the PIC iX and the 5500 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 5500 with a time stamp. In Manual or Auto mode, the measurement can be started using the SmartKeys menu or the SpO_2 measurement menu. In Auto mode, the time interval is configured at the PIC iX and synchronized with the 5500. SpO_2 measurements start automatically when in auto mode at the repeat time interval set at the PIC iX.

Pulse is turned on in the **Measurements/SpO2** page at the PIC iX (default setting is **On**).

5.2 Pulse Alarm Availability

Pulse alarms are available regardless of SpO_2 mode (i.e. Continuous, Auto, or Manual) and also:

- When monitoring SpO_2T Only on the 5500 (via adapter, p/n 989803199081, or ECG manually switched off) PulseT alarms are available.
- When monitoring ECG and SpO_2T on the 5500 and a Leads Off condition occurs, PulseT alarms are available.
- It is not possible to turn the Pulse measurement off or the Pulse alarms off when ECG measurement is off.

When the **ECG Leads Off** condition is corrected, PulseT alarms are no longer available and any active PulseT alarm is dismissed.

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.

WARNING

When the pulse rate measurement is the active alarm source, HR alarms and arrhythmia alarms, including Asystole, Vfib and Vtach are turned off. The ECG/Arrh AlarmsOff INOP is displayed. High and Low Pulse rate and Extreme Bradycardia and Extreme Tachycardia alarms from the pulse rate measurement are active.

Pulse and HR share the same high and low alarm limits. To change the Pulse alarm limits, go to the PIC iX and change in the Measurements/ECG screen. The only exceptions are caused by a low limit clamp for each measurement: the lowest value for Pulse when derived from SpO_2 is 30 bpm; from HR 15 bpm. To change ECG, Resp or SpO_2 alarm limits see “5500 Controls in the Patient Window at the PIC iX” on page 149.

5.3 Displaying the Pulse Rate Measurement at the 5500

To display the pulse rate measurement at the 5500:

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

6 Monitoring Respiration Rate (Resp)

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

6.1 Respiration Rate Measurement

For the respiratory measurement (Resp), the 5500 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 5500 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 or off, alarms, alarm limits and apnea time are defined at the PIC iX. When the ECG measurement is turned off, the Resp measurement is not affected and is still displayed at the 5500.

6.2 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 “Other Accessories” on page 206 section.**
- **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.**
- **Respiration measurement may impact rate adaptive pacemaker. This can result in an incorrect treatment. If pacing is affected, turn off the Respiration function.**
- **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.**

6.3 Lead Placement for Monitoring Resp

Introduction

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 5500. A reminder message to not connect OR-ECG leadsets is displayed.

Respiration Measurements when ECG Adapters are in use: The message **Is an orange OR-ECG leadset connected?** is displayed when you use the ECG adapter cables (pn's: 989803199071, 989803199091, or 989803199101). If you answer **Yes**, then Respiration will not be measured. If you answer **No**, Respiration measurements are possible and you will receive an informational message reminding you to not connect an OR-ECG leadset.

The Resp measurement uses the standard 5500 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).

Correct patient skin preparation techniques for electrode placement are important for Resp measurement. See “Connecting and Positioning ECG Electrodes” on page 91.

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.

6.4 Displaying Resp on the 5500

To display the Resp waveform and/or numeric:

1. At the Information Center, 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 5500, 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 5500 and at the PIC 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**.

7 SpO2 Monitoring

This chapter provides an introduction to the SpO_2 measurement and its application. In the Telemetry Monitor 5500, SpO_2 is labeled as **SpO2T**, with T indicating that the source is Telemetry.

7.1 Measurement Overview

The 5500 supports optional SpO_2 monitoring using the Philips motion-tolerant signal processing algorithm, based on Fourier Artifact Suppression Technology (FAST)[6]. 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 wave - visual indication of patient's pulse.
- Pulse rate (derived from pleth wave) - detected pulsations per minute.

The term "Philips FAST" refers to the Philips FAST SpO_2 algorithm and the FAST measurement board (SO2). The term "Philips sensor" refers to the Philips FAST compatible sensors purchased from Philips. Select Masimo sensors can also be used with the Philips FAST technology. Both Philips and Masimo reusable or disposable sensors may be used. For a list of supported sensors and accessories, see "SpO_2 Accessories" on page 201.

For more information, see the Application Note titled *Validation of SpO2 measurement accuracy*, on Philips InCenter. See "Accessing Paper and Electronic Documentation" on page 6.

(6) SpO_2 monitoring technology is available as a purchased hardware option at the time of order. For more information, contact your Philips sales representative.

SpO2 Safety Information

WARNING

- **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 depending on patient needs.**
- **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.**
- **Do not use in the presence of flammable anesthetics or gases, such as a flammable anesthetic mixture with air, oxygen, or nitrous oxide or in the presence of other flammable substances in combination with air, oxygen-enriched environments, or nitrous oxide. Use of the device in such environments may present an explosion hazard.**
- **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.**
- **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 4 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.**

SpO2 Safety Information

WARNING

- **Avoid placing the sensor on extremities with an arterial catheter or intravascular venous infusion line.**
- **Sensors connected to the 5500 but not applied to the patient, can produce an error measurement. To avoid misdiagnosis, ensure the sensor is properly applied to the patient.**
- **Removal of the SpO_2 sensor from the 5500 patient cable during Continuous SpO_2 monitoring results in a No Sensor technical alarm. Silencing this alarm turns the SpO_2 measurement off. However, the SpO_2 module is still operating in the background and consuming considerable battery power. If you do not intend to resume Continuous or Auto SpO_2 monitoring, change to Manual mode.**

CAUTION

- **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.**
- **When the 5500 is connected to a patient monitor using the 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). For information on which sensors cannot be used with an extension cable, see “Accessories” on page 197.**
- **Position the sensor cable away from power cables to avoid electrical interference.**

7.2 Calculating SpO2 Data

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

Pulse Oximetry Measurement

The 5500 supports an SpO_2 sensor connection using Philips FAST. SpO_2 can be measured continuously, where a value is sent to the PIC iX every second, or as a single, individual manual measurement, or as an automatic measurement at configured intervals. The manual measurement will be removed from the device and the PIC iX after 1 hour.

The SpO_2 measurement assesses 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.

Performance Specification Details for Philips Sensors and Masimo Sensors

For information about SpO_2 accuracy studies, refer to the Application Note titled "Validation of SpO_2 measurement accuracy".

Documentation can be found on InCenter. See “Accessing Paper and Electronic Documentation” on page 6.

7.3 SpO2 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 Telemetry Monitor 5500, see “Accessories” on page 197.

Sensor Application Safety Information

WARNING

- **Failure to apply a sensor properly can reduce the accuracy of the SpO_2 measurement.**
- **Loose/Tight sensor: If a sensor is too loose, it can compromise the optical alignment or fall off. If it is too tight, for example because the application site is too large or becomes too large due to edema, excessive pressure can be applied. This can result in venous congestion distal from the application site, leading to interstitial edema, hypoxia and tissue malnutrition.**
- **Skin irritations or ulcerations can occur as a result of the sensor being attached to one location for too long. To avoid skin irritations and ulcerations, inspect the sensor application site every 2-3 hours, and change the application site at least every 4 hours or according to clinical practice guidelines.**
- **Venous Pulsation: Do not apply sensor too tightly as this results in venous pulsation, which can severely obstruct circulation and lead to inaccurate measurements.**
- **Ambient Temperature: Never apply an SpO_2 sensor at ambient temperatures above 37 °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 SpO2 Sensor

WARNING

- **Use only Philips-approved accessories. Use of product accessories (patient cables, SpO_2 sensors, etc.) other than those specified in this manual may lead to patient injury or result in increased electromagnetic emissions or decreased immunity of the product.**
- **Reuse: Never reuse disposable sensors or accessories that are intended for single use. Never reuse disposable sensors or accessories that are intended for single-patient use.**
- **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.**

The following sensors can be used:

- Philips reusable sensors in adult, pediatric and infant [7] sizes. Infant is an alternative for use on adult patients only.
- Philips disposable sensors.
- Approved Masimo® sensors (reusable/disposable).

This 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.
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.

Applying the Sensor

- ► Follow the SpO_2 sensor cautions.
- ► If necessary, remove colored nail polish from the application site.
- ► 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.
- ► Check that the light emitter and the photo detector are directly opposite each other. All light from the emitter must pass through the patient.

Connecting SpO2 Cables

The sensor cable is either directly connected to the SpO_2 connector on the 5500 patient cable or is connected to an adapter cable that is then connected to the 5500 SpO_2 connector.

(7) The Telemetry Monitor 5500 is intended for use with pediatric and adult patients only.

Philips

Tone Modulation Indication

The pulse signal tone is controlled by the setting **Tone Modulation** in the **Setup SpO2** menu.

NOTE

Tone Modulation Indication is only available when operating in Continuous mode and the screen is on. 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 (SQI) 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 SQI ranges from 0-100%. The triangle shown with the SpO2 numeric indicates the SQI value. The signal quality is at a maximum when the triangle is completely filled.

7.4 Measuring SpO2

WARNING

- **If you measure SpO_2 on a limb that has an inflated NBP cuff, a non-pulsatile SpO_2 technical alarm (SpO_2 No Pulse) 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 hypoxia.**
- **Removal of the SpO_2 sensor from the 5500 patient cable during Continuous SpO_2 monitoring results in a No Sensor technical alarm. Silencing this alarm turns the SpO_2 measurement off. However, the SpO_2 module is still operating in the background and consuming considerable battery power. If you do not intend to resume Continuous or Auto SpO_2 monitoring, change to Manual mode.**

After silencing a **No Sensor** technical alarm and turning the SpO_2 measurement off, plugging the sensor back in turns the measurement back on if operating in Continuous or Auto mode. If operating in Manual mode, the measurement must be manually started at either the PIC iX or the 5500.

SpO_2 measurements can be made manually on an as-needed basis in Manual mode, continuously in Continuous mode, or automatically in Auto mode, depending on your 5500 configuration. A Manual Mode measurement will be removed from the PIC iX display after 1 hour. While operating in Continuous mode, you can also measure pulse, and display the pleth wave at the 5500 and at the PIC iX. The SpO_2 measurement is turned on/off at the 5500 or by a control from the PIC iX.

NOTE

- SpO_2 monitoring requires substantial battery power. Use Continuous mode or Auto mode depending on the patient condition or the 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 5500 or at the PIC iX.
- Before disabling SpO_2 at the PIC iX, acknowledge any active alarms at the 5500.

To resume the SpO_2 measurement after it has been turned off, touch the blank measurement area and select **SpO2** to turn it back on.

Setting the SpO_2 mode can be done at the PIC iX or at the 5500.

To select the measurement mode at the 5500:

1. In **Setup SpO2**, select **Mode**.
2. Select **Continuous**, **Manual** or **Auto** mode.
3. If using Manual or Auto mode, select **Start**.

7.5 SpO2 Only Operation

The 5500 can operate in SpO_2 Only operation in two ways:

- by using the accessory cable, "Philips Telemetry Adapter SpO2 Only" p/n 989803199081 (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 ECG off:

1. Touch the **HR** measurement.
2. In the **Setup ECG** menu, scroll to the second menu page and select **ECG** to toggle **on** to **off**.
3. or
4. Use the **ECG: On** SmartKey icon to turn ECG off
5. Touch **Confirm**

To manually turn ECG back on:

6. Touch any blank Measurement Area on the display.
7. In the **Change Numeric** menu, select **HR**.
8. Or use **ECG: ON** SmartKey icon to turn ECG back on

When operating in SpO_2 Only operation, 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.

7.6 Understanding SpO2 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 1 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 5 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 PIC iX. The sound will be silenced but the message will remain on the display until the condition is resolved.

NOTE

The **SpO2T No Pulse** INOP is available for all measurement modes, but may be delayed by up to 35 seconds after displaying invalid data, noted by "**?**".

8 Monitoring at the PIC iX

This chapter describes the behavior of the Telemetry Monitor 5500 as it relates to what is displayed at the PIC iX.

8.1 Synchronizing with the PIC iX

Once the 5500 has been assigned to a sector at the PIC iX, settings (alarms, arrhythmia, configured Unit settings, date and time) are synchronized with the 5500. You may see a **settings sync'd** message in the Information Area on connection, re-connection, and anytime the settings are updated at the PIC iX. For more information on which device controls are available at the PIC iX, see “Device Controls at the PIC iX” on page 150. And for instructions on how to assign a sector at the PIC iX, etc., see the PIC iX Instructions for Use.

WARNING

Verify that the equipment is assigned to the correct sector, that waveforms and numerics are present, and that the patient demographics appear as expected on the monitoring devices. The Patient Category and Paced Mode fields always contain a value, regardless of whether the patient is admitted. If you do not specify settings for these fields, the default settings are used.

Upon loss of connection to the PiC iX, the 5500:

- turns on its display
- displays the no connection icon 
- displays the **No Central Monit** INOP
- uses the last known settings from the PIC iX. When the device is off network, the controls made on the PIC iX will not take effect on the device until you reconnect.
- announces new physiological alarms (locally only).
- allows viewing of Active alarms that occurred prior to the loss of connection in the Alarm List.
- retains Patient Name.
- retains Vitals Trend data.

