Patient Monitor B125/B105

User's Manual

Software Version 1.0

Patient Monitor B125/B105
English
2092701-002 E (Paper)

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Due to continuing product innovation, specifications in this manual are subject to change without notice.

For technical documentation purposes, the abbreviation GE is used for the legal entity names, GE Medical Systems Information Technologies, Inc.

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1

About this manual and device

Intended use of this manual

This manual is an integral part of the device and describes its intended use. It should always be kept close to the equipment. Observance of the manual is a prerequisite for proper performance and correct operation and ensures patient and user safety. Information which refers only to certain versions of the product(s) is accompanied by the model number(s) of the product(s) concerned. The model number is given on the device plate of the product.

See the supplemental information manual for the technical specifications, default settings and compatibility information, including electromagnetic compatibility.

Intended audience of this manual

This manual is intended for clinical professionals. Clinical professionals are expected to have a working knowledge of medical procedures, practices and terminology required to provide patient care. Using the device should never replace nor impede the human intervention and required patient care provided by clinical professionals.

Manual conventions

This manual uses the following styles to emphasize text or indicate action.

Item	Description
bold	Indicates hardware terms.
bold italic	Indicates software terms.
italic	Indicates terms for emphasis.
>	Indicates menu options to select consecutively.
GE	For technical documentation purposes, the abbreviation GE is used for the legal entity names, GE Medical Systems *Information Technologies*, Inc., and GE Healthcare Finland Oy. It is also used to refer to GE Healthcare.
CARESCAPE Network	CARESCAPE Network is used to refer to the MC Network.
select	The word select means choosing and confirming.
NOTE	Note statements provide application tips or other useful information.

Illustrations and names

This manual uses illustrations as examples only. Illustrations in this manual may not necessarily reflect all system settings, features, configurations, or displayed data.

Names of persons, institutions, and places and related information are fictitious; any similarity to actual persons, entities, or places is purely coincidental.

Related documents

- B125/B105 Patient Monitor Supplemental Information Manual
- B125/B105 Patient Monitor Suppliers and accessories
- B125/B105 Patient Monitor Technical Manual
- CARESCAPE Network Configuration Guide
- CIC Pro Clinical Information Center Operator's Manual
- CARESCAPE Central Station User's Manual
- HL7 Reference Manual

The documents in this list are subject to change without notice. Please, contact your local sales or service representative for possible updates.

Ordering manuals

A paper copy of this manual will be provided upon request. Contact your local GE representative and request the part number on the first page of the manual.

Indications for use

B125/B105 is a portable multi-parameter unit to be used for monitoring and recording of, and to generate alarms for multiple physiological parameters of adult, pediatric, and neonatal patients in a hospital environment and during intra-hospital transport.

The device is intended for use under the direct supervision of a licensed health care practitioner.

The device is not intended for use during MRI.

The device can be a stand-alone monitor or interfaced to other devices via network.

B125/B105 monitors and displays: ECG (including ST segment, arrhythmia detection), invasive blood pressure, heart/pulse rate, oscillometric non-invasive blood pressure (systolic, diastolic and mean arterial pressure), functional oxygen saturation (SpO_2) and pulse rate via continuous monitoring(including monitoring during conditions of clinical patient motion or low perfusion), temperature with a reusable or disposable electronic thermometer for continual monitoring Esophageal/Nasopharyngeal/Tympanic/Rectal/Bladder/Axillary/Skin/Airway/Room /Myocardial/ Core/Surface temperature, impedance respiration, respiration rate, CO_2.

Training requirements

No product-specific training is required for the use of this device.

Trademarks

GE, the GE Monogram, Imagination at work, CARESCAPE, DINAMAP, Trim Knob and TruSignal are trademarks of General Electric Company.

Third party trademarks

Masimo and SET are trademarks of Masimo Corporation.

Nellcor and OxiMax are trademarks of a Medtronic company.

HL7 is a registered trademark of Health Level Seven (HL7), Inc.

All other third-party trademarks are the property of their respective owners.

Manufacturer responsibility

GE is responsible for the effects on safety, reliability, and performance of the equipment only if:

- Assembly operations, extensions, readjustments, modifications, servicing, or repairs are carried out by authorized service personnel.
- The electrical installation of the relevant room complies with the requirements of the appropriate regulations.
- The equipment is used in accordance with the instructions for use.

Product availability

NOTE Due to continual product innovation, design and specifications for these products are subject to change without notice.

Some of the products mentioned in this manual may not be available in all countries. Please consult your local representative for the availability.

Warranty

This Product is sold by GE Medical Systems (China) Co., Ltd. under the warranty set forth in the following paragraphs. Such warranty is extended only with respect to the purchase of this Product directly from GE or GE's Authorized Dealers as new merchandise and is extended to the Buyer thereof, other than for the purpose of resale. For a period of twelve (12) months from the date of original delivery to Buyer, this Product, other than expandable parts, is warranted against functional defects in materials and workmanship and to conform to the description of the Product contained in this manual and accompanying labels and/or inserts, provided that the same is properly operated under the conditions of normal use, that regular periodic maintenance and service is performed and that the replacements and repairs are made in accordance with the instructions provided, using genuine parts and performed by a trained person. The foregoing warranty shall not apply if the Product has been repaired by anyone other than GE or otherwise than in accordance with written instructions provided by GE, or altered by anyone other than GE, or if the Product has been subject to abuse, misuse, negligence, or accident.

GE's sole and exclusive obligation and Buyer's sole and exclusive remedy under the above warranty is limited to repairing or replacing, free of charge, at GE's option, a Product, which is telephonically reported to the nearest GE office or GE's Authorized

Dealers office and which, if so advised by GE, is thereafter returned with a statement of observed deficiency, not later than seven (7) days after the expiration date of the applicable warranty, to the GE office or GE's Authorized Dealers office during normal business hours, transportation charges prepaid, and which, upon GE's examination, is found not to conform to the above warranty. GE shall not be otherwise liable for any damages including but not limited to incidental damages, consequential damages, or special damages. There are no express or implied warranties, which extend beyond the warranty hereinabove set forth. GE makes no warranty of merchantability or fitness for particular purpose with respect to the product or parts thereof.

2

Safety

Safety message signal words

Safety message signal words designate the severity of a potential hazard.

DANGER	Indicates a hazardous situation that, if not avoided, will result in death or serious injury.
WARNING	Indicates a hazardous situation that, if not avoided, could result in death or serious injury.
CAUTION	Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates a hazardous situation not related to personal injury that, if not avoided, could result in property damage.

System safety

System safety messages apply to the entire system. Safety messages specific to parts of the system are found in the relevant section.

System warning safety messages

The following warning safety messages apply to this monitoring system.

Indications for use warnings

WARNING	Read all the safety information before using the device for the first time. This manual contains instructions necessary to operate this device safely and in accordance with its functions and intended use. This manual is intended for clinical professionals. Clinical professionals are expected to have a working knowledge of medical procedures, practices and terminology, as required for the monitoring of all patients.
WARNING	SINGLE PATIENT USE. This equipment is designed for use on one patient at a time. Using this equipment to monitor different parameters on different patients at the same time compromises the accuracy of data acquired.

WARNING INSTRUCTIONS FOR USE. For continued safe use of this equipment, it is necessary that the listed instructions are followed. However, instructions listed in this manual in no way supersede established medical practices concerning patient care.

WARNING INTRAHOSPITAL TRANSPORT. Vibrations during intrahospital transport may disturb SpO_2, ECG, impedance respiration, and NIBP measurements.

Accessories warnings

WARNING Single-use products are not designed to be reused. Reuse may cause a risk of cross-contamination, affect the measurement accuracy and/or system performance, and cause a malfunction as a result of the product being physically damaged due to cleaning, disinfection, re-sterilization and/or reuse.

WARNING Use only approved accessories, including mounts, and defibrillator-proof cables and invasive pressure transducers. For a list of approved accessories, see the Suppliers and accessories provided. Other cables, transducers and accessories may cause a safety hazard, damage the equipment or system, result in increased emissions or decreased immunity of the equipment or system or interfere with the measurement.

WARNING ELECTRIC SHOCK. Only use protected leadwires and patient cables with this device. The use of unprotected leadwires and patient cables creates the potential for making an electrical connection to ground or to a high voltage power source which can cause serious injury or death to the patient.

WARNING For detailed instructions and information regarding supplies and accessories, always refer to their own instructions for use.

Cables warnings

WARNING CABLES. Route all cables away from patient's throat to avoid possible strangulation.

WARNING SITE REQUIREMENTS. Do not route cables or tubing in a way that they may present a stumbling hazard.

WARNING SAFETY GROUND. Remove power cord from the mains source by grasping the plug. Do not pull on the cable.

Defibrillation warnings

WARNING Do not touch the patient, table, bed, instruments, or the monitor during defibrillation.

WARNING DEFIBRILLATOR PRECAUTIONS. Patient signal inputs labeled with the CF and BF symbols with paddles (refer to “Equipment symbols”) are protected against damage resulting from defibrillation voltages. To ensure proper defibrillator protection, use only the recommended cables and leadwires.

Electrical warnings

WARNING POWER SUPPLY. The device must be connected to a properly installed power outlet with protective earth contacts only. If the integrity of the protective earth conductor is in doubt, disconnect the monitor from the power line (and use it with the battery option if available). If the installation does not provide for a protective earth conductor, disconnect the monitor from the power line. All devices of a system must be connected to the same power supply circuit. Devices which are not connected to the same circuit must be electrically isolated when operated.

WARNING EXCESSIVE LEAKAGE CURRENT. Do not use a multiple socket outlet or extension cord in an ME system.

WARNING EXCESSIVE LEAKAGE CURRENT. To avoid summation of leakage currents when interfacing the device with other equipment, the devices may only be interconnected with each other or to parts of the system when it has been determined by qualified biomedical personnel that there is no danger to the patient, the operator, or the environment as a result. In those instances where there is any element of doubt concerning the safety of the connected devices, the user must contact the manufacturers concerned (or other informed experts) for proper use. In all cases, safe and proper operation should be verified with the applicable manufacturer’s instructions for use, and system standards IEC 60601-1 clause 16 must be complied with.

WARNING EXCESSIVE TOUCH CURRENT. To avoid excessive patient leakage current, do not simultaneously touch the patient and the electrical connectors located at the rear panel of the monitor, or within the module housing.

WARNING INTERFACING OTHER EQUIPMENT - Devices may only be interconnected with each other or to parts of the system when it has been determined by qualified biomedical personnel that there is no danger to the patient, the operator, or the environment as a result. In those instances where there is any element of doubt concerning the safety of the connected devices, the user must contact the manufacturers concerned (or other informed experts) for proper use. In all cases, safe and proper operation should be verified with the applicable manufacturer’s instructions for use, and system standards IEC60601-1 must be complied with.

WARNING Do not under any circumstances remove the grounding conductor from the power plug. Always check that power cord and plug are intact and undamaged.

WARNING During intracardiac application of a device, a defibrillator and pacemaker whose proper functioning has been verified must be kept at hand.

WARNING If liquid has accidentally entered the system or its parts, disconnect the power cord from the power supply and have the equipment serviced by authorized service personnel.

WARNING DISCONNECTION FROM MAINS. When disconnecting the device from the power line, remove the plug from the wall outlet first. Then you may disconnect the power cord from the device. If you do not observe this sequence, there is a risk of coming into contact with line voltage by inserting metal objects, such as the pins of leadwires, into the sockets of the power cord by mistake.

WARNING INTRACARDIAC APPLICATION. When applying devices intracardially, electrically conductive contact with parts connected to the heart (pressure transducers, metal tube connections and stopcocks, guide wires, etc.) must be avoided in all cases. To prevent electrical contact, we recommend the following:

- always wear isolating rubber gloves,
- keep parts that are conductively connected to the heart isolated from ground,
- if possible, do not use tube fittings or stopcocks made of metal.

EMC warnings

WARNING Other equipment may interfere with the system, even if that other equipment complies with CISPR emission requirements.

WARNING Use only approved accessories, including mounts, and defibrillator-proof cables and invasive pressure transducers. For a list of approved accessories, see the supplemental information provided. Other cables, transducers and accessories may cause a safety hazard, damage the equipment or system, result in increased emissions or decreased immunity of the equipment or system or interfere with the measurement.

WARNING Pins of connectors identified with the ESD warning symbol should not be touched. Connections should not be made to these connectors unless electrostatic discharge (ESD) precautions are used.

WARNING Do not use the device in high electromagnetic fields (for example, during magnetic resonance imaging).