When a loss of battery power occurs while not connected to the PIC iX using Smart-hopping 1.0, the 5500 retains the last known alarm limits and vitals trends data but this is not sent to the PIC iX at re-connection. For Smart-hopping 2.0, the trend data is uploaded as long as Authentication and Encryption have been enabled. See “Compatibility” on page 18.

When any measurement is off (or manually turned off), its waves and numerics are removed from the 5500 and the PIC iX. The 5500 stops the measurement and is no longer able to alarm for this measurement.

Discharging a patient

Since data collection starts when a patient is connected to the monitor, it is important that you perform a discharge prior to connecting a new patient.

CAUTION

Discharging a patient at the PIC iX removes the patient from the bed and changes their status to discharged. At that point, data storage begins for that bed. Before connecting a new patient, perform a discharge to ensure that data from the previous patient is not mixed with the data from the new patient and alarm limits controlled at the PIC iX revert to unit settings.

8.2 Backfilling Wave Dropouts

If you are using Advanced Mode with Smart-hopping 2.0 and the network drops out between the PIC iX and the 5500, the 5500 makes a best effort attempt to resend up to the last 10 seconds of wave data to the PIC iX review applications. The PIC iX does not backfill wave data in real-time displays.

NOTE

- Wave review data is backfilled for short RF data loss events presented at PIC iX. This short RF data loss is defined as 0.25 seconds data loss. The device buffers up to 10 seconds of data.
- There is no guarantee that gaps will be filled because the backfill wave messages can be lost on the network.
- Wave gaps are not backfilled if the 5500 loses association with the PIC iX.

WARNING

Alarms and Events are not uploaded to the PIC iX.

8.3 Assigning Devices

Multiple Device Assignment at the PIC iX

It is possible to assign additional monitoring equipment and a telemetry device to the same patient, resulting in the information from multiple devices being combined in one sector at the PIC iX. The measurement data from the other devices will be displayed on the monitor screen in the Own Patient Overview window.

WARNING

- **All data presented in the Own Patient Overview window on the bedside is 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, SpO_2T must be the source.**

Monitoring with the 5500 and a Bedside Monitor

WARNING

- **Each medical device may use different alarm settings. Be sure to confirm the settings for the devices in your area after equipment transitions.**
- **As long as the ECG is being measured with the 5500, there will be no signal available at the ECG Analog output or ECG Sync Pulse output.**

CAUTION

- **When the 5500 patient cable is connected to a patient monitor using the Telemetry Monitor 5500 / IntelliVue Patient Monitor Adapter Cable, (p/n 989803172211), the SpO_2 sensor must be directly connected to the patient monitor to monitor SpO_2.**

ECG Source Controls

If the patient's ECG is initially being measured with a patient monitor, and then the patient is connected to the 5500 for monitoring, the PIC iX will use the patient monitor settings for the 5500. When the initial ECG source is the 5500, and then the patient is connected to a patient monitor, the PIC iX uses its Telemetry Setup settings. The following settings will be synchronized (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 PVC 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
SpO_2T	SpO_2 Alarms On/Off, SpO_2 Alarm Limits, NBP Alarm Suppression On/Off, Pulse (SpO_2) On/Off, Desat Limit

5500 Controls in the Patient Window at the PIC iX

The Patient Window at the PIC iX includes controls for a number of 5500 operations. For detailed instructions on these operations, see the *Patient PIC iX iX Instructions for Use* or the *Online Help*. Documentation can be found on InCenter. See “Accessing Paper and Electronic Documentation” on page 6.

To View ECG, Resp 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 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.

   See the PIC iX, Instructions for Use section "Changing the QRS Detection Threshold" for more information.

NOTE

Pulse alarm limits are the same as HR alarm limits and will synchronize. They are changed in the ECG Measurement menu.

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.**
- **When setting alarm limits, it is important to select appropriate values. Selecting extreme values can cause the alarm system to be ineffective.**

To Change ECG Waveform Size at the PIC iX

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.

NOTE

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 PiC iX 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 PIC iX.

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 an option from the list.

To Initiate a Manual SpO_2 Measurement

1. Click the **Measurements** button.
2. Select **SpO_2** from the menu on the left.
3. Select **Start** from the **SpO_2** menu on the right.

Device Controls at the PIC iX

The following table lists the available device controls at the PIC iX that affect the PIC iX, the 5500, or both.

IC — The control is available at the PIC iX only. The effect of the control will be reflected at the 5500.

B — The control is available and will synchronize at both the PIC iX and the 5500.

I — The control is available at the PIC iX and 5500. The effect of the control is only reflected where initiated.

D — The control is available at the 5500 only. The effect of the control will be reflected at the PIC iX.

N/A — The control is not available at either the PIC iX or the 5500.

Control Setting	Affects PIC iX / 5500	Control Setting	Affects PIC iX / 5500
Acknowledge Alarms	B	Recording: Continuous (Start/Stop)	IC
Analysis Lead Selection	IC	Reports from the device	D
Analysis Relearn	B	Resp Alarm Limits	IC
Arrhythmia Alarms On or Off	IC	Resp Alarm On or Off	IC
Arrhythmia Alarm Thresholds	IC	Resp Apnea Time	IC
Arrhythmia Analysis Mode	IC	Resp Measurement On or Off	IC
Bedside Controls (ADT, etc.)	IC	SpO_2 Alarm Limits	IC

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Control Setting	Affects PIC iX / 5500	Control Setting	Affects PIC iX / 5500
ECG Filter	IC	SpO_2 Alarm On or Off	IC
ECG Gain	I	SpO_2 Enable Pulse	B
ECG Hexad Selection	IC	SpO_2 Manual Measurement	B
ECG HR/Arrhythmia/Pulse Alarm	IC	SpO_2 Measurement On or Off	B
ECG Lead Placement Selection	D	SpO_2 Mode Selection	B
ECG Measurement On or Off	D	SpO_2 Pleth Wave Stored	IC
Find Device	IC	SpO_2 Repetition Time	IC
HR Alarm Limits	IC	SpO_2 Suppress INOPs with NBP	IC
HR Alarm On or Off	N/A	ST Alarm On or Off	IC
HR Extreme Tachy/Brady Limits	Based on HR limits IC	ST Alarm Limits	IC
Pause Alarms	B if configured	ST Analysis On or Off	IC
Pulse Alarm On or Off	N/A	ST Baseline	IC
Pulse Limits	Set with HR Limits	ST Measurement Points	IC
QRS Detection Threshold	IC	Standby/Resume	B
QT Alarm Limits	IC	Standby Duration	*
QT Alarm On or Off	IC		
QT Analysis	IC		
QT Analysis Lead Selection	IC		
QT Set Baseline	IC		

*For Standby Duration control information, see “Standby Behavior” on page 44.

8.4 Locating the 5500 (Find Device)

The Find Device feature enables you to generate an alternating pitch repeated tone at the 5500 to assist in locating a missing device. Find Device requires that the 5500 has sufficient battery power and is within the coverage area.

To locate an 5500:

1. Click the **Measurements** application button.
2. Select **Telemetry Setup**.
3. Select **Find**.

To silence this tone, touch the acknowledge alarm button on the 5500.

8.5 Viewing Device Location and Location History

Telemetry Monitor 5500 Device Location information is identified in the Patient Window by a compass icon followed by the location name of the access point that the 5500 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

You can view the location history for a particular 5500 device 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.

Philips

9 Trends

This chapter covers the Trend functionality of the Telemetry Monitor 5500. Trends are patient data collected over time and displayed in tabular or graphic form to give you a picture of how your patient's condition is developing. Trend information is stored in the 5500 for continuously-monitored measurements, such as ECG, as well as for aperiodic measurements, such as SpO_2. One hour of tabular trend information is standard on the 5500, with the option available for 24 hours.

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.

NOTE

- All trend information is erased from the Vital Trend window when you discharge or transfer a patient, or if you change to Demo Mode. Trend information is not affected by battery replacement and remains stored.
- You may see a difference between the value displayed in the tabular trend on the PIC iX and the value displayed on the 5500. This is due to time drift between the PIC iX and the 5500.

9.1 Viewing Trend Information

To view Trend information:

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

To change the time interval:

1. Select a different time interval from the choices at the bottom of the screen.

To change the view:

1. Touch the measurement column on the left.
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.

9.2 Viewing Graphic Trend Information

If desired, the Graphic Trend view can be expanded and scaled to the 5500's display.

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 left.
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 can toggle on or off the **Optimum Scale** setting. The **Trends** menu can also be displayed by touching the measurement column from the **Graph Trend** menu.

10 Maintenance

This chapter provides procedures for maintaining the Telemetry Monitor 5500 after installation, including equipment label assignment, cleaning, battery care, disposal, and storage.

WARNING

Wash hands after use, wear gloves, where possible, and avoid food intake while handling the 5500.

The 5500 cannot be repaired in the field. See the *Telemetry Monitor 5500 Installation and Service Guide* for more information.

10.1 Cleaning

The procedure in this section keeps the 5500 and its accompanying patient cable and accessories (AA battery door and the rechargeable battery) clean and provides protection against infectious agents and bloodborne pathogens. Both the outside and the inside of the 5500 battery compartment and the patient cable must be kept free of dirt, dust, debris, and fluids.

CAUTION

Do not use abrasive cleaning materials, such as brushes with stiff and/or wire bristles on any part or component of the 5500:

- **Using abrasive materials on the protective gold plating on the connector PINs, battery contacts, etc., can lead to damage and corrosion.**
- **Using abrasive materials on the device case, battery case and battery vent can cause liquid intrusion inside the case and damage/corrosion to the electronics.**
- **Using sharp or pointed instruments to remove soil from recessed areas on the 5500 or accessories can lead to damage.**
- **After use, the 5500 and accessories must be cleaned as per the instructions contained herein. Use only recommended cleaners and disinfectants, see “Compatible Cleaners and Disinfectants” on page 161. Others may cause damage (not covered by warranty), degrade performance, reduce product lifetime, or cause safety hazards.**
- **Use only isopropyl alcohol on the gold connector pins and gold battery contacts (located inside the patient cable connector, telemetry monitor battery compartment, AA battery door, and rechargeable battery). Other cleaners can result in chemical residue build-up and corrode the pins and contacts.**

CAUTION

- **The AA battery door 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 AA battery door be replaced every 12 months or sooner when visible wear is recognized.**
- **Keep the SpO_2 protection cap ON while cleaning to prevent liquid from entering the SpO_2 connector. Otherwise, damage may result.**
- **Take extra care to thoroughly remove the cleaner/disinfectant residue with distilled water or isopropyl alcohol IMMEDIATELY following the manufacturer's instructions regarding application duration, especially when using bleach. If residue is left to dry, damage and corrosion may result.**
- **Do not immerse or soak the 5500, the patient cable, the AA battery door, or the rechargeable battery in any liquid solution for cleaning or disinfecting. Damage may result.**
- **Do not use ultraviolet (UV) light to disinfect the device, battery, or battery doors. Damage may result.**

NOTE

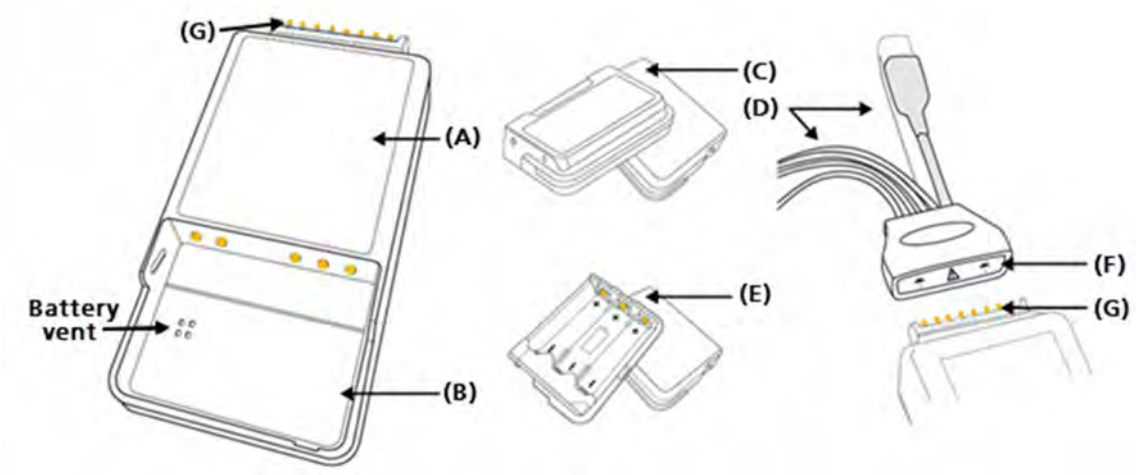
- No calibration needs to be performed on the 5500. For additional test and inspection procedure information, see the *Telemetry Monitor 5500 Installation and Service Guide* located on the “Accessing Paper and Electronic Documentation” on page 6.
- Single-patient use leadsets are intended to be disposed 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.
- Once corrosion to the 5500 battery contacts and/or damage to the silicone part and the battery contacts has occurred, the device cannot be repaired in the field. This 5500 will require a whole unit exchange.
- Once damage to the AA battery door has occurred, the battery door will need to be replaced.
- Once corrosion of the contacts on the patient cable connector has occurred, the patient cable will need to be replaced.

How to clean the 5500 and directly connected accessories*

The steps for cleaning the 5500 and accessories are to (1) Prep, (2) Clean, (3) Disinfect, (4) Remove Chemical Residue, (5) Dry. Please read through each step and take note of the following terminology:

*Directly connected accessories include patient cables, adapter cables, battery door, and rechargeable battery. These are herein referred to as “accessories”.

The term **EXTERIOR** in a step refers to the (A) 5500 device (excluding the gold connector pins), (B) battery compartment (excluding the gold battery contacts), (C) both sides of the rechargeable battery, (D) outside of the patient cable connector (including ECG leadsets, snaps or grabbers, SpO_2 connector and protection cap).



The term **INTERIOR** in a step refers to (E) the AA battery door, (F) inside the patient cable connector, (G) the gold connector pins on the 5500 and the gold battery contacts located in the 5500 battery compartment and on the rechargeable battery.

NOTE

- Use only the enzymatic detergent solution, Prolystica®, to clean the device and directly connected accessories.
- Use only isopropyl alcohol to disinfect the device and directly connected accessories.
- Before cleaning or disinfecting, the use of a new pair of protective gloves is encouraged.

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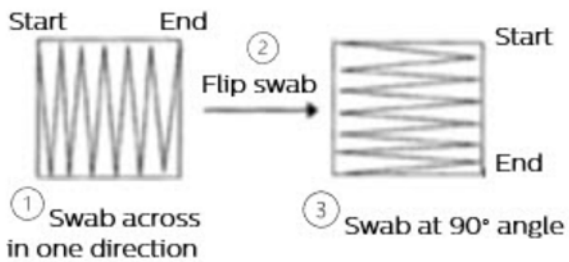
PREP (1 of 5)	
Step	**Action**
1.	Prepare the enzymatic detergent solution, Prolystica®, per manufacturer's instructions.
2.	If you see soil in the seams or crevices where the patient cable connects to the device, remove the patient cable. If applicable, keep the SpO_2 protection cap connected. Refer to the instructions for “Connecting/Disconnecting the Patient Cable” on page 42.
3.	**Rechargeable battery:**Open and remove the battery prior to cleaning. **Disposable AA batteries:**Open and remove the AA battery door. Remove and dispose of the AA batteries according to hospital policy. Refer to “Inserting/Removing Batteries” on page 52.

NOTE

If you are using a cotton swab to more effectively clean or disinfect seams and crevices, swabbing should be unidirectional. Parallel strokes should be used to cover the entire swab area as shown below.



CLEAN (2 of 5)	
Step	**Action**
4.	Use swabs or a lint-free cloth to wipe loose soiling from the outside of the device until visibly clean.
5.	Use a lint-free cloth or cotton swab dampened modestly with a compatible cleaner/disinfectant to clean the **EXTERIOR** of the device and accessories to remove soil, contaminant, dust, or debris. Then use a lint-free cloth or cotton swab dampened modestly with Prolystica® to clean the **INTERIOR** of the device and accessories.

NOTE

Hold the patient cable connector with the open end facing downward while cleaning and/or disinfecting, to prevent liquid from pooling inside the connector.

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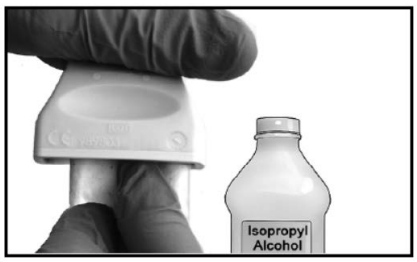

DISINFECT (3 of 5)	
Step	**Action**
6.	For **INTERIOR** and **EXTERIOR** surfaces of the device and accessories as defined above, **disinfect** the device and accessories by wiping using a lint-free cloth or cotton swab dampened modestly with isopropyl alcohol, to thoroughly remove soil, contaminant, dust, or debris. The disinfection procedure described here has been tested and its efficacy validated using 70% isopropyl alcohol (IPA). Follow the manufacturer's instructions regarding application duration required for disinfection.

REMOVE CHEMICAL RESIDUE (4 OF 5)	
Step	**Action**
7.	Remove the cleaner and disinfectant residue from the device and accessories by wiping using a new lint-free cloth or cotton swab dampened modestly with distilled water or isopropyl alcohol. Take extra care to remove any chemical residue from the 5500 gold connector pins and the gold battery contacts located in the battery compartment, on the rechargeable battery, and in the AA battery door.

CAUTION

Remove cleaner/disinfectant residue from the gold connector pins and battery contacts on the 5500 and accessory exteriors. Failure to do so can result in chemical residue build-up and irreversible damage to device and accessories.

DRY (5 of 5)	
Step	**Action**
8.	Allow to air-dry completely or dry with a lint-free cloth.
9.	Store the 5500 until ready to re-use. Do not insert the rechargeable battery or disposable AA batteries until ready for use.

CAUTION

Do not connect the patient cable connector to the 5500 or insert the rechargeable battery, or AA battery door while there is still moisture present. This may result in corrosion of the gold connector pins and battery contacts.

To clean or disinfect other accessories not listed earlier in this chapter, follow the cleaning instructions found in the Addendum, "ECG Lead Sets, Cables, and Adapter Cables Care, Cleaning, and Disinfection". See "Accessing Paper and Electronic Documentation" on page 6.

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10.2 Cleaning and Disinfecting Materials for the 5500

Material Compatibility with Disinfectants

Philips recommends using one of the agents/disinfectants listed in the table below as these disinfectants were tested for material compatibility during product development. If your cleaner and/or disinfectant is not on this list, we cannot attest to its compatibility with the materials used in the 5500. Damage could occur.

Warranty does not cover damage caused by using substances or methods which are not described in this chapter. Of the disinfectants listed, only 70% isopropyl alcohol (IPA) has been validated for its disinfection efficacy. For efficacy information on the other cleaners and disinfectants listed, contact the manufacturer.

NOTE

- To clean or disinfect other accessories not listed earlier in this chapter, follow the cleaning instructions found in the Addendum, “ECG Lead Sets, Cables, and Adapter Cables Care, Cleaning, and Disinfection”. See “Accessing Paper and Electronic Documentation” on page 6.
- Philips is not responsible for the ingredients used or for any changes made to the ingredients after completion of our testing. In case of questions, contact the disinfectant manufacturer.

Compatible Cleaners and Disinfectants

Compatible Cleaners and Disinfectants			
Product Name		Product Name	
1.	Alkaspray Ultra Surface Disinfectant & Cleaner	12.	Meliseptol
2.	Bacillol 30 Sensitive Tissues	13.	Oxivir Tb wipes
3.	Bacillol AF Tissues	14.	Resert™ XL HLD
4.	Big Spray 'new'	15.	Sani-Cloth Bleach Germicidal Disposable Wipes
5.	CaviWipes	16.	Sani-Cloth Plus Germicidal Wipes
6.	Descogen Liquid r.f.u.	17.	Super Sani-Cloth Germicidal Disposable Wipe
7.	Descosept Pur	18.	Sodium hypochlorite 0.5%
8.	Dismozon Plus	19.	Sporox II Sterilizing & Disinfection Solution
9.	Hydrogen peroxide 5%	20.	Techspray, Technical Grade Isopropyl Alcohol (IPA)
10.	Isopropyl alcohol 70%	21.	Viraguard Hospital Surface Disinfectant Cleaner
11.	Lysoformin 0.75%	22.	WipesPlus Disinfecting Wipes

Incompatible Cleaners and Disinfectants

The following cleaners and disinfectants have been tested and found to damage the device. They should not be used to clean the 5500.

Incompatible Cleaners and Disinfectants			
Product Name		Product Name	
1.	Caltech-Dispatch 5200	8.	Metricide
2.	Cidex Activated Dialdehyde	9.	Omnicide
3.	Cidex Formula 7	10.	Procide 14
4.	Cidex OPA	11.	Sanicloth AF
5.	Glutaraldehyde	12.	Virex Tb
6.	Incidin	13.	Wavicide
7.	Liquid Soap (antibacterial soap)		

For a list of incompatible cleaners and disinfectants for accessories, refer to the “Cleaning and Disinfection for Reusable ECG Lead Sets, Cables and Adapters” Addendum. Contact your service team for this addendum.

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10.3 Storing the 5500

CAUTION

Remove the batteries before storing the 5500 for an extended period of time.

Take care that the battery terminals do not contact metal (e.g. coins) or other conductive materials during transporting or storage.

For lithium ion rechargeable battery storage, see “Lithium Ion Rechargeable Battery Storage” on page 52.

For temperature, humidity and pressure specifications relating to storing and transporting the 5500, see “Environmental Specifications” on page 172.

10.4 Disposing of the 5500

WARNING

To avoid contaminating or infecting personnel, the environment or other equipment, make sure you disinfect and decontaminate the 5500 and/or Telemetry Monitor Battery Charger 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.

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

You will find detailed disposal information on the following web page: http://www.philips.com/recycling.

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).

10.5 Label Assignment for a Replacement 5500

During installation, an equipment label is assigned to each 5500 in a clinical unit so that the device can be identified during operation within the network. If a 5500 device is lost, the Assign Label function at the PIC iX enables you to unassign the label from a lost device, and re-assign that label to a replacement device. Labels are limited to those available in an individual clinical unit.

Re-assigning an Equipment Label at the PIC iX

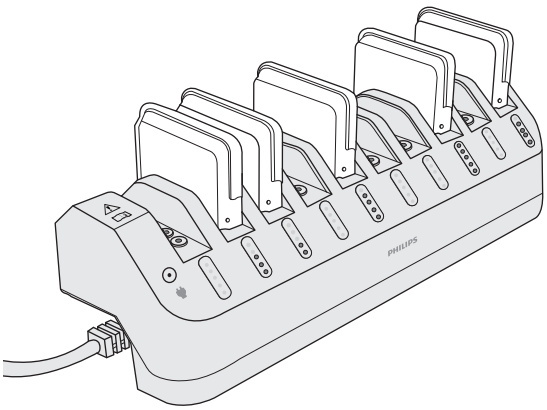
To re-assign an equipment label to a replacement device:

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 5500, select **Confirm**.
6. At the PIC 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 5500.

10.6 Battery Maintenance

Charging Lithium Ion Rechargeable Batteries

The lithium ion rechargeable battery is recharged using the Philips Telemetry Monitor Battery Charger. In order to meet the published battery life specifications, the battery should be fully charged before use.



It is very important to ensure that fully-charged batteries are available as needed. Recharging a discharged battery can take up to 6 hours.

To charge a battery, place it onto a slot on the battery charger. 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 battery charger 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, therefore exceeding allowable limits.**
- **Do not connect any devices that are not supported as part of the system.**

Battery Status LEDs

LEDs on the battery charger help you keep track of the battery power status.

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

The **AC Power**:

- is green when the battery charger is connected to AC power.
- LED is off when the battery is not connected.

The **Error LED:**

- Errors will show up on each charging bay bottom LED as Cyan during startup, if there is an error.

When a battery is put on a battery charger slot, confirm that a beep is issued and the bottom LED is a solid amber/orange to show a connection. The LED will turn to "status" in which case if the battery is <20% charged, it will remain amber/orange. If there is an error with the battery, the bottom LED turns cyan and charging is not possible. Remove the battery from the charger. If the cyan LED remains illuminated, then there is a problem with the charging bay. If the cyan LED goes away, then there may be a problem with the battery. Attempt to re-seat the battery in the charger. If the blue LED persists, it should be removed from use. The Battery Status LEDs will turn green one at a time, starting with the bottom LED, when approximately 20% battery charge is attained. All 5 LEDs will display green when the battery is fully charged.

NOTE

Wiping off battery contacts with an isopropyl alcohol solution after cleaning is recommended.

AA Battery Door

CAUTION

The 5500's AA battery door 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 AA battery door be replaced every 12 months or sooner when visible wear is recognized.

Rechargeable Battery Lifetime Management

The lifetime of a lithium ion battery depends on the frequency and duration of use. When properly cared for, the useful life is approximately 500 complete charge-discharge cycles or 3 years from the date of manufacture, whichever comes first.

As the end of battery lifetime approaches, the device will issue INOPs to give you time to re-order batteries.

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

Alarm Text	Priority	Condition	What to do
Service Batt Soon **NOTE** When the above INOP occurs, the **Tele Battery Low** INOP is suppressed. Source - Telemetry Monitor 5500	Soft	The lithium ion battery has ≤ 25 charge cycles remaining before reaching the maximum number of charge cycles or the age is between the age threshold, minus 2 months and the age threshold, minus 1 month.	• Be aware that the lithium ion battery will soon need replacement. • Order a new lithium ion battery.
Service Batt Now **NOTE** When the above INOP occurs, the **Tele Battery Low** INOP is suppressed.	Hard	This battery has reached the maximum number of charge cycles, its charge status is less than 10% or the age is between the 1-month threshold and the end of its lifetime.	• Order another lithium ion battery now.
!!!Service Bat Now **NOTE** When the above INOP occurs, the **Tele Battery Low** INOP is suppressed. Source - Telemetry Monitor 5500	Red	The battery has reached the end of its lifetime and is no longer able to be charged and may not power the 5500.	• Replace the lithium ion battery. • Dispose of old battery properly. **WARNING! This battery cannot be used to monitor patients.**

NOTE

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

11 Safety Standards & Specifications

This chapter provides a list of Safety Standards adhered to by the Telemetry Monitor 5500 as well as technical specifications.