WARNING EMC. Magnetic and electrical fields are capable of interfering with the proper performance of the device. For this reason make sure that all external devices operated in the vicinity of the monitor comply with the relevant EMC requirements. X-ray equipment or MRI devices are a possible source of interference as they may emit higher levels of electromagnetic radiation. Changes or modifications to this device/system not expressly approved by GE may cause EMC issues with this or other equipment. This device/system is designed and tested to comply with applicable standards and regulations regarding EMC and needs to be installed and put into service according to the EMC information stated as follows: This device/system is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes. Main power should be that of a typical commercial or hospital environment. Device is compliant to Class A.

Equipment warnings

WARNING EXPLOSION. Do not use this system in the presence of flammable anesthetics, vapors or liquids.

WARNING If an error message appears during operation, it is the licensed medical practitioner's responsibility to decide whether the device is still suitable for patient monitoring. As a general rule, monitoring should only continue in extremely urgent cases and under the direct supervision of a licensed healthcare practitioner. The device must be repaired before being used again on a patient. If an error message appears after power-up, the device must be repaired before being used on a patient.

WARNING The acquisition modules are not able to withstand unpacked drops from a height of 1 m without damage. If a module is dropped, please service it before taking it back into use.

WARNING If the monitor is dropped, please service it before taking it back into use.

WARNING SAFETY HAZARD. To avoid risks to personnel and patient, or damage to the equipment, do not perform any assembly, modification, repair, or similar operations to the device or accessories. Only authorized service personnel must perform these operations as required by the manufacturer.

Site requirement warnings

WARNING BEFORE INSTALLATION. Compatibility is critical to safe and effective use of this device. Please contact your local sales or service representative prior to installation to verify system compatibility.

System caution safety messages

The following caution safety messages apply to this monitoring system.

Indications for use cautions

CAUTION U.S. Federal law restricts this device to sale by or on the order of a physician.

CAUTION SUPERVISED USE. This equipment is intended for use under the direct supervision of a licensed healthcare practitioner.

Loss of data

CAUTION LOSS OF DATA. Should the monitor at any time temporarily lose patient data, the potential exists that active monitoring is not being done. Close patient observation or alternate monitoring devices should be used until monitor function is restored. If the monitor does not automatically resume operation within 60 seconds, power cycle the monitor using the On/Off button. Once monitoring is restored, you should verify correct monitoring state and alarm function.

Electrical caution

CAUTION POWER REQUIREMENTS. Before connecting the device to the power line, check that the voltage and frequency ratings of the power line are the same as those indicated on the device's label. If this is not the case, do not connect the system to the power line until you adjust the device to match the power source. In U.S.A., if the installation of this equipment will use 240V rather than 120V, the source must be a center-tapped, 240V, single-phase circuit. This equipment is suitable for connection to public mains as defined in CISPR 11.

EMC cautions

CAUTION Use of known RF sources, such as cell/portable phones, or other radio frequency (RF) emitting equipment near the system may cause unexpected or adverse operation of this device/system. Consult qualified personnel regarding device/system configuration.

CAUTION The device/system should not be used adjacent to, or stacked with, other equipment. If adjacent or stacked use is necessary, the device/system should be tested to verify normal operation in the configuration in which it is being used. Consult qualified personnel regarding device/system configuration.

Site requirement cautions

CAUTION LOSS OF MONITORING. Leave space for circulation of air to prevent the device from overheating. The manufacturer is not responsible for damage to device caused by improperly vented cabinets, improper or faulty power, or insufficient wall strength to support device mounted on such walls.

Notice safety messages

The following notice safety message applies to this monitoring system:

NOTICE The warranty does not cover damages resulting from the use of accessories and consumables from other manufacturers.

NOTICE If the device has been transported or stored outside operating temperature range, allow it to stabilize back to operating temperature range before applying power.

ESD safety precautions

- To avoid electrostatic charges building up, it is recommended to store, maintain and use the equipment at a relative humidity of 30% or greater.
- To prevent applying a possible electrostatic charge to the ESD sensitive parts of the equipment, touch the metallic frame of the component or a large metal object located close to the equipment. When working with the equipment and specifically when the ESD sensitive parts of the equipment may be touched a grounded wrist strap intended for use with ESD sensitive equipment should be worn. See the documentation provided with the wrist straps for details of proper use. Floors should be covered by ESD dissipative carpets or similar. Non-synthetic clothing should be used when working with the component.

3

System introduction

System safety precautions

System warnings

WARNING Never install equipment above the patient.

WARNING Operation of the monitor outside the specified performance range may cause inaccurate results.

WARNING EXCESSIVE LEAKAGE CURRENT A display that is a non-medical grade device and is used within the patient environment, must always be powered from an additional transformer providing at least basic isolation (isolating or separating transformer). Using without an isolating transformer could result in unacceptable enclosure leakage currents.

WARNING Do not touch the electrical connector located within the module housing or frame.

WARNING ELECTRIC SHOCK. Always unplug the grounded cables when not in use. Leaving them connected could result in an electric shock from the ground contact in the other end.

WARNING EXPLOSION OR FIRE. Using non-recommended batteries could result in injury/burns to the patients or users. Only use batteries recommended or manufactured by GE. The warranty can be voided if non-recommended batteries are used.

WARNING EXPLOSION HAZARD. Do not incinerate a battery or store at high temperatures. Serious injury or death could result.

WARNING Do not connect a single-color display to the monitor. Visual alarm indicators may not appear properly.

WARNING To prevent liquids from entering the monitor, do not tilt the monitor.

WARNING Secondary displays will not sound the audible alarms. Keep the patient under close surveillance.

WARNING PHYSICAL INJURY. Make sure the battery is completely inserted and the battery door is completely closed. Falling batteries could seriously or fatally injure neonatal or other vulnerable patients.

System caution

CAUTION To comply with the FCC RF exposure requirements, the monitor with the wireless network (WLAN) option must be operated with a separation distance of 20 cm or more from a person's body.

System components

All components listed below can be used within the patient environment as long as an additional transformer providing at least basic isolation is used with non-medical grade secondary displays and printers.

Your system may not include all these components. Consult your local representative for the available components.

NOTE It is not recommended the system be connected to other non-isolated monitoring equipment or communication networks. In this event it is the end user's responsibility to ensure compliance with IEC60601-1 or other IEC standards.

1. B125 monitor, 12.1' LED display
2. B105 monitor, 10.1' LED display
3. Recorder
4. Acquisition module: E-miniC module, for compatible CO_2 measurement

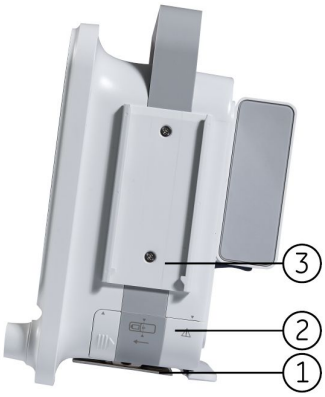
Front view

B105 front view (full configuration)

B125 front view

1. Alarm light
2. Transportation handle
3. Hemo connectors
4. Keypad
5. Trim knob

Main side view

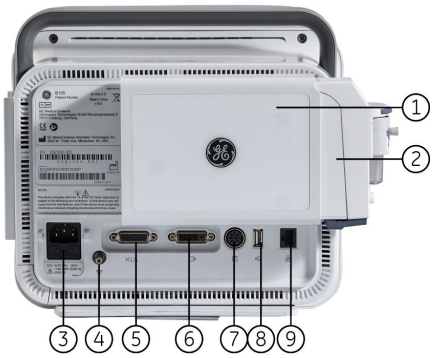


B105 side view (full configuration)

B125 side view

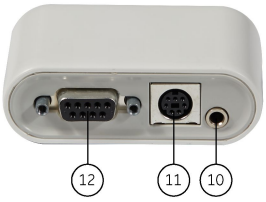
1. Guide rail for GCX mounting
2. Battery compartment
3. Guide rail for recorder

Main back view



B105 back view (full configuration)

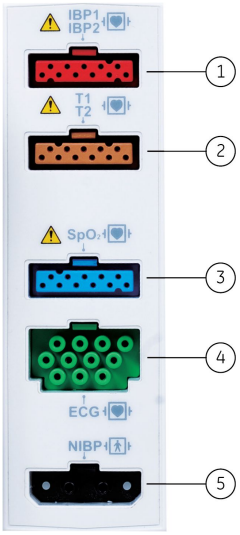
B125 back view



Multi I/O

1. Extension rack
2. E-miniC module
3. Receptacle for power cord
4. Equipotential connector
5. Multi I/O connector
6. DVI connector
7. Recorder connector
8. USB connector
9. Network connector
10. Nurse call connector
11. Defibrillator connector
12. Serial port

Hemodynamics connectors



1. IBP connector
2. Temperature connector
3. SpO_2 connector
4. ECG and impedance respiration connector
5. NIBP connector

Hemodynamics parameters

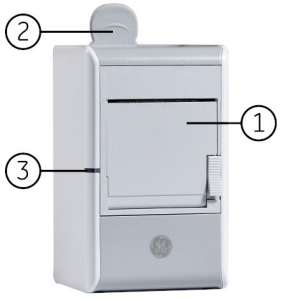
The monitor provides different configurations for hemodynamics measurement. The user can identify the configurations from connectors and label.

Identifier	Basic feature			Optional feature	
	ECG	NIBP	SpO_2	IBP	Temperature
SpO2_IBP_T	X	X	GE	X	X
MasimoSpO2_IBP_T	X	X	Masimo	X	X
NellcorSpO2_IBP_T	X	X	Nellcor	X	X
SpO2_T	X	X	GE		X
MasimoSpO2_T	X	X	Masimo		X
NellcorSpO2_T	X	X	Nellcor		X
SpO2	X	X	GE		
MasimoSpO2	X	X	Masimo		
NellcorSpO2	X	X	Nellcor		

E-miniC module

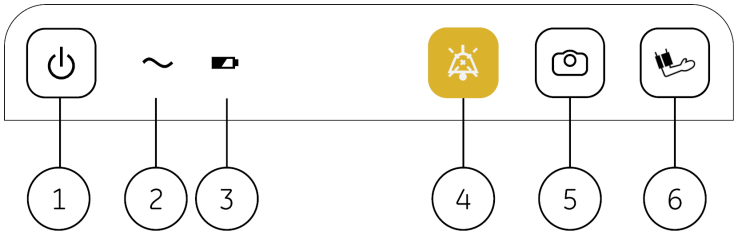
1. Water trap
2. Sample gas inlet
3. Gas outlet

Recorder



1. Recorder door.
2. Tab for removing recorder
3. Power on indicator: Illuminates when connected to power.
4. Symbol indicate the paper install direction.
5. 9-pin connector.
6. Connect line: Connect recorder and monitor.

Keypad



1. On/Off key.

2. AC power status indicator.
3. Battery status indicator.
4. Audio pause key. Temporary audio pause active alarms.
5. Snapshot key. Take up snapshot, which is a set of measured data for this moment.
6. Manual NIBP key. Start a manual NIBP measurement.

Monitor battery

For information regarding the operation and charging time of the batteries, see the supplemental information manual.

You can insert a GE authorized lithium-ion battery and use the monitor on battery power.

The LED indicators on the monitor front panel indicate whether the monitor is being used on battery or main power, and also whether the battery is charging, full or missing:

Front panel indicator	Meaning
	Monitor is operated on main power.
	Green lit. Monitor is operated on battery power.
	Orange flashing. Battery failure or AC/DC failure.
	Orange lit. Battery is charging. The indicator goes off when the battery is fully charged.

NOTE When the recorder or frame temperature high, battery charge will stop.

Inserting and removing battery

1. Open the battery cover by pressing the battery cover and slide out.
2. Insert the battery with the test indicator side up and the connector end first all the way into the battery slot.
3. Close the battery door carefully. Align the up and down arrow, then slide battery cover to the left to close.

4. To remove the battery, open the battery cover and pull the battery out from the cord.

Checking the battery charge with monitor software

You can check the monitor battery status using the monitor software:

1. Select the > ***Battery*** .
2. Check the battery status that appears.

NOTE When the battery charge complete, the ***Capacity Percent:*** may not reach to 100%.

Monitor battery charge symbols on screen

You can check the battery charge level from the monitor battery symbol on the right upper corner of the display.

Screen symbol	Meaning
	Monitor battery is full.
	Monitor battery is less than 87.5% of run time left.
	Monitor battery is less than 62.5% of run time left.
	Monitor battery is less than 37.5% of run time left.
	Monitor battery is empty when there is less than 12.5% of run time left.
	Monitory battery failure or missing battery.
	Monitor battery is charging. There is a white bar inside the symbol.