11.1 Safety Standards

Medical electrical equipment - Part 1: General requirements for basic safety and essential performance IEC 60601-1:2014-Ed. 3.0
Medical electrical equipment - Part 1-2: General requirements for basic safety and essential performance - Collateral standard: Electromagnetic compatibility - Requirements and tests IEC 60601-1-2:2014+AMD1:2020 EN 60601-1-2:2015+AMD1:2021
Medical electrical equipment - Part 1-6: General requirements for basic safety and essential performance - Collateral standard: Usability IEC 60601-1-6:2010 + A1:2013 + A2:2020
Medical electrical equipment - Part 1-8: 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 EN 60601-1-8:2007 + A1:2013 + AC:2014 + AMD11:2017 + A2:2021
Medical electrical equipment - Part 2-27: Particular requirements for the basic safety and essential performance of electrocardiographic monitoring equipment IEC 60601-2-27:2011
Medical device software - Software life cycle processes IEC 62304:2006 + AMD1:2015
Medical devices - Part 1: Application of usability engineering to medical devices IEC 62366-1:2015 + AMD1:2020
Medical electrical equipment - Part 2-49: Particular requirements for the basic safety and essential performance of multifunction patient monitors IEC 80601-2-49:2019
Medical electrical equipment - Part 2-61: Particular requirements for basic safety and essential performance of pulse oximeter equipment ISO 80601-2-61:2019
UL Standard for Safety for Household and Commercial Batteries UL 2054, Second Edition

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Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications - Part 2: Lithium systems IEC 62133-2:2017
NOTICE! Where applicable, the 5500 complies with the country and/or regionally adopted versions of the above international (IEC or ISO) standards, including modifications, if any, for United States (ANSI/AAMI)

11.2 Network Risk Management for the 5500

WARNING

- **The 5500 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 PIC iX. The 5500 sends ECG and optional pulse oximetry data to the PIC iX, which then 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 5500 regardless of the connection to the PIC iX.**
- **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 PIC iX is not clinically acceptable for certain patients, alternatives must be sought. As the 5500 does not provide a wired network connection, we would recommend the use of an IntelliVue patient monitor with a wired connection to the PIC iX for these patients.**

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 5500 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 PIC iX, 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 coverage area 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 5500 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 5500 experiences loss of network connectivity, technical alarms at the PIC iX (No Signal or No Data Tele) and at the 5500 (No Central Monit.) will occur. The 5500 will also automatically revert to local monitor mode which activates display of patient data on the 5500 – however, when in this state, battery life will be shortened.**

11.3 Physical Specifications

Physical Specifications of the Telemetry Monitor 5500 are as follows:

Measurement	Specification
Height	138 mm (5.43 in)
Width	70 mm (2.75 in)
Depth	25 mm (0.98 in)
Weight	
• Without batteries, includes SpO_2	< 175 g (6.2 oz)
• Battery Tray without AA batteries	< 26 g (0.9 oz)
• Lithium ion battery	< 75 g (2.65 oz)
Display	
• Type	• QVGA Color LCD
• View Area	• 43.2 mm x 57.6 mm (1.70" x 2.26")
• Dimensions at widest point	• 138.0mm x 70.0mm x 25.6mm (HxWxD) +/- 2%
• Resolution	• 240 x 320
• Backlight	• White LED
Alarm Signal Sound Pressure Level at minimum volume, on network	≥ 45 dB(A) to ≤ 70 dB(A) at minimum altitude (sea level) for red alarms ≥ 42 dB(A) to < 60 dB(A) at minimum altitude (sea level) for yellow alarms ≥ 42 dB(A) to < 55 dB(A) at minimum altitude (sea level) for INOP volume
Alarm Signal Sound Pressure Level at maximum volume, off network	≥ 55 dB(A) to ≤ 70 dB(A) at minimum altitude (sea level) for red alarms ≥ 42 dB(A) to < 60 dB(A) at minimum altitude (sea level) for yellow alarms ≥ 42 dB(A) to < 55 dB(A) at minimum altitude (sea level) for INOP volume
Alarm Signal Sound Pressure Level, volume set to 0, on network	0 dBA (Off) for red and yellow alarms and INOPs. When the volume is set to 0, only INOPs in the form of text messages will be available.

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Measurement	Specification
Sound level priority Volume priority based on the limits of human perception in the operating environment, actual sound pressure level measurement comparisons can be within ± .5 dB	Red alarm volume is > yellow alarm volume. Yellow alarm volume is ≥ short yellow alarm and is > INOP volume, which is preserved in the alarm volume control.

11.4 Environmental Specifications

Measurement	Specification
Temperature	
Operating	0 to 37 °C (32 to 99 °F)
Surface Temperature	The 5500 does not exceed 41 °C (106 °F) when touched continuously.
Storage and Transportation	-30 °C (-22 °F) to 60 °C (140 °F) without batteries.
Humidity	
Operating	15% Relative humidity (RH) to 95% RH non-condensing.
Storage and Transportation	5% RH to 90% RH without batteries.
Altitude Range (Operating)	-500 m to 3,000 m
Pressure	
Transport Storage Atmospheric Pressure	50 to 106 kPa [8]
Mechanical Shock	According to ISO 80601-2-61, the 5500 operates after a stress condition, with no structural change.
Vibration	According to ISO 80601-2-61, the 5500 operates after a stress condition, with no structural change.
Push, Impact, Drop, Molding Stress Relief	According to IEC 60601-1 for Body Worn Devices, the 5500 operates after a stress condition, with no structural change.
Water Resistance	The device itself and the rechargeable battery are rated for Ingress Protection IPX8 defined as submersion in 1 m of water for 35 minutes.

(8) At normal conditions this correlates to an operating atmospheric pressure rang of approximately 70 to 106 kPa.

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11.5 Measurement Specifications

Essential Performance Characteristics

This section defines the essential performance for the 5500.

- The 5500 provides Essential Performance (EP) under normal operating conditions (includes EMC exposure) only as a complete Medical Electrical System, consisting of the Patient-Connected Device, Philips approved network and the PIC iX.
- The 5500 protects the patient from unacceptable immediate clinical risk by generating specific Physiological Alarms when appropriate. If the system cannot generate Physiological Alarms, then a Technical Alarm (INOPs) characterized as relevant “Severe” or “Hard-Level” will be generated.

Additional essential performance requirements may be specified in particular standards of IEC 60601-1 series. In case of conflicting essential performance requirements between parameter specific particular standards (e.g. IEC 60601-2-27 for ECG) and the particular standard for multifunction patient monitoring equipment (IEC 80601-2-49), the essential performance requirement of the parameter specific particular standard for the respective parameter take priority over the essential performance requirements of the particular standard for multifunction patient monitoring equipment. For example the essential performance requirements in IEC 60601-2-27 take priority for ECG, ISO 80601-2-61 take priority for SpO_2, etc. If there is no parameter specific particular standard, then the essential performance requirements of IEC 80601-2-49 apply.

Under normal and single fault conditions either at least the performance/ functionality listed in the tables below is provided or failure to provide this performance/ functionality is readily identifiable by the user (e.g. technical alarm, no waves and/ or numeric values, complete failure of the monitor, readily identifiable distorted signals, etc.).

The following table also represents the minimum performance when operating under non-transient electromagnetic phenomena according to IEC 60601-1-2:

- Radiated electromagnetic fields.
- Conducted disturbances induced by RF fields.
- Conducted disturbances induced by magnetic fields.

As a battery-powered device, the following non-transient electromagnetic phenomena according to IEC 60601-1-2 are not in scope.

- Voltage dips/voltage variations.

The risks and their assessment are provided in detail in the risk matrices in chapter “4 Risk Management Summary Matrices”. This shows how these risks are addressed; including appropriate mitigations in order to avoid/minimize situations that may result in unacceptable risks. That is how risk severities are considered as a part of essential performance.

Essential performance under normal operating conditions

Parameter	Essential Performance
General	No unforeseen loss of monitoring
	No operation by itself/without user interaction
	Visual and auditory alarm indications
ECG	Measurement of heart rate within ±10% or ±5 bpm, whichever is greater
	Alarming on Asystole, or heart rate limit violation within specified delay time
	Detection of VFIB and alarming on it
Respiration	Measurement of respiration rate within specified accuracy/error limits
	Alarming on Apnea and on respiration rate limit violation
SpO_2	Measurement of oxygen saturation within $4\%_{RMS}$ over the range from 70 to 100% and pulse rate within ±10% or ±5 bpm, whichever is greater
	Alarming on oxygen saturation and pulse rate limit violation

The following table identifies minimum performance for defibrillation and the following transient electromagnetic phenomena according to IEC 60601-1-2:

- Electrostatic Discharge (ESD)
- Electrical Fast Transients/Bursts
- Electrosurgery (ESU)

Essential performance for defibrillation and transient electromagnetic phenomena

Parameter	Essential Performance
All	After electrostatic discharge, fast transients/ bursts and defibrillation the equipment returns to previous operation mode within 30 seconds without operator intervention and without loss of any stored data.

As a battery-powered device with the exclusion of being used during electrosurgery, the following transient electromagnetic phenomena according to IEC 60601-1-2 are not in scope.

- Surges
- Voltage interruptions

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ECG

Measurement	Specification
ECG channel transmitted Leads	
3 electrodes	Channel #1 = I, II, or III
5 electrodes, Standard	Channel #1 = II Channel #2 = III Channel #3 = MCLa
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 (5500 and PIC iX monitors)
ECG Input, Defib Protection (Type CF)	Differential, defib protected against 360 joules discharge into a 100 Ω load. Supports one defib pulse of equivalent energy at 360 joules applied to each ECG Lead independently per IEC60601-2-27. Defib protection resistance, less than 1% change in Defib protection resistor after applied Defib pulse. Meets ANSI/AAMI/IEC 60601-2-27 201.8.5.5.1 Meets IEC60601-1 clause 8.9.1.5 & 8.9.1.15, creepage and clearance distances for high voltage separation distance at altitude of 3000 meters.
Input Impedance	> 5 MΩ (@ 10 Hz)
Input Dynamic Range	± 9 mV
DC Offset Range	± 320 mV
Common-Mode Rejection Ratio (CMRR)	≥ 90 dB @ 50, 60 Hz (Note: active RL-drive is used for best CMRR performance.)
Bandwidth +/- 3 dB	0.05 to 40 Hz (ST bandwidth)
Gain Accuracy	± 5% at 25 °C (77 °F)
Noise Referred to ECG Input (Peak-to-Peak)	Association for the Advancement of Medical Instrumentation (AAMI): 30 µV (peak-to-peak), excludes external Electromagnetic Interference (EMI) condition Note: Test performed with LAB tools. AAMI test statistic apply (where 10:1 trial success is accepted)

Measurement	Specification
Noise Referred to ECG Input with external Electromagnetic Compatibility (EMC) condition	ECG noise ≤ 100 µV (peak-to-peak) (less than QRS min detection threshold at 150 µV) with IEC 60601-1-2 reduced immunity level.(9)
Noise referred to input for ST performance	75 µV, peak-to-average, measured at 500 sps input. **NOTE** This is the same rate used by ST/AR for analysis.
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)
Pacer Rejection Performance (10) (Pace pulses with no tails)	Positive pacers 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 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
EMC Performance Limits, radiated immunity	Meets Essential Performance.
EMC Performance, Electrostatic Discharge (ESD) immunity	ESD protection incorporated to control impact to pacer and ECG noise performance.
ECG Leadset Disconnection Safety	All ECG connections are patient safe within 750 msec of Leadset 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 40 µA maximum per lead. Total patient auxiliary current <10 µA.
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 <10 µA for all conditions.

(9) ECG Noise & ST Performance is defined to include the operation with the internal radio at max RF power levels from the 5500.

(10) Philips cannot claim, verify or validate support for all available pacemakers. ECG noise & ST performance includes operation with radio at max Rf level.

ECG Performance Disclosure/Specifications

Measurement	Specification
Response Time of Heart Rate Meter to Change in Heart Rate	Using test waveform as indicated in ANSI/AAMI/IEC 60601-2-27 201.7.9.2.9.101 b)5) a) For a rate increase, the average time to reach the specified heart rate (80 bpm to 120 bpm) is 10 seconds. b) For a rate drop 80 bpm to 40 bpm, the average time is 7 seconds.
Heart Rate Numeric (range, resolution and accuracy)	a) Heart Rate numeric range: 15 bpm to 300 bpm (Adult, Pedi) b) The resolution is 1 bpm and the accuracy ± 1% of the range. The beat detection sensitivity is ≥ 200 µV peak. c) For heart rates less than 15 bpm the value is 0 bpm.
Heart Rate Averaging Method	Three different methods are used: 1. Normally, heart rate is computed by averaging the 12 most recent R-R intervals. 2. For runs of PVCs, up to 8 R-R intervals are averaged to compute the HR. 3. If each of three consecutive R-R intervals is greater than 1200ms (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 using test waveforms as indicated in ANSI/AAMI/IEC 60601-2-27 201.7.9.2.9.101 b)4). Provides correct heart rates within HR accuracy.
Time to Alarm for Tachycardia	The ranges of time to alarm using test waveforms as indicated in ANSI/AAMI/IEC 60601-2-27 201.7.9.2.9.101 b)6) are 4 to 5 seconds.
Range and Accuracy of Heart Rate Meter	Heart rate range is 15 bpm to 300 bpm (Adult, Pedi) The resolution is 1 bpm and the accuracy ±1% of the range. The beat detection sensitivity is ≥ 200 µV peak. For heart rates less than 15 bpm, the value is 0 bpm.
QRS Detection Threshold	150 µV minimum, adjustable.
Alarm Limit Range - Low Limit	Low alarm limit is 15 - 295 bpm, increments of 5 bpm for HR ≥ 40 bpm adult, and HR > 50 bpm ped. HR < 40 bpm, increment set to 1 bpm adult. HR < 50 bpm, increment in 1 bpm ped.
Alarm Limit Range - High Limit	High alarm limit is 16-300 bpm, increments of 5 bpm HR > 40 bpm adult, and HR > 50 bpm ped.
Resolution of Alarm Limit Settings	Meets the IEC 60601-2-27 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 IEC 60601-2-27 standard. Error less than ±10% or ±5 bpm

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Measurement	Specification
Time to Alarm for Cardiac Standstill	Meets the IEC 60601-2-27 standard: maximum alarm time <10 seconds, using the test waveforms as indicated.
Time to Alarm for Low Heart Rate	Meets the IEC 60601-2-27 standard: maximum alarm time <10 seconds, using the test waveforms as indicated.
Time to Alarm for High Heart Rate	Meets the IEC 60601-2-27 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.
Input Signal Reproduction Accuracy: Overall Error	-2.9%. Meets the IEC 60601-2-27 standard: maximum = ±20%.
Frequency Response Sinusoidal	0.67 to 40 Hz (3 db down). Displayed at the 5500 and PIC iX.
Frequency Response Triangular	0 to 25% reduction. Displayed at the 5500 and PIC iX.
Impulse Response: (for waves marked with ST bandwidth)	Displacement = 0.08 mV, slope = 0.11 mV/s. Meets the IEC 60601-2-27 standard: displacement maximum = 0.1 mV; slope maximum = 0.30 mV/s.
Pacemaker Pulse Display Capability	Minimum = 0.2 mV RTI. Displayed at the 5500 and the PIC iX.
Tall T-Wave Rejection Capability	Meets ANSI/AAMI/IEC 60601-2-27 clause 201.12.1.101.17: Bandwidth 0.5 – 40 Hz: 1.8mV maximum T-wave amplitude Bandwidth 0.05 – 40 Hz: 0.8mV maximum T-wave amplitude

ECG, Resp and Pleth Display Specifications

The following table lists ECG, Resp, and Pleth parameters for various display configurations.

Parameter	Two waves with two numerics Or One wave with four numerics	Two waves with three numerics	One wave (RESP and SpO2 disabled, 3 wire leadset.)	One wave (RESP SpO2 disabled, 3 wire leadset.)	Multi-wave with one numeric
Orientation	**Portrait**	**Landscape**	**Portrait**	**Landscape**	**Landscape**
ECG Sensitivity @ Gain X4	10.0 mm/mV ±10%	5.0 mm/mV ±10%	20.0 mm/mV ±10%	10.0 mm/mV ±10%	5.0 mm/mV ±10%
ECG Sensitivity @ Gain X2	5.0 mm/mV ±10%	2.5 mm/mV ±10%	10.0 mm/mV ±10%	5.0 mm/mV ±10%	2.5 mm/mV ±10%
ECG Sensitivity @ Gain X1	2.5 mm/mV ±10%	1.25 mm/mV ±10%	5.0 mm/mV ±10%	2.5 mm/mV ±10%	1.25 mm/mV ±10%
ECG Sensitivity @ Gain X1/2	1.25 mm/mV ±10%	0.625 mm/mV ±10%	2.5 mm/mV ±10%	1.25 mm/mV ±10%	0.625 mm/mV ±10%
Sector Size	75 pixels (13.5 mm)	47 pixels (9.1 mm)	150 pixels (27 mm)	110 pixels (19.8 mm)	38 pixels (6.84 mm)
ECG and Pleth wave sweep speed	10 mm/s ±10%	10 mm/s ±10%	10 mm/s ±10%	10 mm/s ±10%	10 mm/s ±10%
ECG and Pleth alternative sweep speed	25 mm/s ±10%	25 mm/s ±10%	25 mm/s ±10%	25 mm/s ±10%	25 mm/s ±10%
RESP wave sweep speed	2.5 mm/s ±15%	2.5 mm/s ±15%	2.5 mm/s ±15%	2.5 mm/s ±15%	2.5 mm/s ±15%

NOTE

- Signal Range can be calculated by multiplying sensitivity with sector size.
- Display sweep speed for ECG or Pleth is within ±10% accuracy, equivalent to IEC60601-2-27 (clause 201.12.1.101.7).
- Display sweep speed for Resp is within ±15% accuracy.
- ECG display Aspect ratio meets IEC60601-2-27 (clause 201.12.1.101.16, < 0.4s/mV).

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Respiration

Measurement	Specification
Leads Used for Measurement	RA, LL (standard)
Range	Adult/Pediatric: 0 to 120 rpm
Bandwidth	0.3Hz to 2.5Hz (-6dB)
Noise	Less than 25 mOhm (rms) referred to the input
Cardiac Overlay Artifact Suppression	Automatic suppression of ecg QRS artifacts over the range 15 – 350 bpm ±20% deviation from respiration rate Respiration amplitude > 1 Ohm
Test Signal	Adult: 15 rpm ±2 Pedi: 30 rpm ±2
Calibration Signal	Signal: 1 Ohm p-p; Accuracy: ±20%
Resolution of Respiration Rate	Resolution is 1 rpm
Accuracy of Respiration Rate	Accuracy is ±1 rpm for 0 to 120 rpm
EMC	Meets EMC Standard EN60601-1-2 (Radiated Immunity, 3V/m)
Auxiliary current, Respiration excitation signal	<470uA rms @48kHz, sinusoidal waveform, compliant with IEC60601-1 clause 8.7.3 as test circuit applies 30dB attenuation at 48KHz, (effective current is 470uA/ 10(30/20) = 15uA rms at 0.1Hz)

Respiration Alarms

Alarm	Range	Delay
High	Adult/Pediatric: 10 to 100 rpm	≤15 s
Low	Adult/Pediatric: 0 to 95 rpm	for limits from 0-20 rpm: ≤4 s for limits above 20 rpm: ≤15 s
Apnea Alarm	10 to 40 seconds	The Apnea alarm delay with PIC iX depends on the user-configured Apnea time (10-40 seconds). The actual delay may increase by 6 seconds of set delay (i.e 16 s to 46 s overall delay).

Philips FAST

Measurement	Specification
SpO_2 Measurement Range (Calibration and Display)	0 to 100%
SpO_2 Accuracy	±2% (1 Standard deviation) with Philips reusable sensor (M1191B, M1192A): 70-100%[11] See "SpO_2 Accessories" on page 201 for other sensor types.
SpO_2 Resolution	1%
SpO_2 Numerics - Averaging	Averaging of SpO_2 numerics is 5, 10, and 20 seconds (Default=10 seconds)
SpO_2 & Pulse Numerics - Update Rate	Typical numeric update rate is ~1 sec. The maximum numeric update rate is ≤30 s if NBP INOP suppression is off or ≤60 s if NBP INOP suppression is on.
Pleth Wave-Sampling Rate	125 sps typical
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
Pulse Rate Measurement	Range: 30 to 300 bpm Resolution: 1 bpm Accuracy: ±2% or 1 bpm (whichever is greater) [12]
Display of SpO_2 numerics	SpO_2 data values will be displayed as xxx % SpO_2 or xxx SpO_2 to ISO 80601-2-61
Emitted Light Energy	≤15 mW

(11) The specified accuracy is the root-mean-square (RMS) difference between the measured values and the reference values.

(12) Reference method for the computation of the pulse rate accuracy is an electronic pulse simulator.

SpO2 Alarm Specs

Alarm	Range	Delay*
High	The time that the averaged SpO_2 needs to be above the limit before an alarm is activated. The range is from 0 to 30 seconds in 1-second intervals. The factory default is 10 seconds.	10 seconds
Low	The time that the averaged SpO_2 needs to be below the limit before an alarm is activated. The range is from 0 to 30 seconds in 1-second intervals. The factory default is 10 seconds.	10 seconds
Desat	The time that the averaged SpO_2 needs to be at the Desat limit before an alarm is activated. The range is from 0 to 30 seconds in 1-second intervals. The factory default is 20 seconds.	20 seconds
SpO2T No Pulse	N/A	0 to 35 seconds after displaying invalid data, noted by "?".

* Adjustable (in Configuration at the PIC iX) in 1 second steps. The delay time for alarm availability on the network is less than 5 seconds.

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11.6 Distributed Alarm System Delay Specification

For complete Distributed Alarms System Delay information and specifications, see the *Patient Information Center iX Instructions for Use*. Documentation can be found on InCenter. See "Accessing Paper and Electronic Documentation" on page 6.

11.7 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.

WARNING

- **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.**
- **The product should not be used next to or stacked with other equipment. If you must stack the product, you must check that normal operation is possible in the necessary configuration before the product is used on patients.**

Reducing Electromagnetic Interference

The 5500 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 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 5500 from the source as much as possible. If assistance is needed, contact your service team.

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 5500, with the requirements of IEC 60601-1-2.

Electromagnetic Emissions

Emissions Test	Compliance	Avoiding Electromagnetic Interference
Radio Frequency (RF) emissions	Group 1	The 5500 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 5500 is suitable for use in all establishments.
Voltage fluctuations/Flicker IEC 61000-3-3	Not Applicable	Device is battery powered only

Electromagnetic Immunity

The Telemetry Monitor 5500 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	Electromagnetic Environment Guidance
Electrostatic discharge (ESD) IEC 61000-4-2	±8 kV contact ±15 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%.
IEC 61Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	30 A/m	Power frequency magnetic fields should be a t levels characteristic of a typical location in a typical commercial and/or hospital environment
Radiated fields in close proximity IEC 61000-4-39	134.2 kHz; pulse modulation 2.1 kHz; 65 A/m 13.56 MHz; pulse modulation 50 kHz; 7.5 A/m	
Conducted RF IEC 61000-4-6	3 Vrms 0.15 to 80 MHz 6 Vrms in ISM bands	
Radiated RF IEC 61000-4-3	385 MHz, 18 Hz pulse modulation, 27 V/m (TETRA 400) 450 MHz, frequency modulation ±5 kHz with 1 kHz sine, 28 V/m (GMRS 460, FRS 460) 710 MHz, 745 MHz, and 780 MHz, 217 Hz pulse modulation, 9 V/m (LTE Band 13, 17) 810 MHz, 870 MHz, and 930 MHz, 18 Hz pulse modulation, 28 V/m (GSM 800/900, TETRA 800, iDEN 820, CDMA 850, LTE Band 5) 1720 MHz, 1845 MHz, and 1970 MHz, 217 Hz pulse modulation, 28 V/m 2450 MHz, 217 Hz pulse modulation, 27 V/m (Bluetooth, WLAN, 802.11 b/g/n, RFID 2450, LTE Band 7) 5240 MHz, 5500 MHz, and 5785 MHz, 217 pulse modulation, 9 V/m (WLAN 802.11 a/n) 3 V/m, 80-2700 MHz. 80% AM @1KHz	Required separation distance can be calculated by d=6*SQRT(P)/E. $E = \frac{6}{d}\sqrt{P}$ Where *P* is the maximum power in *W*, *d* is the minimum separation distance in *m*, and *E* is the Immunity Test Level in V/m.

WARNING

High EMC interference may result in the inability to turn the touch screen on and/or buttons may lockup.

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Recommended Separation Distance

WARNING

- **The 5500, 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.**
- **Portable RF communications equipment (including peripherals such as antenna cables and external antennas) should be used no closer than 30 cm (12 inches) to any part of the 5500, including cables specified by the manufacturer. Otherwise, degradation of the performance of this equipment could result.**

Portable and mobile RF communications equipment should be used no closer to any part of the 5500, 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:

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 5500 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 5500 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.

Electrosurgery Interference/Defibrillation/Electrostatic Discharge

WARNING

Do not expose the equipment to X-ray or strong magnetic fields (MRI).

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 5500 is not for use during electrosurgery.

Restart Time

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

11.8 1.4 GHz Smart-hopping Radio

The following table includes the Transmitter and Receiver Specifications for the 1.4 GHz Smart-hopping 2.0 radio and the Smart-hopping 1.0 radio, in compatibility mode.