Battery test button

When the battery is not inserted into the monitor, you can check its status by using the TEST button on the battery itself. Push the button and check the green charging level indicators to see how much charge is left:

- Four LEDs illuminated: 75% to 100% of full-charge capacity.
- Three LEDs illuminated: 50% to 74.9% of full-charge capacity.

- Two LEDs illuminated: 25% to 49.9% of full-charge capacity.
- One LED illuminated: 10% to 24.9% of full-charge capacity.
- One LED flashing: < 10% of full-charge capacity.

Network central station

Central stations	Description
	CIC Pro Clinical Information Center The MC Network establishes communication and allows patient data to be sent to an optional CIC Pro Clinical Information Center (central station). See the CIC Pro Clinical Information Center Operator's Manual for operating instructions.
	CARESCAPE Central Station The MC Network establishes communication and allows patient data to be sent to an optional CARESCAPE Central Station. See the CARESCAPE Central Station User's Manual for operating instructions.

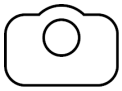
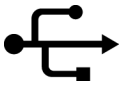
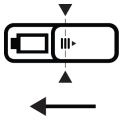
Other devices

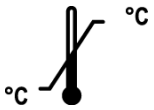
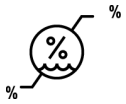
Other devices	Description
	External display The monitor has the DVI port for the commercial display, which resolution should be 1280*800.
	USB storage device (file system: FAT32) To save and load the settings.

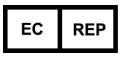
Equipment symbols

For user interface keys and symbols, please refer to "Monitoring basics" chapter.

	On the Hemo connectors: **WARNING** Protection against cardiac defibrillator discharge is due in part to the accessories for pulse oximetry (SpO2), temperature (T) and invasive pressure (P) measurement.
	On the X1, X2 connector, and recorder: **CAUTION** Electric shock hazard. Do not open the cover or the back. Refer servicing to qualified personnel. On the power label at the rear cover: **CAUTION** For continued protection against fire hazard, replace the fuse only with one of the same type and rating. **CAUTION** Disconnect from the power supply before servicing. On the battery cover: **CAUTION** Make sure to use the compatible battery: FLEX-3S3P; Close the battery door to aviod battery drop out.
	Follow instructions for use.
	Consult operating instructions.
	Electrostatic sensitive device. Connections should not be made to this device unless ESD precautionary procedures are followed.
	Non-ionizing electromagnetic radiation. Interference may occur in the vicinity of this device.
	Type BF (IEC 60601-1) protection against electric shock. Isolated (floating) applied part suitable for intentional external and internal application to the patient, excluding direct cardiac application.
	Type BF (IEC 60601-1) defibrillator-proof protection against electric shock. Isolated (floating) applied part suitable for intentional external and internal application to the patient, excluding direct cardiac application.
	Type CF (IEC 60601-1) protection against electric shock. Isolated (floating) applied part suitable for intentional external and internal application to the patient, including direct cardiac application.

	Type CF (IEC 60601-1) defibrillator-proof protection against electric shock. Isolated (floating) applied part suitable for intentional external and internal application to the patient including direct cardiac application.
	Power indicator.
	Alternating current. The monitor is being used on main power.
	Battery. Green lit. Monitor is operated on battery power. Orange lit. Battery is charging. The indicator goes off when the battery is fully charged. Orange flashing. Battery failure or AC/DC failure.
	On the keypad: Audio pause key. Temporary audio off. On the alarm light side: Indicates temporary audio off.
	Snapshot key.
	Manual NIBP key. Start a manual NIBP measurement.
	Equipotentiality. Connect device to a potential equalization conductor.
X1	Multi I/O connector.
	DVI connector. Video output connector for digital source.
X2	Recorder connector.
	USB connector.
	Ethernet connector.
	Battery cover open/close indication. The operator should align the up and down arrow, then push the cover to close.

	Gas inlet.
	Gas outlet.
	Mini D-fend: Add date.
	Recorder.
	Recorder paper install direction.
	Fuse. Replace with identical type and rating fuse.
IP21	Degree of ingress protection.
	Date of manufacture. This symbol indicates the date of manufacture of this device. The first four digits identify the year and the last two digits identify the month.
	Manufacturer name and address.
PN	Abbreviation for product number.
SN	Device serial number.
UDI	Every device has a unique marking for identification. The UDI marking appears on the device label.
	Atmospheric pressure limitations.
	Temperature limitations.
	Humidity limitations.

	Keep dry. Protect from rain.
	Fragile. Handle with care.
	This way up.
	This symbol indicates that the waste of electrical and electronic equipment must not be disposed as unsorted municipal waste and must be collected separately. Please, contact an authorized representative of the manufacturer for information concerning the decommissioning of your equipment. The separate collection symbol is affixed to a battery, or its packaging, to advise you that the battery must be recycled or disposed of in accordance with local or country laws. To minimize potential effects on the environment and human health, it is important that all marked batteries that you remove from the product are properly recycled or disposed. For information on how the battery may be safely removed from the device, please consult the service manual or equipment instructions. Information on the potential effects on the environment and human health of the substances used in batteries is available at this url: http://www.gehealthcare.com/euen/weeerecycling/ index.html
	Recycled materials or may be recycled.
	Recyclable Lithium-Ion.
	European authorized representative.
	European Union Declaration of Conformity.
	FCC. USA only. Complies with applicable US government (Federal Communications Commission) radio-frequency interference regulations.
Rx ONLY U.S.	Prescriptive Device. USA only. For sale by or on the order of a Physician.

	Russia only. GOST-R mark.
	Eurasian Economic Union countries only. Eurasian Conformity mark. Conformity to applicable technical regulations of Customs Union.
	China only. This symbol indicates the product contains hazardous materials in excess of the limits established by the Chinese standard GB/T 26572 Requirements for Concentration Limits for Certain Hazardous Substances in Electronic Information Products. The number in the symbol is the Environment-friendly User Period (EFUP), which indicates the period during which the toxic or hazardous substances or elements contained in electronic information products will not leak or mutate under normal operating conditions so that the use of such electronic information products will not result in any severe environmental pollution, any bodily injury or damage to any assets. The unit of the period is "Year". In order to maintain the declared EFUP, the product shall be operated normally according to the instructions and environmental conditions as defined in the product manual, and periodic maintenance schedules specified in Product Maintenance Procedures shall be followed strictly. Consumables or certain parts may have their own label with an EFUP value less than the product. Periodic replacement of those consumables or parts to maintain the declared EFUP shall be done in accordance with the Product Maintenance Procedures. This product must not be disposed of as unsorted municipal waste, and must be collected separately and handled properly after decommissioning.
	Underwriters Laboratories product certification mark.
CMIIT ID	China only. China Ministry of Industry and Information Technology identification number for Radio Transmission Equipment Type Approval.
	Brazil only. Approved under ANATEL (Agência Nacional de Telecomunicações) requirements.
	Brazil only. INMETRO certificate.

4

Monitoring basics

Operation safety precautions

Operation warnings

WARNING To avoid risk of electric shock, this equipment must only be connected to a supply mains with protective earth.

WARNING After transferring or reinstalling the device, always check that it is properly connected and all parts are securely attached.

WARNING When detaching module, be careful not to drop it. Always support with one hand while pulling out with the other

WARNING ACCURACY. If the accuracy of any value displayed on the monitor, central station, or printed on a graph strip is questionable, determine the patient's vital signs by alternative means. Verify that all equipment is working correctly.

WARNING If you accidentally drop the monitor or module, have it checked by authorized service personnel prior to clinical use.

WARNING Do not use the monitor without manufacturer approved mounting attached.

Monitor installation points to note

- To avoid electrostatic charges building up, it is recommended to store, maintain and use the equipment at a relative humidity of 30% or greater. Floors should be covered by ESD dissipative carpets or similar ESC dissipative products. Non-synthetic clothing should be used when working with the component.
- Choose a location that affords an unobstructed view of the display and easy access to the operating controls, including power code, connectors at the monitor or remotely via View on Alarm or remote devices like central stations.
- Set up the monitor in a location that affords sufficient ventilation. The ventilation openings of the device must not be obstructed (by equipment, walls, or blankets, for example).
- The environmental operating conditions specified in the technical specifications must be ensured at all times.
- The monitor is designed to comply with the requirements of IEC 60601-1.

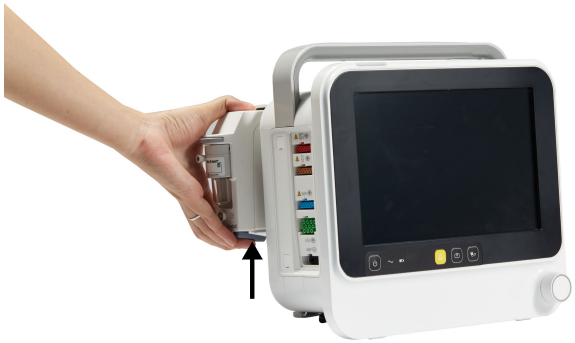
- Using the power cord supplied with the monitor, connect it to the power line. Use only the original cord.
- The operating position of the processing unit does not influence the performance of the monitor in any way.

Connecting and removing parts

Connecting E-module

To use the E-module, your device need to be pre-configured with the extension rack.

1. With the module properly oriented (module release latch facing down), align the insertion guide slot in the module with the insertion guide in the extension rack.
2. Push the module into the module frame until it clicks.



Removing E-module

1. Press the release latch at the bottom of the module.
2. While pressing the release latch, grasp the module firmly and pull out.

NOTE It is recommended to insert the E-Blank module after removing E-module, to avoid dust and liquid into extension rack.

Connecting the recorder

Please make sure the monitor is pre-configured with recorder fixing plate.

1. Use cable to connect the recorder to the **X2** connector on the monitor.
2. When the monitor is power on, make sure the power indicator on recorder is lit.

NOTE The recorder also can be used stand alone.

Inserting the recorder

1. Align the recorder to the insertion guides.
2. Push down the recorder until it clicks.

Removing the recorder

1. Pull the recorder outwards by the tab. Make sure not to drop it when it comes out.

User interface keys

Various functions of the monitor can be accessed through the monitor's soft keys on screen.

	Home • Close all menus displayed on the monitor and back to the normal screen.
	Admit/Discharge Open ***Admit/Discharge*** menu to: • Admit/discharge patient. • Select mode
	Trends Open ***Trends*** menu to: • View and setup graphical trends • View and setup numerical trends • View snapshot • View alarm history
	Print • Start or stop local waveform recording. **NOTE** Only connect recorder will display this key.
	Auto NIBP • Start or stop NIBP auto cycling.
	Layout Switch • Shift between waveform layout and large number layout.
	Standby • Enter standby mode in 2 minutes.
	Alarm Reset • Reset active alarms.
	Audio Pause • Audio pause active alarms.
	More • Display more quick access icons.
	***Lock*** • Lock the touch screen.
	***IBP Zero*** • Zero all invasive pressure channels. This does not apply to ICP.

	***Alarm Setup*** Open ***Alarms Setup*** menu to: • Use default limits or Auto limits • Adjust alarm volume • Audio off alarms or activate alarms
	***Recorder Setup*** Open ***Record & Print*** menu to: • Setup and record waveforms • Setup and record numerical or graphical trends
	***Screen Setup*** Open ***Screen Layout Setup*** menu to: • Setup waveform screen layout • Setup large number screen layout
	***Parameter Setup*** Open ***Parameter Setup*** menu to: • Enter each parameter's menu for settings
	***OxyCRG*** Open ***OxyCRG*** menu to: • View realtime OxyCRG. • View OxyCRG Snapshot. • Setup OxyCRG.
	***Night Mode*** • Open ***Night Mode*** menu to setup and enter night mode.
	***Battery*** • Open ***Battery Information*** menu to display battery status.
	***Monitor Info*** • Open ***Monitor Information*** menu to display the version information and network status.
	***Sound Volumes*** • Open ***Sound Volumes*** menu to adjust auditory information signals.
	***Brightness*** • Adjust monitor screen brightness.

	***Service*** • Open ***Install/Service*** menu to setup clinical and basic service
	***USB Disk*** Open ***Export Logs*** menu to: • Export logs to USB Disk. • Empty USB Disk. • Safe to remove USB Disk.