Measurement	Specification
Frequency Ranges WMTS spectrum	Bands: 1395-1400 MHz and 1427-1432 MHz (see channel spacing table below)
Frequency Accuracy	<10ppm relative to channel frequency, includes temperature compensation & aging effects.
Supported Modulation Types	**Smart-hopping 2.0 (compatibility mode):** Gaussian frequency-shift keying (GFSK) **Smart-hopping 2.0:** Pi/2-Differential Binary Phase-Shift Keying (DBPSK) Pi/4-Differential Quadrature Phase-Shift Keying (DQPSK)
99% Power Occupied Bandwidth	**Smart-hopping 2.0 (compatibility mode):** GFSK: ≤1600 kHz **Smart-hopping 2.0:** PSK: ≤1800 kHz
Signal Rate	1.152 MHz
Received Signal Strength Indicator (RSSI) Algorithm	Operates over Receiver range –95dBm to –40dBm. The RSSI is calibrated to +/-4dB accuracy
Conducted Rx Sensitivity at 10% BER	**Smart-hopping 2.0 (compatibility mode):** GFSK: < -87 dBm **Smart-hopping 2.0:** Pi/2-DBPSK: < -87 dBm Pi/4-DQPSK: < -86 dBm

The following tables show the Channel Number and frequencies for Smart-hopping 1.0 and Smart-hopping 2.0 in Compatibility mode.

Smart-hopping 1.0 and Smart-hopping 2.0 (Compatibility mode)			
Channel Number	**Start of Channel**	**Middle of Channel**	**End of Channel**
Channel 1	1395.0977MHz	1395.8977MHz	1396.6977MHz
Channel 2	1396.6970MHz	1397.4970MHz	1398.2970MHz
Channel 3	1398.2963MHz	1399.0963MHz	1399.8963MHz
Channel 4	1427.0979MHz	1427.8979MHz	1428.6979MHz
Channel 4a	1429.4410MHz	1430.2410MHz	1431.0410MHz
Channel 5	1428.6972MHz	1429.4972MHz	1430.2972MHz
Channel 6	1430.2965MHz	1431.0965MHz	1431.8965MHz

Smart-hopping 2.0			
Channel Number	**Start of Channel**	**Middle of Channel**	**End of Channel**
Channel 14	1395.7720MHz	1396.636 MHz	1397.5000MHz
Channel 15	1397.5000MHz	1398.364 MHz	1399.2280MHz
Channel 16	1427.6490MHz	1428.513 MHz	1429.3770MHz
Channel 17	1429.3770MHz	1430.241 MHz	1431.1050MHz

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1.4 GHz 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.

NFC tag

The 5500 contains a passive Near-Field Communication (NFC) tag mounted in the rear housing behind the primary label to support device pairing.

Parameter	Specification
NFC Tag Type	Passive NFC Tag ISO 1443A/B and NFC Forum Tag Type II compliant
Frequency	13.56 MHz, bandwidth ±7KHz
Data rate	106 to 424 Kbit/s
Operating Range	approx. 5 mm
Programming	The NFC Tag shall be factory programmed with device information.

11.9 Battery Specifications

Battery Life

NOTE

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

Battery Life - AA Batteries

The battery life specifications listed below are based on the use of three Duracell MN1500 AA batteries. Battery life for other brands may differ.

Telemetry Mode Networked (Display Off)	Battery Life
ECG only (SpO_2 Off)	>46 hours
ECG/SpO_2 Continuous	>24 hours
Monitor Mode Networked (Display On)	**Battery Life**
ECG Only (SpO_2 Off)	>12 hours
ECG/SpO_2 Continuous	>7 hours
Monitor Mode Non-networked (Display On)	**Battery Life**
ECG only (SpO_2 Off)	>5 hours
ECG/SpO_2 Continuous	>4 hours

- **Battery life with ECG and SpO2 Auto mode:** In SpO_2 Auto mode battery life depend on auto time setting, the battery life will be between "ECG Only" battery life and "ECG/SpO_2 (Continuous)" battery life.
- **Battery life with ECG and SpO2 manual mode:** In SpO_2 manual mode battery life depend on usage rate, will be between "ECG Only" battery life and "ECG/SpO_2 (Continuous)" battery life.

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Battery Life - Lithium Ion Batteries

The battery life specifications listed below are based on the use of the Philips rechargeable lithium ion battery.

Lithium ion battery life is specified at the normal use room temperature (20°C to 25°C) with a new fully charged 5500 lithium ion Battery. 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.

Telemetry Mode Networked (Display Off)	Battery Life
ECG only (SpO_2 Off)	>30 hours
ECG/SpO_2 FAST Continuous	>15 hours
Monitor Mode Networked (Display On)	**Battery Life**
ECG Only (SpO_2 Off)	>12 hours
ECG/SpO_2 FAST Continuous	>10 hours
Monitor Mode Non-networked (Display On)	**Battery Life**
ECG only (SpO_2 Off)	>7 hours
ECG/SpO_2 FAST Continuous	>6 hours

- **Battery life with ECG and SpO2 Auto mode:** In SpO_2 Auto mode battery life depend on auto time setting, the battery life will be between “ECG Only” battery life and “ECG/SpO_2 (Continuous)” battery life.
- **Battery life with ECG and SpO2 manual mode:** In SpO_2 manual mode battery life depend on usage rate, will be between “ECG Only” battery life and “ECG/SpO_2 (Continuous)” battery life.

Lithium Ion Battery Charge Time

Definition	Charging Method	Charge Time
The lithium ion battery charge time from 90% depletion state	The lithium ion battery is charged on a separate external battery charger. It must be removed from the 5500 to charge.	6 hours

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11.10 Safety Symbols and Other Marks

The table below describes the safety symbols and other markings present on the Telemetry Monitor 5500 and the Philips rechargeable lithium ion battery.

 Manufacturer - Indicates the manufacturer.

 Prescription Device - U.S. Federal Law restricts this device to sale by or on the order of a medical practitioner.

 Refer to instruction manual/booklet - Signifies that the instruction manual/booklet must be read.

 Consult Instructions For Use (IFU) - Indicates the need for the user to consult the instructions for use.

 Caution - Indicates that caution is necessary when operating the device or control close to where the symbol is placed, or that the current situation needs operator awareness or operator action in order to avoid undesirable consequences.

 MR Unsafe - Indicates that the item poses unacceptable risks to the patient, medical staff or other persons within the MR environment.

 Defibrillation-proof type CF applied part - Identifies a defibrillation-proof type CF applied part complying with IEC 60601-1.

 Catalogue number - Indicates the manufacturer's catalogue number so that the medical device can be identified.

 Serial number - Indicates the manufacturer's serial number so that a specific medical device can be identified.

 Technical Part Number - Indicates the technical part number of the labeled component/part.

 Machine Access Code - Indicates the unique 12-digit hexadecimal number assigned to each product connected to a network.

 Unique device identifier - Indicates a carrier that contains unique device identifier information.


2D Barcode - contains information in horizontal and vertical 2-dimensional format.

Country of manufacture - Identifies the country of manufacture of products.

Batch code - Indicates the manufacturer's batch code so that the batch or lot can be identified.


Use-by date - Indicates the date after which the medical device is not to be used.


Packaging unit - Indicates the number of piece in the package.


ECG connector - Indicates that the product has an ECG connector.

FAST SpO_2 - Indicates the device supports FAST SpO_2 technology.


Temperature limit - Indicates the temperature limits to which the medical device can be safely exposed.


Humidity limitation - Indicates the range of humidity to which the medical device can be safely exposed.


Atmospheric pressure limitation - Indicates the range of atmospheric pressure to which the medical device can be safely exposed.


NFC Reader - Indicates the location of a Near Field Communication Reader.

Ingress Protection - Followed by two alphanumeric indicates the degree of ingress protection grade. The two characters represent different forms of environmental influence: The first digit represents protection against ingress of solid objects. The second digit represents protection against ingress of liquids.

Battery Polarity - Refers to the positive and negative ends of a battery.


FCC Declaration of Conformity 47 CFR 15 - Indicates product radio electromagnetic interference is under limits and approved by the FCC.

Federal Communications Commission (FCC) Identification Number.

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UL Classified Mark - Indicates that the device is UL certified for Canada and the US.

Canadian Standards Association Mark Canada, US - Indicates that the device was tested and has met the certification requirements for electrical or mechanical products.

12 Accessories

This chapter lists the accessories for use with the Telemetry Monitor 5500. Accessories are subject to change. Some accessories are not supplied by Philips.

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

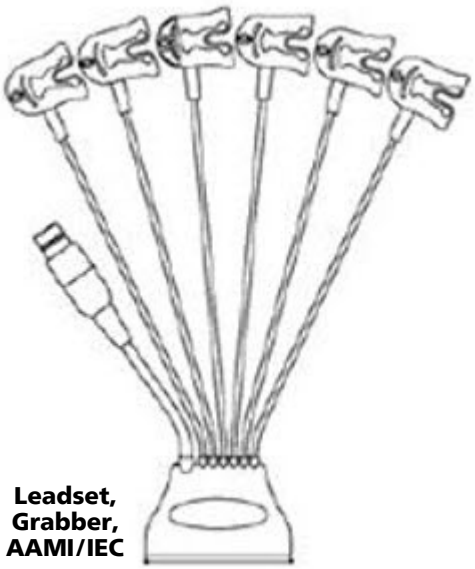
WARNING

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

12.1 ECG Accessories

Leadsets and Patient Cables

Reusable ECG/Pulse Oximetry (SpO2) Accessories



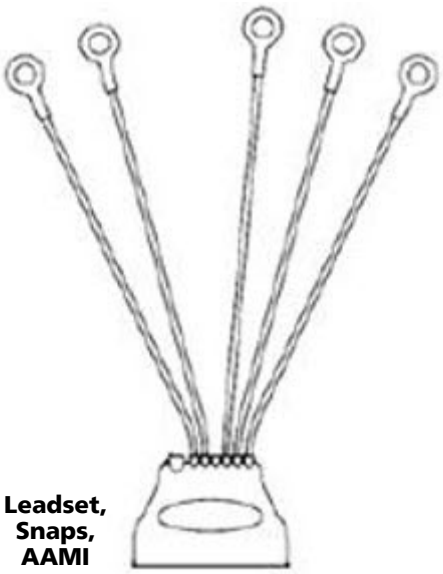
Leadset, Grabber, AAMI/IEC

Leadsets are 85 cm (33.5")

Order Number	Product Description
989803171811	ECG 3 lead grabber AAMI + SpO_2, Tele
989803171831	ECG 5 lead grabber AAMI, Tele
989803171851	ECG 5 lead grabber AAMI + SpO_2, Tele
989803171871	ECG 6 lead grabber AAMI + SpO_2, Tele
989803171911	ECG 3 lead grabber IEC + SpO_2 , Tele
989803171931	ECG 5 lead grabber AAMI, Tele
989803171951	ECG 5 lead grabber IEC + SpO_2, Tele
989803171971	ECG 6 lead grabber IEC + SpO_2, Tele

Philips

Reusable ECG Only Accessories

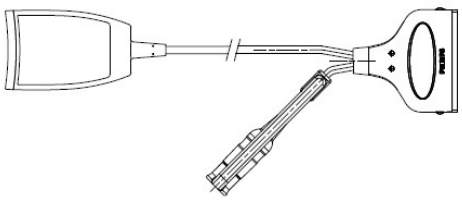


Leadset, Snaps, AAMI

Leadsets are 85 cm (33.5")

Order Number	Product Description
989803171821	ECG 5 lead snaps AAMI, Tele
989803171841	ECG 5 lead snaps AAMI + SpO_2, Tele

Combined ECG/SpO2 Adapters



Order Number	Product Description
989803199101	Philips Telemetry Adapter 3 lead + SpO_2
989803199091	Philips Telemetry Adapter 5 lead + SpO_2
989803199071	Philips Telemetry Adapter 6 lead + SpO_2
989803199081	Philips Telemetry Adapter SpO_2Only

Compatible Philips ECG Leadsets

Order Number	Product Description	Note
989803173121	3 leads disposable AAMI Bedside	Requires a combined ECG/SpO2 adapter.
989803173131	5 leads disposable AAMI Bedside	
989803173151	5 leads disposable AAMI Tele	Requires a combined ECG/SpO2 adapter. Has a silicone shower cover.
989803174201	3 leads disposable IEC Bedside	Requires a combined ECG/SpO2 adapter
989803174211	5 leads disposable IEC Bedside	
989803197511	6 leads disposable AAMI Bedside	
989803197521	6 leads disposable IEC Bedside	

12.2 SpO_2 Accessories

The following SpO_2 accessories are approved for use with 5500 devices equipped with the S02 option (SpO_2).

SpO2 Only Accessory

Combined ECG/SpO2 Adapter

Order Number	Product Description
989803199081	Philips Telemetry Adapter SpO_2 Only

Compatible SpO2 Sensors

NOTE

- The combination of the M1943A adapter cable and M1941A extension cable (2 m) can be replaced by M1943AL (3 m).
- Masimo sensors should only be used with Masimo validated SpO_2 cables.
- For SpO_2, the maximum overall length of the sensor + adapter cable + extension = 4 m.

Reusable Philips Sensors

The Telemetry Monitor 5500 is compatible with the SpO_2 sensors outlined in the table below. For details on each sensor, refer to the sensor-specific Instructions for Use (IFU).

In order to connect these sensors to the 5500, a reusable combined ECG/SpO_2 leadset is required.

Product Number	Product Description	Accuracy A_{rms} (%) (70-100%)	Adapter Cable	Optional Extension Cable
M1191B (989803144371)	Adult Finger Glove, >50 kg 2 m (6.6 ft) cable	2.0	No adapter cable required.	M1941A (2 m or 6.6 ft)
M1191BL (989803144381)	Adult Finger Glove, >50 kg 3 m cable (9.85 ft)	2.0	No adapter cable required.	No

Philips

Product Number	Product Description	Accuracy A_{rms} (%) (70-100%)	Adapter Cable	Optional Extension Cable
M1191T (989803128591)	Adult Finger Glove, >50 kg 0.45 m cable (1.5 ft)	3.0	M1943A (1 m or 3.25 ft)	No
M1192A (989803205871)	Pediatric/Small Adult Finger Glove, 15 kg to 50 kg, 1.5 m cable (5.0 ft)	2.0	No adapter cable required.	M1941A (2 m or 6.6 ft)
M1194A (989803205891)	Adult & Pediatric Ear Clip, >40 kg 1.5 m cable (5.0 ft)	3.0	No adapter cable required.	M1941A (2 m or 6.6 ft)
M1196A (989803205901)	Adult Finger Clip, >40 kg 3 m cable (9.85 ft)	3.0	No adapter cable required.	No
M1196T (989803205911)	Adult Finger Clip, >40 kg 0.9 m cable (3.0 ft)	3.0	M1943A (1 m or 3.25 ft)	No

Reusable Masimo Sensors

The Telemetry Monitor 5500 is compatible with the sensors outlined in the table below. For details on each sensor, refer to the sensor-specific Instructions for Use (IFU).

In order to connect these sensors to the 5500, a reusable combined ECG/SpO_2 leadset or pigtail adapter is required.

Product Number	Product Description	Accuracy A_{rms} (%) (70-100%)	Adapter Cable	Optional Extension Cable
LNCS TC-I	LNCS Tip-Clip Ear >30 kg Reusable Sensor	3.5	LNC MP10 3 m (10 ft) (989803148221) LNC MP4 1.20 m (4 ft)	N/A
LNCS YI	LNCS YI, multi-site sensor >1 kg	3.0	LNC MP10 3 m (10 ft) (989803148221) LNC MP4 1.20 m (4 ft)	
M-LNCS YI	Reusable Multi-Site Sensor: foot or hand, for patients between 1 kg and 3 kg foot, toe, hand, finger, for patients >3 kg	3.0	M-LNC MP4 M-LNC MP10	
M-LNCS TC-I	Reusable Ear Sensor ear lobe or pinna, for patients >30 kg	3.5	M-LNC MP4 M-LNC MP10	
RD SET TC-I	RD SET Tip-Clip Ear Reusable Sensor, for patients >30 kg	3.5	RD SET MP5 RD SET MP12	

Philips

Disposable Philips Sensors

The Telemetry Monitor 5500 is compatible with the SpO_2 sensors outlined in the table below. The sensors are disposable and for Single Patient Use.

NOTE

The sensors' product descriptions reflect all their compatible populations and application sites. However, when used with the Telemetry Monitor 5500, the sensors must be used in accordance with its intended use and indications. The Telemetry Monitor 5500 is only intended for use in adult and pediatric (child and adolescent) patients[13]. See "Contraindications" on page 17. For details on each sensor, refer to the sensor-specific Instructions for Use (IFU).

Part Number	Product Description	Accuracy A_{rms} (%) (70-100%)	Adapter Cable	Optional Extension Cable
M1131A (989803205831)	Adult/Pediatric Finger Clip, >20 kg, 0.9 m (3 ft) cable	3.0	M1943A (1 m)	M1941A (2 m)
M1132A (989803205841)	Infant[14], Finger/Toe Wrap, 3 kg to 10 kg, 0.9 m (3 ft) cable	2.0		
M1133A (989803205851)	Neonatal[14] Foot/Hand, Infant[14] Toe/Thumb, Adult Finger Wrap, 0.9 m (3 ft) cable foot or hand, for neonatal patients less than 3 kg big toe or thumb, for patients between 10 kg and 20 kg any finger except thumb, for patients >40 kg	2.0		
M1134A (989803205861)	Adhesive-free Neonatal[14] Foot/Hand, Infant[14] Toe/Thumb, Adult Finger Wrap, 0.9 m (3 ft) cable foot or hand, for neonatal patients less than 3 kg big toe or thumb, for patients between 10 kg and 20 kg any finger except thumb, for patients >40 kg	2.0		
Philips FAST only Alar Sensor (989803205381)	Adult/Pediatric Nasal Alar Clip FAST Only, >15 kg, 0.9 m (3 ft) cable	3.0		
Philips Multi-compatible Alar Sensor (989803205391 and 989803205401)	Adult/Pediatric Nasal Alar Clip MLT CPTL, >15 kg, 0.9 m (3 ft) cable	3.0		

(13) The US Food and Drug Administration defines pediatric subpopulations as: Children - 2 years to less than 12 years old, and Adolescents - aged 12 through 21.

(14) The Telemetry Monitor 5500 is intended for use with pediatric and adult patients only.

Disposable Masimo Sensors

The Telemetry Monitor 5500 is compatible with the sensors outlined in the table below. The sensors are disposable and for Single Patient Use.

NOTE

The sensors' product descriptions reflect all their compatible populations and application sites. However, when used with the Telemetry Monitor 5500, the sensors must be used in accordance with its intended use and indications. The Telemetry Monitor 5500 is only intended for use in adult and pediatric (child and adolescent) patients[15]. See "Contraindications" on page 17. For details on each sensor, refer to the sensor-specific Instructions for Use (IFU).

Part Number	Product Description	Accuracy A_{rms} (%) (70-100%)	Adapter Cable	Optional Extension Cable
LNCS ADTx	Adult Adhesive Sensor, 18 in (.46 m): finger, for patients >30 kg	3.0	LNC MP10 (10 ft) (989803148221), LNC MP4, 4 ft (1.22 m)	N/A
LNCS ADTx-3	Adult Adhesive Sensor, 3 ft (.91 m): finger, for patients >30 kg			
LNCS PDTx	Pediatric Adhesive Sensor, 18 in (.46 m): finger, for patients between 10 kg and 50 kg			
LNCS PDTx-3	Pediatric Adhesive Sensor, 3 ft (.91 m): finger, for patients between 10 kg and 50 kg			
LNCS Inf	Infant[16] Adhesive Sensor, 18 in (.46 m): great toe, for patients between 3 kg and 20 kg			
LNCS Inf-3	Infant[16] Adhesive Sensor, 3 ft (.91 m): great toe, for patients between 3 kg and 20 kg			
LNCS Inf-L	Infant[16] Adhesive Sensor: great toe or thumb, for patients between 3 kg and 20 kg			
M-LNCS Adtx	Adult Adhesive Sensor, 18 in (.46 m): finger or toe, for patients >30 kg		M-LNC MP4, M-LNC MP10	
M-LNCS Adtx-3	Adult Adhesive Sensor, 3 ft (.91 m): finger or toe, for patients >30 kg			

(15) The US Food and Drug Administration defines pediatric subpopulations as: Children - 2 years to less than 12 years old, and Adolescents - aged 12 through 21.

(16) The Telemetry Monitor 5500 is intended for use with pediatric and adult patients only.

Disposable Masimo Sensors cont.

Part Number	Product Description	Accuracy A_{rms} (%) (70-100%)	Adapter Cable	Optional Extension Cable
M-LNCS Pdtx	Pediatric Adhesive Sensor, 18 in (.46 m): finger or toe, for patients between 10 kg and 50 kg	3.0	M-LNC MP4, M-LNC MP10	N/A
M-LNCS Pdtx-3	Pediatric Adhesive Sensor, 3 ft (.46 m): finger or toe, for patients between 10 kg and 50 kg			
M-LNCS Inf	Infant(17) Adhesive Sensor, 18 in (.46 m): great toe or thumb, for patients between 3 kg and 20 kg			
M-LNCS Inf-3	Infant(17) Adhesive Sensor, 3 ft (.91 m): great toe or thumb, for patients between 3 kg and 20 kg			
M-LNCS Inf-L	Infant(17) Adhesive Sensor: great toe or thumb, for patients between 3 kg and 20 kg			
M-LNCS Trauma	Specialty, Adult Sensor: finger or toe, for patients >30 kg			
RD SET ADT	Adult Adhesive Sensor: finger or toe, for patients >30 kg	2.0	RD SET MP5, RD SET MP12	
RD SET PDT	Adult Adhesive Sensor: finger or toe, for patients between 10 kg and 50 kg			
RD SET Inf	Infant(17) Adhesive Sensor: thumb or great toe, for patients between 3 kg and 10 kg. Finger or toe, for patients between 10 kg and 20kg			
RD SET Trauma	Specialty, Adult Adhesive Sensor: finger or toe, for patients > 30 kg			

(17) The Telemetry Monitor 5500 is intended for use with pediatric and adult patients only.

12.3 Other Accessories

Batteries

Order Number	Product Description
989803208061	AA battery door adapter, pack of 3
989803207731	Philips rechargeable lithium ion battery, pack of 3

Electrodes

Order Number	Product Description
989803101671 (40493D)	Foam electrodes, 60 packages of 5 (300 per box)
989803101681 (40493E)	Foam electrodes, 10 packages of 30 (300 per box)
989803129091 (M4612A)	Solid gel electrodes, 5/pouch 300 per case
989803129101 (M4613A)	Solid gel electrodes, 5/pouch 300 per case
989803100491 (13951C)	Neo/Pediatric solid gel electrode, disp. 300/case
989803100581 (13955C)	Neo/Pediatric snap electrode, square, disp. 300/case

Pouches

Order Number	Product Description
989803210401	Protective Carry Pouch, box of 50
989803211031	Protective Carry Pouch, box of 200

13 Device Default Settings

This chapter documents the most important default settings of your Telemetry Monitor 5500 as it is delivered from the factory. The 5500's configuration settings can be changed permanently in Configuration Mode.

NOTE

At the time of writing this IFU, the defaults are as indicated.

For a comprehensive list and explanation of default settings, see the *Patient Information Center iX Clinical Configuration Guide* (use the guide that corresponds with your equipment revision). Documentation can be found on InCenter. See"Accessing Paper and Electronic Documentation" on page 6.

13.1 Configuration Default Settings at the 5500

Defaults are shown as **bold** in the table below.

Setting	Factory Default
Touch ToneVolume	1-5 **2**
Screen Color	**Blue** Green Aqua Purple Orange
Alarm Sounds	**Traditional** ISO
Unit Defaults	Confirm to return to unit default settings
Standby Time	Infinite 10 minutes 20 minutes 30 minutes **1 hour** 2 hours 3 hours 4 hours 6 hours 8 hours
Lock On Start	**Off** On

Setting	Factory Default
Lock Password	**Off** On

13.2 Alarm Default Settings

Alarm Setting	Factory Default	
Alarm Volume	On Network: 0 Off Network: 5	Configured at the 5500
Tone Modulation	Off	Configured at the 5500
Alarm Sounds	Traditional	Configured at the PIC iX
Pause Alarms	2 min.	
Alarm Reminder (Red, Yellow)	On	
Alarm Reminder (INOP)	On	
Reminder Time	3 min.	
ECG Leads Off (severity)	Yellow	
Replace Battery (severity)	Yellow	
Leadset Unplugged (severity)	Cyan	
No Pulse (severity)	Cyan	

13.3 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 Clinical Configuration Guide* (use the guide that corresponds with your equipment revision). Documentation can be found on InCenter. See "Accessing Paper and Electronic Documentation" on page 6.

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 & Yellow Yellow Only (red alarms must be turned off at the device) Not Allowed	Yellow Only

Control	Function	Setting Choices	Factory Default
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 acknowledged even if the condition no longer exists (applies to non-arrhythmia alarms only).	Red & Yellow Red Only	Red & Yellow
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 5500 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	Adjusts the severity level of this technical alarm (INOP).	Cyan Yellow Red	Cyan

Philips

Control	Function	Setting Choices	Factory Default
No Pulse	Adjusts 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
Standby Duration	Sets the standby duration time when Standby is selected at the PIC iX. **NOTE** Standby Duration can also be set at the 5500. The Standby time period may differ between the device and the default setting at the PIC iX. The duration is determined by the location of the Standby selection, i.e. placing the 5500 in Standby mode at the device or at the PIC iX. When the 5500 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 6 hours (at 5500 only) 8 hours (at 5500 only) Infinite	Infinite or 1 hour (depending on your PIC iX version)
Global Resume	When set to On, resumes both the 5500 and patient monitor from Standby.	On Off	Off

Control	Function	Setting Choices	Factory Default
Remote Pause	Enables all alarms to be paused at the device for the same configured amount of time that they are paused at the PIC iX.	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 Not used with 5500.	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 Not used with 5500.	Reduces the delay time when fast switching between the 5500 and the patient monitor	On Off	On
Allowed Leadset Not used with 5500. See "Choosing EASI or Standard Lead Placement" on page 96.	Determines the default lead placement.	Standard EASI	Standard
Screen On Time	Determines how long the 5500 display is active by default.	1 min 2 min 5 min 15 min 30 min	1 min
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

Control	Function	Setting Choices	Factory Default
Pleth Wave	This setting determines if the Pleth wave is displayed and stored at the PIC iX. If this setting is on, only three waves of ECG are available. Make sure that this is known if the customer is using Hexad monitoring with a 6-lead cable.	On and Off	On

NOTE

- Waves in **Telemetry Setup** must all be set to **ECG** if using Hexad derivation and you want to store 12 ECG waves. If set to less than 4 ECG waves, the telemetry monitor continues to derive these waves. 12 ST Snippets are sent, but the number of ECG waves stored is reduced.
- Waves in **Telemetry Setup** must have 3 ECG waves if using EASI derivation and you want to store 12 waves of ECG. If set to less than 3 ECG waves, the telemetry monitor continues to derive these waves. 12 ST Snippets are sent, but the number of ECG waves stored is reduced.