User interface symbols

The following symbols appear in the software user interface.	
	Alarm off indicator - Displays in the upper right corner of the digit field when physiological alarms for this parameter are turned off. The symbol may not display at the central station.
	Audio alarms off indicator - Displays in the upper left corner of the message field when physiological audible alarms are turned off.
	Alarm pause indicator - Displays in the upper left corner of the message field and indicates that alarms are audio paused.
	Alarms audio pause indicator. Displays in the upper left corner of each alarm message and indicates that alarm audio pause has been activated.
	Network connection indicator. Indicates the monitor is connected to the Local Area Network (LAN).
	Network (WLAN) signal strength. The number of segments corresponds to the signal strength: four segments indicate strong signal, one segment weak signal.
	Network (WLAN) is failed.
	Monitor battery is full.
	Monitor battery is less than 87.5% of run time left.
	Monitor battery is less than 62.5% of run time left.
	Monitor battery is less than 37.5% of run time left.
	Monitor battery is empty when there is less than 12.5% of run time left.

The following symbols appear in the software user interface.	
	Monitory battery failure or missing battery.
	Monitor battery is charging.
	Night mode indicator. Indicates the monitor is on the night mode.
	Snapshot indicator. Indicates the event has an associated snapshot.
	Beat volume icon. Adjust the volume of the QRS beep tone. Also the beat source indicator. Displays next to the selected beat source.
	Respiration indicator. Indicates a breath is detected by the impedance respiration algorithm.
	Lock indicator. Indicates the screen has been locked.
	Masimo SpO_2 only. SpO_2 signal strength indicator. Indicates the signal strength, with three asterisks indicating the strongest signal.
	NIBP progress bar. Indicates the amount of time remaining until the next automatic measurement.

Normal screen layout

The normal screen displays alarms, information, trends, waveforms, digits, and the main menu in pre-defined areas.

Waveform layout

<table>
<tr><td colspan="4">Information Field</td><td rowspan="2"></td></tr>
<tr><td colspan="4">Message Field</td></tr>
<tr><td colspan="3">Waveform 1</td><td>Upper Field 1</td><td rowspan="6">Soft Key Field</td></tr>
<tr><td colspan="3">Waveform 2</td><td>Upper Field 2</td></tr>
<tr><td colspan="3">Waveform 3</td><td>Upper Field 3</td></tr>
<tr><td colspan="3">Waveform 4</td><td>Upper Field 4</td></tr>
<tr><td colspan="3">Waveform 5</td><td>Upper Field 5</td></tr>
<tr><td>Lower Field 1</td><td>Lower Field 2</td><td>Lower Field 3</td><td>Lower Field 4</td></tr>
</table>

The information field of the screen displays the following information:

- Patient name (if entered).

- Bed name and care unit of the local monitor (if connected to the MC Network).
- WLAN signal symbol (if connected to the wireless network).
- Network symbol (if connected to the MC Network).
- Battery status icon.
- Current time.

NOTE The monitor displays up to 5 waveforms and 4 lower digit field at a time, or displays up to 6 waveforms.

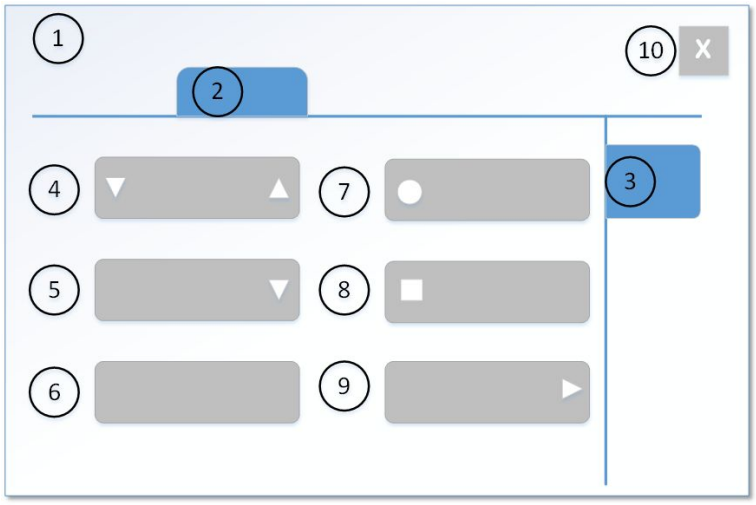
Large number layout

<table>
<tr><td colspan="2">Information Field</td><td rowspan="4">Soft Key Field</td></tr>
<tr><td colspan="2">Message Field</td></tr>
<tr><td>Large Number Field 1</td><td>Large Number Field 2</td></tr>
<tr><td>Large Number Field 3</td><td>Large Number Field 4</td></tr>
</table>

Each large number field includes the large number and one waveform of the parameter, (except NIBP and Temperature, which not have waveform).

An example of a menu

The following is an example of a menu illustrating some of the components and how they are referred to in this manual:



1. Menu title (for example, ***ECG***)
2. Horizontal tab (for example, ***Alarms Setup***, ***Alarms***)
3. Vertical tab (for example, ***SYS***, ***MAP***)
4. Arrow selector spinner for increasing/decreasing a value

5. Selection lists: when selecting the arrow, a list of options appears
6. Button for initiating a actionable function
7. Radio button for selecting or deselecting a feature from the available options
8. Check box for selecting or deselecting a feature
9. Further menu selections
10. Exit key (for example, Close, Previous Menu)

NOTE Not all menus have these same components.

Menu options

To reach the system settings, select the soft key to open the related menu.

To reach the parameter settings, three ways as follow:

- Select the digit field to open each parameter's setup menu.
- Select the waveform field to open the related shortcut menu. The parameter quick access menu will display.
  For more settings, you can select ***More...*** to open the related parameter's setup menu.
- Select  >  ***Parameter Setup*** to open the all parameter's setup menu.

Selecting menu options with a touchscreen

NOTE Do not use pencils, pens, or other sharp objects to activate the touchscreen. The touchscreen will not function properly if tape or paper is stuck to the display surface.

1. Touch the menu option with your finger.
2. The highlight on screen moves to this option.
3. Lift your finger off the screen, and the selected function is performed (e.g., a list opens).

Selecting menu options with the Trim Knob control

1. Rotate the Trim Knob control in either direction to move the highlighted cursor from option to option on the display.
2. Press the Trim Knob control once to select the highlighted option.

Entering data

When data entry is required, the monitor automatically displays an on-screen keyboard for you to use.

1. Select the desired data field.

   The selected field is highlighted with yellow focus, indicating that you can begin entering the text.
2. Enter data: Select the characters with the Trim Knob, or touchscreen.

Setting the touchscreen off

You can set the touchscreen feature off when you need to clean the screen.

1. Select  >  ***Lock*** .
2. To enable the touchscreen, press any keypad key, or use the Trim Knob.

NOTE Press the **On/Off** key will turn off the monitor.

Turning on/off the monitor

The monitor is preset at the factory for a specific AC voltage. Before applying power, be sure that the power requirements match your power supply. Refer to the label on the device for voltage and current requirements.

1. Ensure all cables are properly connected.
2. Turn on the power:

   Press the **On/Off** button located on the keypad.

   The welcoming screen will appear with a status bar indicating the progress of the startup procedure.
3. Turn off the power:

   Press the **On/Off** button.

   The message "***Monitor is shutting down...***" will appear on the screen.

Performance check

After turning on the monitor, and during operation, the monitor runs automatic self-tests. If a malfunction is detected, the monitor displays a message or an alarm, depending on the severity of the malfunction.

Pre-monitoring checklist

Before you start monitoring a patient check the following:

- Acquisition module is firmly in place.
- Accessories are intact and properly connected.
- Monitor is displaying the monitoring screen.
- No messages display indicating the monitor is not functioning.
- Desired parameters are selected to view on the screen.
- Alarm signals are working and can be seen and heard in your care environment.
- Required parameter calibrations are completed.

Supply mains interruption

If the supply mains to the equipment is interrupted for less than 120 minutes, the monitor keeps the trend data and the latest user-made settings. If not, contact authorized service personnel. After 120 minutes, all patient information and trend data is lost and the monitor returns to the user default settings (start-up mode).

Downloading logs to USB disk

You can download the error log, alarm log, keyboard log, and WLAN log, supplicant log to the USB disk for service use.

1. Discharge the patient first.
2. Select  >  ***USB Disk***.
3. To download log: select ***Export logs to USB Disk***.

   When finish to download logs, a message "***Export logs successfully.***" displays on the menu.
4. To empty all the files in USB storage device: select ***Empty USB Disk***.

   NOTE All items on the USB disk will be deleted.

   When finish to empty the USB disk, a message "***Empty successfully.***" displays on the menu.
5. To remove the USB Disk: select ***Safe to remove USB Disk***, then remove the USB disk.

5

Setting up the monitor before use

Waveform field safety precautions

WARNING Always make sure that the waveform size is sufficient for the care environment.

CAUTION The waveform autoscaling feature automatically updates the display from the best possible signal amplitude. Always make sure that the waveform display scale is correctly understood and does not lead to delayed patient treatment.

Normal screen

When monitoring begins, the main page appears automatically. This preconfigured page is called the normal screen. Any changes you make to the screen setup during monitoring are changes to this normal screen. These changes are not permanent unless they are saved to a mode. They are valid until the the patient is discharged They are also kept in the device memory for 120 minutes after the power is turned off.

You can return to the normal screen any time during the monitoring.

- Select the  to return to the normal screen.

Adjusting sound volumes

You can adjust various sound volumes according to your care environment needs. While you are adjusting the volume, you will hear a corresponding sound that will guide you in determining a suitable level. All volumes other than ***Alarm Volume*** can be set to 0 if required.

1. Select the  >  ***Sound Volumes***.
2. Adjust following sound volumes with the arrows.
   - ***Alarm Volume***
   - ***Beat Volume***
   - ***Completed NIBP Volume***

You can also adjust each volumes from the Alarm setup, ECG/SpO_2, Service or NIBP menu.

Adjusting the display brightness

You can set the display brightness level according to your needs.

1. Select the .
2. Adjust the display brightness with the ***Brightness***.

Screen setup modifications

Waveform layout

NOTE The monitor displays up to 5 waveforms and 4 lower digit field at a time, or displays up to 6 waveforms.

When waveforms are configured to be displayed, they will be displayed or removed automatically when a module and/or cables are connected or disconnected. Waveforms are always evenly distributed to fill the entire waveform area. Whenever there are less waveforms configured on the screen, the remaining waveforms are enlarged. Changing a displayed waveform to another waveform also will update the associated digit field that is displayed to the right of the waveform.

If the ***Lower Digital*** is turned off, up to 6 waveforms can be displayed.

Depends on your configuration, if the same measurement in the lower digit field that is currently in the waveform field, the waveform field disappears.

Large number layout

The large number layout displays up to 4 fields at a time. Each field displays large number of digit field and one waveform for each parameter.

You can shift two layouts between waveform and large number during monitoring.

- Using the to shift two layouts.

Setting waveform layout

1. Select the > ***Screen Setup***.
2. Select the ***Waveform*** tab > ***Upper Area*** vertical tab.
3. Select the parameters for related waveforms.
4. Select the ***Lower Area*** vertical tab.
5. Check that the ***Lower Digital*** is turned on.
6. Select the parameters for related digit fields.

NOTE If you turn off the ***Lower Digital***, the parameter selections for digit fields are gray. And on the ***Upper Area*** vertical tab, you can set six waveforms.

Setting large number layout

1. Select the  >  ***Screen Setup***.
2. Select the ***Large Number*** tab.
3. Select the parameters for related fields.

Setting parameters

1. Select the  >  ***Parameter Setup***.
2. Select each parameter to adjust the settings.

You can also select each parameter's digit field or waveform field to open the setup menu.

For details about the settings, refer to the parameter's chapter.

Setting up printing options

You can check that the printing options for waveforms and trends are set according to your needs when you start monitoring a patient.

1. Select the  >  ***Recorder Setup*** .
2. Check the settings by going through the different options and change if necessary.

For more information, see the Printing chapter.

Other setup changes

All other setup changes require a password.

- Alarm options
- Snapshot
- Units
- Colors
- Save Modes
- Time and date
- Time zone
- Parameter settings

For more information, see the supplemental information manual.

6

Starting and ending monitoring

Starting and ending safety precautions

Starting and ending warnings

WARNING LOSS OF MONITORING and MISSED ALARMS. When starting to monitor a patient, always make sure that you are in the normal monitoring mode and not in the DEMO mode. Ensure that there is no ***DEMO MODE*** text in the message field. If the DEMO mode is active when you start monitoring, there is a risk of loss of monitoring and missed alarms.

Starting and ending caution

CAUTION DISCHARGE TO CLEAR PATIENT DATA. When admitting a new patient, you must clear all previous patient data from the system. To accomplish this, be sure the acquisition module is securely mounted, disconnect the patient cables, then discharge the previous patient.

About the user default settings

User default settings mean those settings (start-up mode etc.) that the user has saved into the monitor to replace the factory default settings. The monitor uses these settings when it is turned on and after a power off situation that lasts more than 120 minutes. If there are no user default settings, factory default settings are used.

About user modes

When start monitoring a patient, you can use the startup mode or select another mode. The device has seven user modes to choose. Mode control many settings, including parameter defaults, alarm detection limits, and screen display.

You can:

- save the current settings to target mode.
- revert the target mode to factory default settings.
- export all modes to the USB disk.
- import all modes from the USB disk.
- choose the startup mode.

NOTE

Reach these selections through the  >  ***Service*** > ***Save Modes***, and they are password protected.

For more information, see the supplemental information manual.

Selecting a mode

The monitor starts with the startup mode, but you can select another mode according to your needs. You can also change the mode while monitoring a patient without losing any patient data.

1. Select  .
2. Select the ***Select Mode*** tab.
3. Select a mode from the ***Select Mode*** list.
4. You can return to the previous mode by selecting ***Return to previous mode:***.

If you make changes to mode settings and need to return to its previous settings, first select another mode and then re-select the one you were using.

Starting monitoring

A patient is automatically admitted when the monitor detects any of the following vital signs: ECG, impedance respiration, Art, ABP, UAC, NIBP, SpO_2, or CO_2. When a patient is admitted at the bedside monitor and the monitor is connected to the network, patient data will display at the central station.

A patient is manually admitted when any patient data is entered or loaded. Patient data can be entered locally using the monitor, or entered remotely using a central station.

Always observe the monitor and the patient carefully during start-up periods and when inserting acquisition module.

The following are generic instructions listing the basic steps for starting monitoring. Parameter-specific instructions are more detailed and should always be followed as well.

1. Connect the patient to the monitor according to the measurement setup requirements. The alarms and parameter settings become active.
2. If the startup mode is not suitable, select another mode.
3. Enter patient demographics.
4. Start the measurement.
5. Zero invasive pressure lines.
6. If required, change the parameters on screen.
7. Check alarm limits and adjust if necessary.

Entering patient data with the monitor

1. Select  .
2. Edit or enter patient data:
   a. Edit or enter the ***First Name***, ***Last Name*** and ***Patient ID*** by selecting the letters or numbers.
   b. Select ***Age Years*** with arrows.
   c. Select the ***Patient Type*** from the list. Choices are:
      - ***Adult/Pediatric***
      - ***Neonatal***
3. Double confirm the patient data you have entered.

NOTE When you select ***Patient Type*** to ***Neonatal***:

- The mode will automatically become ***NEONATAL***.
- The ***AgeYears*** are not available.
- The ***OxyCRG*** will display.

About standby

When you remove the patient temporarily from the monitor, you can use the standby option.

NOTE When the patient is discharged, the standby mode is not allowed to start.

Starting standby

1. Select  .

   If patient cables are still connected and the monitor is receiving physiological data, a text message will be displayed, indicating that audio alarms have been paused.
2. Disconnect patient cables and stop NIBP automatic measurements to start the standby.

   If you do not disconnect the cables and physiological data is still present after the audio pause time expires, the standby is canceled. You can also select  to cancel entering standby immediately.

The screen will go blank and the ***Standby*** text appears.

End of standby

The monitor ends the standby state automatically when any of the following conditions occur:

- Any physiological data is detected.
- User input is received: a keypad key is pressed, Trim Knob is pressed or rotated, or the touchscreen is pressed.

After that, a continue menu will open, the options are:

- ***Continue***: ***Continue monitoring of previous patient.***
- ***Discharge***: ***Discharge current patient and erase patient data from monitor.***
- ***Standby***: ***Enter Standby mode.***

About night mode

The night mode feature allows the patient to sleep or rest without being disturbed. In the night mode, the screen brightness, the volume can be set separately. Alarms are logged and trended. If the monitor is connected to the network, alarms and parameter data will continue to be sent over the network.

When in night mode, a symbol will appear on the information area.

Setting and entering night mode

1. Select > ***Night Mode*** .
2. Adjust the following settings if needed.
   - ***Beat Volume*** : HR beat volume
   - ***Alarm Volume***: Alarm volume
   - ***Screen Brightness***: Monitor display brightness
   - ***Completed NIBP Volume***: NIBP complete beep
3. Select ***Enter Night Mode***.

The night mode symbol appears on the information field.

Exiting night mode

1. Select > ***Night Mode***.
2. Select ***Exit Night Mode*** to exit.

The night mode symbol is removed from the information field.

About Demo Mode

The Demo Mode is designed for training and demonstration of primary operations before use. Under Demo Mode, the monitor displays the main vital signs values and waveforms. No accessories, central station or any other peripheral equipment are needed while in Demo Mode.

The Demo Mode menu is under the service menu of the monitor and requires a password to enter. Please consult a qualified service personnel to enter or exit the Demo Mode.

NOTE All the values and waveforms on the monitor's display are fictional.

NOTE The Demo Mode is only designed for training and demonstration of primary operations. It is not intended for clinical use or patient monitoring and diagnosis.

About patient discharge

Discharging a patient deletes all patient information in the monitor. This also happens when the monitor is in the DEMO mode.

The monitor discharges a patient automatically after 24 hours when vital signs for parameters (except Temperature) are not available. When this happens, all trend data will be cleared and alarm settings will return to the default values.

The patient can be discharged remotely using a central station, provided that this option has been enabled.

Discharging a patient

1. Print necessary data and wait until the printing is completed.
2. Disconnect patient cables.
3. Select  .
4. Select the ***Discharge*** tab.
5. Select ***YES*** from the ***Discharge*** list.

Parameter settings, including alarm limits, return to the default settings. All patient data and trend data is removed from the monitor.

7

Alarms

Alarm safety precautions

Alarm warnings

WARNING When the alarms are off or while alarm audio is paused either temporarily or indefinitely, observe the patient frequently.

WARNING MISSED ALARMS. Always make sure that the audio alarm volume level is adequate in your care environment to avoid missing alarms or not recognizing them due to too low a volume.

WARNING Always make sure that the alarm light brightness is adequate in your care environment.

WARNING Always make sure that necessary alarm limits are active and set according to the patient's clinical condition when you start monitoring a patient.

WARNING Verify alarm processing is active and check the patient to ensure no arrhythmias occurred during a power interruption.

WARNING Always check the alarm status after a prolonged power interruption.

WARNING Alarms do not sound, alarm histories are not stored, alarm graphs do not print, and alarms are not sent to the network when the alarms are turned off.

WARNING Alarms do not sound and alarms are not sent to the CARESCAPE Network during Audio Pause.

WARNING The audible alarm signal may be paused temporarily from a central station.

WARNING To avoid missed detection of critical alarms, always inform personnel dependent on the CARESCAPE monitor alarms of remote alarm silencing or pausing interactions.

WARNING There are no alarm indications until parameter-specific alarm prerequisites have been met.

WARNING Only the most recent, highest priority alarm is sent to remote devices on the CARESCAPE Network. Therefore, less recent alarms of equal or lower priority may not be displayed or may not be indicated with their associated priority remotely.

WARNING Alarm messages may not be visible on the alarm display area when four higher priority alarms are active.

WARNING Equipment malfunctions, network disconnection, nurse call disconnection, and alarm volume settings may result in missed alarms. Always keep the patient under close surveillance.

WARNING Latched alarms are not retained through a monitor reset if the alarm condition has been removed.

WARNING The secondary alarm system shall not be relied upon for receipt of alarm signals.

WARNING MIXED ENVIRONMENT. A hazard can exist when the same type of monitors in the same care area are using different monitoring profiles and default configuration settings.

WARNING MISSED ALARM. Do not rely on receipt of certain alarm conditions at a central station, or alarm notification device when connected to the CARESCAPE Network. Notification of any of these alarms will only be given when it is the most recent, highest priority active alarm coming from the bedside monitor. This applies to those limit alarms and technical alarms that are defined as broadcast only alarms in this manual.

WARNING MISSING CRITICAL EVENTS. Reducing the physiological alarms' priority levels lower than the default level can lead to missed detection of critical or serious events and therefore to adverse patient outcome. If you adjust the priority levels for the following alarms lower than the default value, keep the patient under close surveillance: non-lethal arrhythmias.

WARNING Do not connect a single-color display to the monitor. Visual alarm indicators may not appear properly.

WARNING Reducing the physiological alarms' priority levels lower than the default level can lead to missed detection of serious events and therefore to adverse patient outcome. If you adjust the priority levels for non-lethal arrhythmias alarms lower than the default value, keep the patient under close surveillance.

Alarm overview

Alarm types

There are two types of alarm settings, system and patient-specific. System alarm settings are set globally across an entire care environment. They are configured

at the time of installation and are password protected. Examples of system alarm settings are:

- Minimum alarm volume
- Audio off allowed
- Alarm tones

Patient-specific alarm settings are individualized, based on a patient's current condition. Examples of patient-specific alarm settings are:

- Parameter alarm limits
- Arrhythmia alarm priority settings

Alarm conditions

- Physiological alarm conditions are triggered by a patient measurement that are outside the parameter limits, by apnea, or by an arrhythmia condition.
- Technical alarm conditions are triggered by an electrical, mechanical, or other failure of the equipment, or by failure of a sensor or component. Technical alarm conditions may also be caused when an algorithm cannot classify or interpret the available data. The visual manifestation of a technical alarm is active as long as the reason for that alarm exists.

Alarm priority levels

Physiological and technical alarms are categorized by priority level:

- High priority alarms require an immediate response.
- Medium priority alarms require a prompt response.
- Low priority alarms require you to be aware of this condition.
- Informational priority messages provide information you should know.

NOTE Informational messages are not sent to the network, and they are never latched.

Alarm priority escalation

An escalating alarm starts at a designated priority level (low or medium) and will escalate to the next higher priority level (after a set number of seconds) if the alarm condition has not been resolved. It is important to note that the alarms escalate up to the next level but will not reset until the condition has been resolved.

NOTE Alarm priority escalation affects the currently ongoing alarm condition, not any future alarms of the same type. Any new alarms will alarm at their designated priority level, not at the escalated level.

For more information, see the supplemental information manual.

Broadcast only alarms

Alarms are sent to the CARESCAPE Network and displayed on the central station.

For more information, see the supplemental information manual.

Checking alarm function

1. Set a parameter alarm limit outside of the current measured patient values. For example, connect the SpO_2 sensor and adjust the SpO_2 high limit under the measured SpO_2 values.
2. Confirm that the following alarm notification occur:
   - The audible alarm sounds the correct priority tone.
   - The alarm light illuminates.
   - The SpO_2 numeric value flashes in the parameter window with the correct priority color.
   - An alarm printout (if enabled) is initiated.
3. Audio pause the alarms and confirm that the audible alarms are paused.
4. Return the parameter alarm limit to the original value.

Alarm indications

Alarm icons on the screen

For more information for the on screen alarm icons, see User interface symbols (48).

Description of alarm and information messages

Alarm and information messages can be displayed in three areas:

- The digit field
- The waveform field
- The message field (upper part of the screen)

In the message field, up to four alarms or information messages may be displayed from left to right, from the newest highest priority alarm to the oldest lowest priority alarm.

Alarm messages are stored in the ***Alarm History***. You can access through  . The alarm and information messages stored in the ***Alarm History*** include:

- Time of occurrence
- Alarm or information message text
- Label for the parameter, if available
- Current value and the associated alarm limit if a limit alarm
- Unit of measure for the value
- Snapshot, if available

Audible alarm signals

When more than one alarm occurs at the same time, the monitor will sound an alarm tone for the highest priority alarm. Any lower priority audible alarm tones are suppressed by the higher priority alarm tone.

The most recent of the alarms that has the highest priority level at this moment is the alarm that is broadcast on the network. For example, if there is one medium-priority

alarm and a low-priority alarm appears, the medium-priority alarm is broadcast, not the most recent (low-priority) alarm. If there is one medium-priority alarm and another medium-priority alarm appears, the latest alarm that appeared is broadcast. Physiological alarms always take precendence over technical alarms.

Alarm tones

The alarm tones can be configured to sound in one of four different tone patterns: ***General***, ***IEC***, ***ISO***, or ***ISO2***.

For more information, see the supplemental information manual.

Adjusting the alarm volume

1. Select > ***Alarm Setup*** > ***Setup*** tab.
2. Adjust the value with ***Alarm Volume*** arrows.

   The lower the number, the quieter the alarm volume.

NOTE

The minimum allowed alarm volume levels are set under > ***Service*** (password protected) > ***Alarm Options*** > ***Min Alarm Volume***.