ECG Management

Control	Function	Settings	Factory Default
Primary Lead	Sets which lead will default to the Primary Lead for ECG analysis.	I, 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

SpO2 Limits

Configures SpO_2 settings for each telemetry profile.

Control	Function	Settings	Factory Default
High Limit	The High Limit cannot be lower than the Low Limit and will dynamically change to reflect this.	The range is from 100 to 51% in increments of 1%.	100%
Low Limit	The Low Limit cannot be higher than the High Limit and will dynamically change to reflect this.	The range is from 99 to 50% in increments of 1%.	90%
Desat Limit	The Desat Limit cannot be higher than the Low Limit and will dynamically change to reflect this.	The range is from 99 to 50% in increments of 1%.	80%
Alarms		On and Off	On
High Alarm Delay	The time that the averaged SpO_2 needs to be above the limit before an alarm is activated.	The range is from 0 to 30 seconds in 1-second intervals.	10 seconds
Low Alarm Delay	The time that the averaged SpO_2 needs to be below the limit before an alarm is activated.	The range is from 0 to 30 seconds in 1-second intervals.	10 seconds
Desat Delay	The time that the averaged SpO_2 needs to be at the Desat limit before an alarm is activated.	The range is from 0 to 30 seconds in 1-second intervals.	20 seconds
SpO2		On and Off	On
Repeat Time	When SpO_2 is in Auto mode, you can set the default auto repeat time(18).	1 min 2 min 2.5 min 3 min 5 min 10 min 15 min 20 min 30 min 45 min 60 min 120 min 240 min	15 min

(18) Choices >59 minutes are displayed in hours on the 5500.

Philips

Control	Function	Settings	Factory Default
Mode		Manual Continuous Auto	Manual
Pulse Alarm On/Off	This setting determines if the pulse measurement from SpO_2T for the telemetry monitor will be on or off by default.	On and Off	On
Average	The SpO_2 numeric represents an average value calculated from several SpO_2 values. You can adjust the averaging time between 5, 10, and 20 seconds. It represents the approximate time period used for the calculation. The exact averaging algorithm depends on the SpO_2 technology (option) used and the signal conditions. The longer the averaging time, the longer the time needed until the SpO_2 value reflects the physiological event. Fast averaging is useful for situations where an extremely fast measurement is required or few artifacts are expected. Use slow averaging where you expect the number of artifacts to be relatively high.	5, 10, and 20 seconds	10 seconds

Respiration

Configures the Resp settings for each telemetry profile. This Respiratory measurement is available by purchase on the 5500.

Control	Function	Settings	Factory Default
High Limit	The High Limit will never be set lower than the Low Limit.	The range is from 1-100 in increments of 5 until it is set lower than 20, then the increments are in single steps.	30
Low Limit	The Low Limit cannot be set higher than the High Limit.	The range is from 1-95 in increments of 5 until it is set lower than 20, then the increments are in single steps.	8

Control	Function	Settings	Factory Default
Apnea Time		10 sec	20 sec
		15 sec	
		20 sec	
		25 sec	
		30 sec	
		35 sec	
		40 sec	

13.4 Factory Defaults for ST/AR Profiles for Telemetry

CAUTION

Ensure that the appropriate PIC iX default profile is assigned to the appropriate bed label and matches the default bedside profile settings for Patient Category and Paced Mode.

NOTE

- If you are a new PIC iX release 4.0 customer, the Adult Basic profile is hidden and is replaced by the Adult B profile.
- If you have migrated from a previous PIC iX release, the Adult Basic profile may be shown in addition to the Adult B profile, if in active use upon migration.
- At the time of writing this IFU, the defaults are as indicated below.

Factory Defaults for ST/AR Profiles

Setting	Adult A (Default)	Adult B	Adult Basic	Pediatric
Profiles				
Category	**Adult**	Adult	Adult	Pediatric
Pacer Algorithm	**On**	On	On	On
Paced Mode (UI setting)	**Unconfirmed**	Unconfirmed	Unconfirmed	Unconfirmed
ECG				
High Limit	**120** bpm	140 bpm	120 bpm	160 bpm
Low Limit	**50** bpm	50 bpm	50 bpm	75 bpm
QRS Detection	**300 µV**	300 µV	300 µV	300 µV
Δ ExtrTachy	**20** bpm	20 bpm	20 bpm	20 bpm
Tachy Clamp	**200** bpm	200 bpm	200 bpm	220 bpm

Philips

Setting	Adult A (Default)	Adult B	Adult Basic	Pediatric
Δ ExtrBrady	**20** bpm	20 bpm	20 bpm	20 bpm
Brady Clamp	**40** bpm	40 bpm	40 bpm	40 bpm
Arrhythmia				
Arrhythmia	**On**	On	On	On
Arrhythmia Mode	**Enhanced**	Enhanced	Basic	Enhanced
Asystole Thresh.	**4.0** sec	4.0 sec	4.0 sec	4.0 sec
Pause Threshold	**2.0 sec**	2.0 sec	2.0 sec	2.0 sec
VTach HR	**100** bpm	100 bpm	100 bpm	120 bpm
Vent Rhythm	**>14** PVCs	>14 PVCs	>14 PVCs	>14 PVCs
VTach Run	**5** PVCs	5 PVCs	5 PVCs	5 PVCs
SVT HR	**180** bpm	180 bpm	180 bpm	200 bpm
SVT Run	**≥5** SVBs	≥5 SVBs	Off & Hide SVBs	≥5 SVBs
PVCs/min	**>10**	>10	>10	>5
Non-Sustain	**On & Unlock**	On & Unlock	Off & Hide	On & Unlock
Vent Rhythm	**On & Unlock**	On & Unlock	Off & Hide	On & Unlock
Run PVCs	**On & Unlock**	On & Unlock	Off & Hide	On & Unlock
Pair PVCs	**On & Unlock**	Off & Unlock	Off & Hide	On & Unlock
R-On-T PVC	**On & Unlock**	Off & Unlock	Off & Hide	On & Unlock
Vent Bigeminy	**On & Unlock**	Off & Unlock	Off & Hide	On & Unlock
Vent Trigeminy	**On & Unlock**	Off & Unlock	Off & Hide	On & Unlock
PVCs/min	**On & Unlock**	Off & Unlock	On & Unlock	On & Unlock
Multiform PVC	**On & Unlock**	Off & Unlock	Off & Hide	On & Unlock
Pacer n.Cap	**On & Unlock**	On & Unlock	On & Unlock	On & Unlock
Pacer n.Pac	**On & Unlock**	On & Unlock	On & Unlock	On & Unlock
Missed Beat	**On & Unlock**	On & Unlock	Off & Hide	On & Unlock
Pause	**On & Unlock**	On & Unlock	Off & Hide	On & Unlock
SVT	**On & Unlock**	On & Unlock	Off & Hide	On & Unlock
Afib	**On & Unlock**	On & Unlock	Off & Hide	Off & Hide
Irregular HR	**On & Unlock**	Off & Unlock	Off & Hide	On & Unlock
Analysis Mode	**Multi-Lead**	Multi-Lead	Multi-Lead	Multi-Lead
Afib/IHR End Dly	**5 min**	5 min	5 min	5 min

Philips

Setting	Adult A (Default)	Adult B	Adult Basic	Pediatric
Afib/IHR Remind.	**30 min**	30 min	30 min	30 min
TimeOut 1st	**3 min**	3 min	3 min	3 min
TimeOut 2nd	**10 min**	10 min	10 min	10 min
ST Analysis				
ST Analysis	**Off**	Off	Off	Off
ST-I High	**1 mm**	1 mm	1 mm	1 mm
ST-I Low	**-1 mm**	-1 mm	-1 mm	-1 mm
ST-II High	**1 mm**	1 mm	1 mm	1 mm
ST-II Low	**-1 mm**	-1 mm	-1 mm	-1 mm
ST-III High	**1 mm**	1 mm	1 mm	1 mm
ST-III Low	**-1 mm**	-1 mm	-1 mm	-1 mm
ST-aVR High	**1 mm**	1 mm	1 mm	1 mm
ST-aVR Low	**-1 mm**	-1 mm	-1 mm	-1 mm
ST-aVL High	**1 mm**	1 mm	1 mm	1 mm
ST-aVL Low	**-1 mm**	-1 mm	-1 mm	-1 mm
ST-aVF High	**1 mm**	1 mm	1 mm	1 mm
ST-aVF Low	**-1 mm**	-1 mm	-1 mm	-1 mm
ST-MCL High	**2 mm**	2 mm	2mm	2 mm
ST-MCL Low	**-2 mm**	-2 mm	-2 mm	-2 mm
ST-V High	**2 mm**	2 mm	2mm	2 mm
ST-V Low	**-2 mm**	-2 mm	-2 mm	-2 mm
ST-V1 High	**1 mm**	1 mm	1 mm	1 mm
ST-V1 Low	**-1 mm**	-1 mm	-1 mm	-1 mm
ST-V2 High	**1 mm**	1 mm	1 mm	1 mm
ST-V2 Low	**-1 mm**	-1 mm	-1 mm	-1 mm
ST-V3 High	**1 mm**	1 mm	1 mm	1 mm
ST-V3 Low	**-1 mm**	-1 mm	-1 mm	-1 mm
ST-V4 High	**1 mm**	1 mm	1 mm	1 mm
ST-V4 Low	**-1 mm**	-1 mm	-1 mm	-1 mm
ST-V5 High	**1 mm**	1 mm	1 mm	1 mm
ST-V5 Low	**-1 mm**	-1 mm	-1 mm	-1 mm

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Setting	Adult A (Default)	Adult B	Adult Basic	Pediatric
ST-V6 High	**1 mm**	1 mm	1 mm	1 mm
ST-V6 Low	**-1 mm**	-1 mm	-1 mm	-1 mm
ST-V7 High	**1 mm**	1 mm	1 mm	1 mm
ST-V7 Low	**-1 mm**	-1 mm	-1 mm	-1 mm
ST-V8 High	**1 mm**	1 mm	1 mm	1 mm
ST-V8 Low	**-1 mm**	-1 mm	-1 mm	-1 mm
ST-V9 High	**1 mm**	1 mm	1 mm	1 mm
ST-V9 Low	**-1 mm**	-1 mm	-1 mm	-1 mm
ST-V3R High	**1 mm**	1 mm	1 mm	1 mm
ST-V3R Low	**-1 mm**	-1 mm	-1 mm	-1 mm
ST-V4R High	**1 mm**	1 mm	1 mm	1 mm
ST-V4R Low	**-1 mm**	-1 mm	-1 mm	-1 mm
ST-V5R High	**1 mm**	1 mm	1 mm	1 mm
ST-V5R Low	**-1 mm**	-1 mm	-1 mm	-1 mm
Alarms	**On**	On	On	On
Auto Limits	**Off**	Off	Off	Off
ISO/J Point	**Auto**	Auto	Auto	Auto
ISO Point	**-80 msec**	-80 msec	-80 msec	-56 msec
J Point	**40 msec**	40 msec	40 msec	32 msec
ST Offset	**J + 60**	J + 60	J + 60	J + 60
STE	**Off**	Off	Off	Off
STE Alarms	**On**	On	On	On
STE Female Limbs	**1 mm**	1 mm	1 mm	1 mm
STE Fem. V1,V4-6	**1 mm**	1 mm	1 mm	1 mm
STE Female V2,V3	**1.5 mm**	1.5 mm	1.5 mm	1.5 mm
STE Male Limb	**1 mm**	1 mm	1 mm	1 mm
STE Male V1,V4-6	**1 mm**	1 mm	1 mm	1 mm
STE Male V2,V3	**2 mm**	2 mm	2 mm	2 mm
QT Analysis				
QT Analysis	**Off**	Off	Off	Off
QTc High Alarm	**On**	On	On	On

Setting	Adult A (Default)	Adult B	Adult Basic	Pediatric
QTc High Limit	**500 ms**	500 ms	500 ms	480 ms
ΔQTc High Alarm	**On**	On	On	On
ΔQTc High Limit	**60 ms**	60 ms	60 ms	60 ms
QTc Formula	**Bazett**	Bazett	Bazett	Bazett
QT Lead	**All**	All	All	All

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