Visual alarm signals

Alarm signals indicate that an alarm condition is present. The alarm priority levels are indicated by visual and audible signals. The visual and audible alarm signals assume that the patient monitor and the operator are within the patient environment (1.5 meters).

The following table lists alarm signals for different alarm priority levels:

Signal	Priority level			
	High	**Medium**	**Low**	**Informational**
Digit field physiological data values	Black text flashes inside a red box.	Black text flashes inside a yellow box.	Not applicable.	Not applicable.
Message field	White text inside a red box.	Black text inside a yellow box.	White text inside a cyan (blue) box.	Black text inside a grey box.
Waveform field messages	Text	Text	Text	Text
Alarm light indicator	Flashes red Frequency: 1.667 Hz ±10%	Flashes yellow Frequency: 0.625 Hz ±10%	Solid blue Constant on	No effect

Auditory information signals

The monitor performs a self-diagnostic procedure at startup and generates an auditory test signal. There are also other auditory information signals indicating the status of some parameter measurements.

- Start-up sound
- HR beat beep
- Completed NIBP volume

- Reminder beep

Audible alarms off behavior

Depending on the ***Audio Off Allowed*** default settings configured during installation, you can turn on or turn off audible alarms.

For more information, see the supplemental information manual.

When audible alarms are turned off:

- All audible alarms are turned off except for any high priority alarms configured to breakthrough the audio off setting.
- The audio off bell icon displays in the upper left corner of the display screen.

Turning audible alarms on/off

You can turn on/off the audible physiological alarm tones for an alarm group or for all alarms.

1. Select > ***Alarm Setup***.
2. Select the ***Audio*** tab.
3. Select an alarm group. Choices are:
   - ***None***: No audible alarms are turned off.
   - ***Silence Apnea***: Turns off audible alarms for apnea, $EtCO_2$, $FiCO_2$, respiration rate limit alarms.
   - ***Silence ECG***: Turns off audible alarms for all HR source limit and arrhythmia alarms.
   - ***Silence Apn&ECG***: Turns off audible alarms for all HR source limit, arrhythmia, apnea, $EtCO_2$, $FiCO_2$, respiration rate limit alarms.
   - ***Silence ALL***: Turns off all audible alarms except some high priority alarms defined as breakthrough alarms.
4. To turn on all audible alarms again, select ***Activate Alarms***, or select ***None*** as instructed above.

NOTE If alarms are turned off for any of the defined alarm groups and an alarm occurs within the alarm group, a beep tone will sound every 2 minutes as a reminder that audible alarms are turned off. The ***Reminder Volume*** can be adjust through ***Alarm Options*** (password protected).

NOTE France only: The ***Reminder Volume*** menu is not available. A reminder beep tone sounds every 2 minutes when audible alarms are turned off.

Pause audio and alarm reset behaviors

When monitor is on the network, alarms can also be audio paused at the central station.

Selection	Result	Indicator
Select (audio pause) once	• Start a 2 minute audio pause state for all alarms except the specified breakthrough alarms[1]. • Remove all latched alarms[2] (including message and light).	• Alarm light: Yes • Alarm message: Yes and display the audio pause countdown icon • Alarm audio: No, except the breakthrough alarms
Second selection of (audio pause) during the 2 minute pause	• Cease the audio pause state. • Deactivate some alarms in 2 minutes list below.	• Alarm light: Yes • Alarm message: Yes • Alarm audio: Yes
Select (alarm reset)	• Start a 2 minute alarm silence for all current active alarms. • Remove all latched alarms (including message and light). • Does not silence any new alarms. • Cease the audio pause state, if available.	• Alarm light: Yes • Alarm message: Yes, with audio pause symbol in the message block • Alarm audio: No
[1] For more information about breakthrough alarms, see the supplemental information manual. [2] For details about latched alarms, refer to "Latched alarms" paragraph below.		

Alarms' deactivation with the pause audio key

Certain alarms can be deactivated by second selection of audio pause key.

- Physiology alarms:
  - ***NIBP DIA high/NIBP SYS high/NIBP MAP high***
  - ***NIBP DIA low/NIBP SYS low/NIBP MAP low***
- Technical alarms:
  - ***Leads off***
  - ***No SpO2 probe***
  - ***SpO2 probe off***
  - ***Check SpO2 probe***
  - ***No SpO2 pulse***
  - ***No x transducer***
  - ***Zero ICP separately***
  - ***NIBP cuff loose***
  - ***NIBP cuff occlusion***
  - ***Check NIBP***
  - ***Weak pulsation***
  - ***Long measurement time***
  - ***NIBP manual***
  - ***NIBP cuff overpressure***
  - ***NIBP call service error***
  - ***Gas measurements removed***

- ***Alarm volume changed***
- ***Recorder module removed***
- ***Recorder system error***
- ***Recorder: cover open***
- ***Recorder: input voltage high***
- ***Recorder: input voltage low***
- ***Recorder: out of paper***
- ***Recorder thermal array overheat***
- ***No battery backup***
- ***NIBP measurement removed***
- ***ECG measurements removed***
- ***STP measurements removed***
- ***SpO2 measurement removed***

Breakthrough alarms

The breakthrough alarms feature allows pre-defined and user-selectable alarms to "breakthrough" (interrupt) a 2 minute audible alarm pause state.

The following alarms will breakthrough when escalated to or activated at high priority alarm condition regardless of the 2 minute audible alarm pause: ***Asystole***, ***V Fib / V Tach***, ***V Tach***, and ***Brady*** (when ***Breakthrough Alarm*** option is selected as ***Peds***).

The ***Breakthrough Alarm*** settings is configured in ***Alarm Options*** and it is password protected.

For more information, see the supplemental information manual.

Latched alarms

When alarms are latched, the visual message remains after the alarm condition no longer exists. You will also hear a reminder beep every 10 seconds. Alarms can be configured to latch or not. The ***Latching Alarms*** setting is configured in the ***Alarm Options*** and it is password protected.

For more information, see the supplemental information manual.

To clear the information field and beep of the no longer active alarm messages:

- Select  , Or
- Select 

Alarm limits setup

Setting parameter alarm limits

Parameter alarm limits are set in the parameter menus' own ***Alarms*** tab. Alarm limits should not be set beyond reasonable physiological boundaries in order to maintain patient safety. Parameter settings outside of reasonable boundaries would cause the alarms to be ineffective.

- Select the parameter menu's ***Alarms*** tab where you can select alarms on or off, and set their limits.

Setting arrhythmia alarms

You can set the arrhythmia alarms in the ***ECG*** menu.

1. Select the ECG digit field.
2. Select the ***Alarms*** tab.
3. You can select the vertical tabs for the ***Lethal***, ***Ventricular*** and ***Atrial*** alarms.
   - ***Lethal***: You can select the ***Create Snapshot*** options, the alarm priority for lethal alarms are always high.
   - ***Ventricular***: You can select the alarm priority or turn off, ***Create Snapshot*** options.
   - ***Atrial***: You can select the alarm priority or turn off, ***Create Snapshot***, and ***Pause Interval*** options.

Setting alarm limits automatically

When selected, the Auto Limits feature automatically sets new high limit and low limit values, based upon the current physiological value. The Auto Limits should only be used for patients whose currently measured values are considered safe.

1. Select the  >  ***Alarm Setup*** > ***Setup*** tab.
2. Select ***Auto Limits***.

If you need to undo these changes and return to the previous alarm limit settings, select ***Cancel Changes*** before closing the menu.

Auto alarm limits

Parameter	High limit	Low limit
NIBP	Sys/Dia/Mean: Value*1.25+10 mmHg Value*1.25+1.3 kPa	Sys/Dia/Mean: Value*0.75-10 mmHg Value*0.75-1.3 kPa
All HR/PR parameters (ECG, SpO_2, UAC, Art, ABP)	All HR*1.25 of the current HR value (averaged over last 10 s)	All HR*0.75 of the current HR value(averaged over last 10 s)
ST group	Greatest value in group: +1 if group is enabled, otherwise limit is +2	Smallest value in group: -1 if group enabled, otherwise limit is -2
PVC	PVC+10	Not applicable
SpO_2	SpO_2 +5%	SpO_2 -5%
Art, ABP, IBP1	Sys/Dia/Mean: Value*1.25+10 mmHg Value*1.25+1.3 kPa	Sys/Dia/Mean: Value*0.75-10 mmHg Value*0.75-1.3 kPa
CVP, PA, RAP, RVP, LAP, ICP, CPP, IBP2, UAC, UVC	Sys/Dia/Mean: Value*1.25+5 mmHg Value*1.25+0.67 kPa	Sys/Dia/Mean: Value*0.75-5 mmHg Value*0.75-0.67 kPa

Parameter	High limit	Low limit
Temperature	Tx+1°C Tx+1.8°F	Tx-1°C Tx-1.8°F
RR	RR*1.25+2	RR*0.75-2
$EtCO_2$	$EtCO_2$ +5%	$EtCO_2$ -5%

Returning the default alarm limits

1. Select the > ***Alarms Setup*** > ***Setup*** tab.
2. Select ***Default Limits***.

If you need to undo these changes, select ***Cancel Changes*** before closing the menu.

For more information about the factory default alarm limits, see the supplemental information manual.

Remote management of alarms

The alarm remote control settings are defined in the ***Alarm Options*** and they are password protected. The following settings are available:

- Allowing alarm reset for this monitor from a central station (audio pause) when the ***Remote Control*** setting is ***Active***.

For more information, see the supplemental information manual.

Nurse call

The nurse call settings are defined in the ***Alarm Options*** and they are password protected. You can select whether nurse call can be turned on according to the nurse call system electrical level in the hospital.

- ***Normal Open***: high electrical level is exported from the nurse call connector when there is medium or high priority alarm.
- ***Normal Close***: low electrical level is exported from the nurse call connector when there is medium or high priority alarm.

For more information, see the supplemental information manual.

Alarm settings after a power loss

If the monitor loses power, the amount of time without power affects whether or not the alarm settings need to be reset.

Power loss duration	Alarm setting status after a power loss
Up to 120 minutes	The alarm settings that are in effect before the power loss are restored automatically.
Greater than 120 minutes	The alarm settings revert back to the user default settings (startup mode). You must manually reconfigure any patient-specific alarm settings.

Stored alarm data during a power cycle or power loss

If the monitor goes through a power cycle or loss power, the stored alarm data in the Alarm log will not be affected. The alarm data remains stored in the Alarm log until the monitor automatically clears the oldest stored data to allow new data to be stored.

NOTE The Alarm log is a service level function and it is password protected.

8

ECG

ECG safety precautions

ECG warnings

WARNING Make sure that the leadwire set clips or snaps do not touch any electrically conductive material including ground.

WARNING When using an electrosurgery unit, note that the measurement cables do not incorporate means to protect against burns in case of a defective ESU return electrode. To avoid burns at the monitor measurement sites, ensure the following:

- Proper contact of the ESU return electrode to the patient.
- ESU return electrode near the operating area.
- Measurement electrodes, leadwires and probes far from the surgical site and the ESU return electrode.

WARNING This device is intended to record electrocardiograms from surface ECG electrodes. It is not meant for positioning (floating) temporary pacemaker leadwires, performing pericardiocentesis, or other internal applications.

WARNING CONDUCTIVE CONNECTIONS. Extreme care must be exercised when applying medical electrical equipment. Many parts of the human/machine circuit are conductive, such as the patient, connectors, electrodes, transducers. It is very important that these conductive parts do not come into contact with other grounded, conductive parts when connected to the isolated patient input of the device (e.g. electrodes, SpO_2 sensor). Such contact would bridge the patient's isolation and cancel the protection provided by the isolated input.

WARNING Artifact alarm. The ***Artifact*** alarm indicates that the system is no longer monitoring ECG and there may be no ***Tachy*** or ***Brady*** alarms. If you adjust the alarm priority level lower than the default value, keep the patient under close surveillance.

WARNING ELECTRODES. Whenever patient defibrillation is a possibility, use non-polarizing (silver/silver chloride construction) electrodes for ECG monitoring. Polarizing electrodes (stainless steel or silver constructed) may cause the electrodes to retain a residual charge after defibrillation. A residual charge will block acquisition of the ECG signal.

WARNING DEFIBRILLATOR PRECAUTIONS. Patient signal inputs labeled with the CF and BF symbols with paddles are protected against damage resulting from defibrillation voltages. To ensure proper defibrillator protection, use only the recommended cables and leadwires.

WARNING HEART RATE ALARM INTERFERENCE. Poor cable positioning or improper electrode preparation may cause line isolation monitor transients to resemble actual cardiac waveforms and thus inhibit heart rate alarms. To minimize this problem, follow proper electrode placement and cable positioning guidelines provided with this device.

WARNING Disconnected electrodes or loose electrode connections can lead to missed critical severity alarms. If the monitor reports ***Leads off*** after selecting 3/5 lead option, always check the electrode connections to the patient.

ECG cautions

CAUTION The patient's skin may become irritated after prolonged contact with electrode gel or adhesive.

ECG measurement limitations

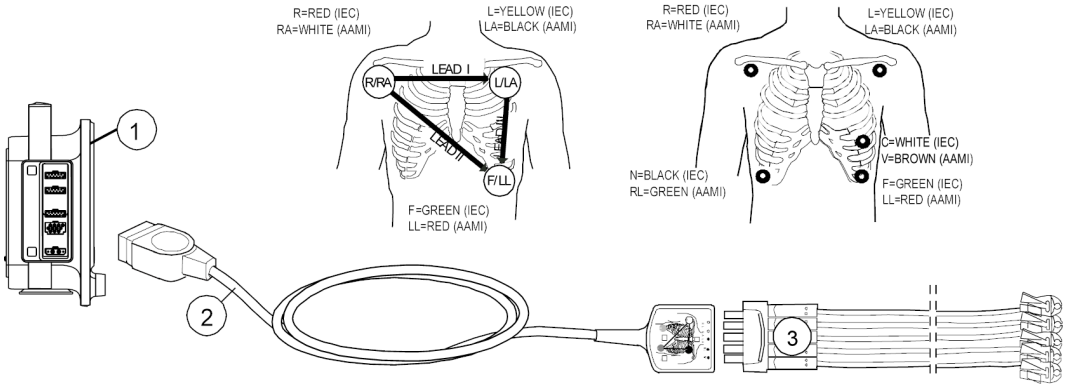
- The monitor will display a ***Leads off*** message in an input overload condition, or upon disconnection of electrode leadwires.

ECG points to note

- This equipment is suitable for use in the presence of electrosurgery, as tested according to IEC 60601-2-49 clause 202.6.2.101 Electrosurgery interference.
- Pre-gelled ECG electrodes are recommended. Check the expiration date.
- Make sure the electrode gel is moist.
- Make sure the electrodes have good skin contact.
- Replace all electrodes at least every 24 to 48 hours.
- Use the Multi-Link electrosurgical unit (ESU) ECG patient cable when using the monitor in the presence of an electrosurgical unit. This cable, with a built-in ESU filter, helps reduce electrosurgical noise detected on the ECG signal.
- Whenever a cable, electrode or V-lead is changed, the monitor automatically relearns.
- Don't use the electrodes with dissimilar metals.

ECG measurement setup

ECG equipment to patient connection



1. The monitor
2. Multi-Link 3/5-lead ECG cable
3. 3-leadwire, 5-leadwire set

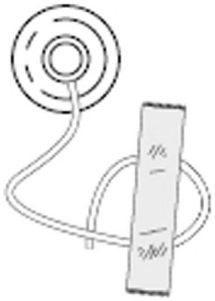
Preparing the patient's electrode sites

Excessive body hair or skin oil reduces electrode contact with the skin and decreases the quality of electrode signal. When preparing the electrode sites, avoid bones close to skin, obvious layers of fat and major muscles.

1. Shave any hair from the electrode site.
2. Gently rub the surface of the skin to increase capillary blood flow.
3. Clean the skin with alcohol or a mild soap and water solution to remove skin oil and dead or abraded skin cells.
4. Dry the skin completely before applying the electrodes.

Applying the electrodes to the patient

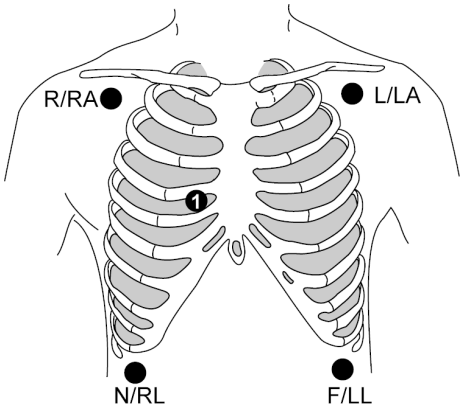
1. Place the electrodes on the prepared sites.
2. Stabilize the electrode and leadwire with a leadwire stress loop near the electrode.
3. Tape the stress loop to the patient (excluding neonates).



A secured stress loop prevents leadwire rotation about the electrode snap, leadwire tugging at the electrode, and ECG artifact.

3– lead or 5–lead ECG electrode placement

For a 3-leadwire electrode placement, the R/RA, L/LA, and F/LL electrodes should be used.



IEC	AAMI/AHA	Electrode placement
R (red)	RA (white)	Just below the right clavicle.
L (yellow)	LA (black)	Just below the left clavicle.
C (white)	V (brown)	For the 5-lead placement, place the precordial electrode according to the physician's preference.
N (black)	RL (green)	Lower right edge of the rib cage.
F (green)	LL (red)	Lower left edge of the rib cage.

Checking the ECG measurement

1. Check that the waveforms and parameter values are displayed when the cable is connected to the patient.

Using the ECG measurement

Setup the parameter to main screen if need: > ***Screen Setup***.

ECG leads settings

You can choose the order of the ECG waveforms displayed in the ECG waveform area.

Lead selection depends on the type of ECG cable used.

The ***ECG1 Lead***, ***ECG2 Lead***, and ***ECG3 Lead*** settings affect arrhythmia detection.

If ***ECG1 Lead*** is not available, the monitor looks for lead II, then lead I, and lastly lead III.

Selecting the first displayed ECG lead

The ***ECG1 Lead*** is the first ECG lead displayed in the ECG waveform area.

1. Select the HR digit field > ***Setup*** tab.
2. Select a lead from the ***ECG1 Lead*** list.

Selecting the second displayed ECG lead

The ***ECG2 Lead*** is the ECG lead displayed after the ***ECG1 Lead*** in the ECG waveform field.

NOTE For 3–lead ECG, the ***ECG2 Lead*** and ***ECG3 Lead*** can't select the lead. The menu is gray. They are fixed to ***Cascade***.

1. Select the HR digit field > ***Setup*** tab.
2. Select a lead from the ***ECG2 Lead*** list.

   If your selection is ***Cascade***, the displayed ***ECG1 Lead*** waveform continues into the ***ECG2 Lead*** waveform area. The ***Cascade*** text is shown by the left side of the waveform.

Selecting the third displayed ECG lead

The ***ECG3 Lead*** is the ECG lead displayed after the ***ECG2 Lead*** in the ECG waveform field.

NOTE For 3–lead ECG, the ***ECG2 Lead*** and ***ECG3 Lead*** can't select the lead. The menu is gray. They are fixed to ***Cascade***.

1. Select the HR digit field > ***Setup*** tab.
2. Select a lead from the ***ECG3 Lead*** list.

   If your selection is ***Cascade***, the displayed ***ECG2 Lead*** waveform continues into the ***ECG3 Lead*** waveform field. The ***Cascade*** text is shown by the left side of the waveform.

Selecting the V ECG lead position

With 5–lead ECG, one V lead is measured according to the placement of the V lead electrode.

NOTE When use the 3–lead cable or ***5 Lead Cable*** is selected ***3elect***, the ***V Lead*** menu will turn to gray, it's disabled.

1. Select the HR digit field > ***Setup*** tab.
2. Select a lead from the ***V Lead*** list.

Selecting the ECG waveform size

This selection adjusts the size of the displayed ECG waveform.

1. Select the HR digit field > ***Setup*** tab.
2. Select a value from the ***Size*** list.

   The selections are ***0.5x***, ***1x***, ***2x***, ***4x***. The smaller the value, the smaller the waveform.

NOTE The ***Size*** setting affects arrhythmia detection and heart rate calculation sensitivity. Normal waveform size/QRS detection sensitivity is ***1x***. Size ***2x*** and greater increases the QRS detection sensitivity. This may be helpful for low amplitude QRS waveforms. Use with caution since baseline artifact may be detected as a QRS complex.

Selecting the hemodynamic waveform sweep speed

NOTE This setting adjusts the waveform speed for all of the hemodynamic parameters.

1. Select the HR digit field > ***Setup*** tab.
2. Select a numeric value from the ***Hemodynamics Sweep Speed*** list.

   The smaller the value, the slower the sweep speed.

Setting the beat volume

NOTE This setting adjusts beat volume for both of ECG and SpO_2 parameters.

You can adjust the volume of heart/pulse beat sound. The beat tone depends on HR source to calculate.

1. Select the HR digit field > ***Setup*** tab.
2. Set the beat tone volume with the ***Beat Volume*** arrows.

   The range is 0 (volume off) to 10.

Selecting the ECG waveform filter

You can select how the waveform appears on the display and on the printout.

1. Select the HR digit field.
2. Select the ***Advanced*** tab.
3. Select a filter from the ***Waveform Filter*** list. Choices are:
   - ***Monit***: Use Monitor filter for poor ECG signal.
     0.5 to 40 Hz
   - ***STfilt***: Use ST filter for optimal ST analysis.
     0.05 to 40 Hz
   - ***Diagn***: Use Diagnostic filter for waveform analysis. This filter is sensitive to artifacts.
     0.05 to 145 Hz

Setting the QRS width

NOTE This setting affects the arrhythmia detection sensitivity.

1. Select the HR digit field.
2. Select the ***Advanced*** tab.
3. Select a setting from the ***QRS Width*** list. Choices are:
   - ***Narrow***: Intended for use with all neonates and the pediatric patient with a QRS complex width of 100 ms or less.
   - ***Normal***: Intended for ECG rhythms that have QRS complex widths of approximately 70 ms or wider (for example, almost all adult patients and any patient with electronic ventricular pacing).

Selecting the number of electrodes for 5–lead ECG

When use 5–lead cable, there is a choice for ECG measurement with 5 or 3 electrodes.

1. Select the HR digit field.
2. Select the ***Advanced*** tab.
3. Select the number of electrodes from the ***5 Lead Cable*** list.

Setting the primary HR source

The primary heart rate can be calculated from the ECG leads, SpO_2 measurement, or invasive pressure waveform.

NOTE This setting adjusts the primary heart rate source for all of the hemodynamic parameters.

1. Select the HR digit field.
2. Select the ***Advanced*** tab.
3. Select a parameter from the ***Primary HR Source*** list.

Showing a second HR value

You can display a second heart rate source in the HR digit field.

1. Select the HR digit field.
2. Select the ***Advanced*** tab.
3. Select a setting from the ***Display with Primary HR*** . The choices are:
   - ***None***
   - ***2nd HR Source***
     - If the primary HR source is ***ECG***, the secondary HR source displayed in this priority: ***UAC***, ***Art***, ***ABP***, ***Pleth***. ***UAC*** is available in the Neonatal mode only.
     - If the primary HR source is anything else than mentioned above, the secondary HR source is always ***ECG***.
   - ***PVC***

Displaying the ECG grid

You can have a reference grid in the ***ECG1***, ***ECG2***, and ***ECG3*** waveform areas. The grid points will be at 200 ms horizontally and 0.5 mV vertically.

1. Select the HR digit field.
2. Select the ***Advanced*** tab.
3. Select the check box of the ***ECG Grid*** to display the grid.

Relearning the patient's QRS pattern

During ECG monitoring, you may need to use the ***Relearn*** feature when a dramatic change in the patient's ECG pattern has occurred. Allowing the monitor to learn the new ECG pattern may correct false arrhythmia alarms and heart rate values, and restores the ST measurements.

Relearning typically takes 30 seconds or less. This relearn key will turn to gray and display ***Learning*** while the monitor relearns the QRS pattern. During this time, arrhythmia detection may not be available. If the monitor is not able to relearn due to a low amplitude QRS, for example, an ***Arrhythmia Paused*** alarm is triggered.

1. Select the HR digit field.
2. Select the ***Advanced*** tab.
3. Select ***Relearn***.

Automatic relearning takes place when:

- The measurement mode changes between a 3–lead mode and 5–lead mode.
- The ***ECG1 Lead*** selection is changed in the 3–lead mode.
- The V lead selection is changed in the 5–lead mode.

ECG alarm limits

From the ***Alarms*** tab, you can set

- One common HR limit for multiple sources (e.g., ECG, SpO_2, Art).

Setting the HR alarm limits

1. Select the HR digit field
2. Select the ***Alarms*** tab.
3. Check that the ***Alarm*** is turned on.
4. Adjust the alarm limits with the arrows. Limits are adjust in increments of 5 bpm per step.

NOTE If you want the HR alarm off, select from the ***Alarm*** list.

Setting PVC alarm limits

1. Select the HR digit field.
2. Select the ***Alarms*** tab.
3. Select the ***PVC*** vertical tab.
4. Check that the ***Alarm*** is turned on.
5. Adjust the PVC alarm limit with the arrows.

NOTE If you want the PVC alarm off, select from the ***Alarm*** list.

ECG measurement practicalities

Alternate pulse rate source

The alternate pulse rate source allows clinicians to acquire a pulse rate from a source other than ECG (Art, ABP, UAC or SpO_2). The following circumstances may warrant the use of an alternate pulse rate source:

- Excessive artifact due to an electrical interference from equipment (e.g., electrosurgical device).
- Excessive patient movement causing significant artifact (e.g., seizure activity).

- Inability to use standard lead placement (e.g., burns).

Auto algorithm

The monitor use the AUTO algorithm. ***AUTO*** selects the first available heart rate source based on a pre-defined parameter priority:

1. ECG
2. UAC (Neonatal mode only)
3. Art
4. ABP
5. SpO_2

ECG troubleshooting

Problem	Solution
ECG signal is noisy or no QRS is detected	• Ensure that the patient is not shivering. • Select the correct filter by selecting the HR digit field > ***Advanced*** tab > ***Waveform Filter***. • Check the electrode quality and positioning. Do not place electrodes on body hair, bones close to skin, layers of fat and major muscles. Pre-gelled electrodes are recommended. • Change the lead in ECG1 to the best available signal. • Consider using ***Size*** > ***2x***. • Try on alternative location for the V lead to improve signal quality. • Check all cable connectors.

Pacemaker detection

Pacemaker detection warnings

WARNING RATE METERS. Keep pacemaker patients under close observation. Rate meters may continue to count the pacemaker rate during cardiac arrest and some arrhythmias. Therefore, do not rely entirely on rate meter alarms. See the supplemental information provided for disclosure of the pacemaker pulse rejection capability of this device.

WARNING FALSE CALLS. False low heart rate indicators or false Asystole calls may result with certain pacemakers because of pacemaker artifact such as electrical overshoot of the pacemaker overlapping the true QRS complexes.

WARNING MONITORING PACEMAKER PATIENTS: the monitoring of pacemaker patients can only occur with the pace program activated.

WARNING PACEMAKER INDICATION. Pacemaker activity is indicated on the electrocardiogram through the display of a different colored pacemaker marker pulse. All pacemaker marker pulses appear upright and uniform and should not be used for diagnostic interpretation.

WARNING PATIENT HAZARD. A pacemaker pulse can be counted as a QRS during Asystole. Keep pacemaker patients under close observation.

WARNING PATIENT HAZARD. Asystole may not be detected if the patient has a pacemaker that produces high-amplitude pacer spikes, the pacemaker detection is on. Keep pacemaker patients under close observation.

Pacemaker detection points to note

- Pacemaker detection is always on.
- If the patient has an atrial pacemaker, ST calculations can be performed if the pacer spike does not coincide with the ISO point's adjustment range.

Selecting the pacemaker detection

1. Select the HR digit field.
2. Select the ***Advanced*** tab.
3. Select a value from the ***Pacemaker Detection*** list.

   Choices are:

   - ***Show***: Displays pacemaker spikes on the ECG waveform.
   - ***Hide***: Hides the pacemaker spikes on the ECG waveform.
     An indicator will display on the left side of the waveform, when the selection is ***Hide***.
   - ***Sensitive***: Increases pacemaker detection sensitivity and displays the pacemaker spikes on the ECG waveform. By selecting this option you can improve the detection of small amplitude pacemakers. However, this mode is also more sensitive to false pacemaker detections.

Pacemaker detection troubleshooting

Problem	Solution
How does activating pacemaker detection impact monitoring?	• Beats that would otherwise be classified as ventricular are instead classified as V-paced if a ventricular pacemaker event is detected. • Residual pacemaker energy that might otherwise appear in the ECG is removed, and a pacemaker enhanced spike is placed in the ECG. • On the ECG waveform, pacemaker detection is indicated by uniform, upright pacemaker enhancement spikes in the ECG data, both displayed and graphed.
How can pacemaker detection be improved?	• Possible problems include: ▪ Heart rate double counting.

Problem	Solution
	▪ Inaccurate alarms for low heart rate or asystole. ▪ Pacemaker spikes not recognized by the software. ▪ False PVC detections and arrhythmia alarms. • Possible solutions include: ▪ Relearn arrhythmia. ▪ Re-prepare the patient skin, replace the electrodes, and adjust the electrode placement. ▪ Try an alternate electrode placement. ▪ Switch to another pacemaker detection mode.
Why is the monitor double-counting the heart rate, alarming for a low heart rate, or not detecting pacemaker spikes?	The monitor is not detecting pacemaker activity. Causes may include: • The pacemaker signal is too weak for the monitor to detect. • The ECG signal is too weak for the monitor to detect. • The monitor is detecting atrial pacemaker artifact or non-QRS features as beats. If the monitor is alarming for low heart rate or asystole, assess the QRS amplitude: • View all ECG leads to assess the amplitude of the QRS complexes. To ensure correct HR readings, a 0.5 mV QRS amplitude is recommended for a normal ECG signal. If the QRS amplitude drops below 0.5 mV or an abnormal QRS width occurs (more than 120 ms), QRS detection may be reduced, leading to false asystole alarms. • If necessary, reprep the skin and reposition the electrodes. • Relearn ECG.

Arrhythmia monitoring

Arrhythmia monitoring warnings

WARNING V Fib/V Tach should not be considered a substitute for the V Tach arrhythmia alarm. Efforts to lower the V Tach alarm level can result in missed ventricular tachycardia alarms.

WARNING LOSS OR DETERIORATION OF ARRHYTHMIA DETECTION. Automated arrhythmia analysis programs may incorrectly identify the presence or absence of an arrhythmia. A physician must therefore interpret the arrhythmia information in conjunction with other clinical findings. Please take special note of the following ECG waveform conditions:

- Noisy waveforms. Noisy portions of ECG waveforms are typically excluded from analysis. The exclusions are necessary to reduce the occurrence of inaccurate beat interpretations and/or rhythm alarms. If the excluded noisy portions of the ECG waveform contain true arrhythmia events, those events may remain undetected by the system.
- Beat amplitude and duration. Accurate detection and interpretation of beats becomes increasingly difficult as the amplitude and/or duration of those beats approach the design limits of the analysis program. Thus, as beats become extremely wide or narrow, or especially as beats become small, arrhythmia interpretation performance may degrade.
- Other morphology considerations. Automated arrhythmia detection algorithms are designed fundamentally to detect significant changes in QRS morphology. If an arrhythmia event is present and does not exhibit a significant change from the patient's predominant morphology, it is possible for those events to remain undetected by the system.

WARNING PAUSED ANALYSIS. Certain conditions pause arrhythmia analysis. When paused, arrhythmia conditions are not detected and alarms associated with arrhythmias do not occur. Conditions causing paused arrhythmia analysis include arrhythmia paused, leads off, alarm pause, all alarms off, and discharged patient. Always keep the patient under close surveillance.

WARNING FAILURE TO DETECT LETHAL ARRHYTHMIA. Always monitor ECG for arrhythmia detection purposes. HR calculated from pulsatile SpO_2 waveform may differ significantly from ECG HR measured values. Users should be aware that the ***SpO2 probe off*** and ***No SpO2 pulse*** alarms escalate no higher than a Medium priority.

WARNING FAILURE TO DETECT LETHAL ARRHYTHMIA. The SpO_2 parameter pulsatile heart rate measurement is based on the optical detection of a peripheral flow pulse and therefore may not detect certain arrhythmias. The pulse oximetry parameter should not be used as a replacement or substitute for ECG based arrhythmia analysis.

WARNING ARRHYTHMIA PAUSED alarm. The ***Arrhythmia Paused*** alarm indicates that the system is no longer monitoring arrhythmia or heart rate from ECG. If you adjust the alarm priority level lower than the default value, keep the patient under close surveillance.

Arrhythmia measurement limitations

- Since the arrhythmia detection algorithm sensitivity and specificity is less than 100%, sometimes there may be some false arrhythmias detected and also some true arrhythmia events may not be detected. This is especially true when the signal is noisy.
- The ECG size and QRS width settings affect arrhythmia detection and heart rate calculation sensitivity.
- If QRS amplitude is low, the monitor might not be able to calculate HR and false Asystole may occur.
- During the learning phase of the algorithm, arrhythmia detection may not be available. As a result, the patient condition should be closely monitored during the learning phase and for several minutes after the learning phase to allow the algorithm to reach optimal detection performance.
- Alarm ***Missing Beat*** can't be set from Central Station.

Setting arrhythmia alarms

You can set the arrhythmia alarms in the ***ECG*** menu.

1. Select the ECG digit field.
2. Select the ***Alarms*** tab.
3. You can select the vertical tabs for the ***Lethal***, ***Ventricular*** and ***Atrial*** alarms.
   - ***Lethal***: You can select the ***Create Snapshot*** options, the alarm priority for lethal alarms are always high.
   - ***Ventricular***: You can select the alarm priority or turn off, ***Create Snapshot*** options.
   - ***Atrial***: You can select the alarm priority or turn off, ***Create Snapshot***, and ***Pause Interval*** options.

Setting the alarm pause interval

You can set the time interval between the two adjacent beats before the pause alarm condition is annunciated.

1. Select the HR digit field.
2. Select the ***Alarms*** tab.
3. Select the ***Atrial*** vertical tab.
4. Select a value from the ***Pause Interval*** list.

Arrhythmia alarm messages

NOTE A clinician must analyze the arrhythmia information in conjunction with the other clinical findings.

Lethal alarms

Alarm message	Arrhythmia detection criteria
Asystole	HR decreased to zero.
V Fib / V Tach	ECG waveform indicates a chaotic ventricular rhythm.
V Tach	A run of PVCs is detected with a run length of six beats or more and the effective HR exceeds 100 bpm (160 bpm in Neonatal mode).

Ventricular alarms

Alarm message	Arrhythmia detection criteria
VT > 2	A run of PVCs is detected with a run length of more than two beats but less than the six beats. In addition at least two consecutive RR intervals in the run must have an effective HR that exceeds 100 bpm.
R on T	Isolated PVC is detected within 100 ms of the peak of the T-wave of the patient's predominant normal beat.
V Brady	Run of PVCs are detected with a run length of at least three beats. In addition, at least two consecutive RR intervals in the run must have an effective heart rate less than 50 bpm (60 bpm in Neonatal mode).
Couplet	Two consecutive PVCs are detected between normal beats, N-V-V-N. The coupling interval between the PVCs must be less than 600 ms.
Bigeminy	Every other beat is PVC (N-V-N-V-N-V).
Accel. Ventric.	Accelerated ventricular rhythm - Run of PVCs with a run length of at least six beats and the rate requirements have not met for V Tach or V Brady.
Trigeminy	Every third beat is PVC (N, N, V, N, N, V, N, N, V).
Multifocal PVCs	Over the last 15 beats two or more PVCs with different morphologies are detected.

Atrial alarms

Alarm message	Arrhythmia detection criteria
A Fib	Absence of P-waves and irregular RR-interval.
Missing Beat	Actual RR interval more than 1.8 times the average RR interval.
Pause	Coupling interval between two beats exceeds: 1 to 5 seconds (configurable)

Arrhythmia detection description

When an ECG signal is detected at the start of monitoring, the arrhythmia detection algorithm begins acquiring and analyzing QRS complexes in the leads used for arrhythmia detection. This phase is known as learning. Once learning is complete, the dominant QRS complex is stored as a reference template. Reference template is used as a normal morphology of that patient and it is compared with incoming beats to identify possible arrhythmias.

The EK-Pro arrhythmia detection algorithm is used. EK-Pro simultaneously analyzes leads I, II, III, and V. Once learning is complete, the dominant QRS complex becomes the template.

The algorithm uses continuous correlation, incremental template updating and contextual analysis. Continuous correlation attempts to find the best match between each incoming complex and the set of stored (learned) templates. If no match is found with the existing template, a new template is stored for the identified new QRS shape. Incremental template updating allows information from each beat, that correlates over time, to be reflected in the associated template. Contextual analysis uses information from neighboring QRS complexes along with existing template measurements to make the best possible decision regarding the beat's origin (e.g., early, wide).

Arrhythmia troubleshooting

Problem	Solution
Why is the monitor alarming for asystole, bradycardia, or inaccurate heart rate when a visible QRS waveform is present?	The monitor may not be detecting sufficient QRS amplitude in all analyzed leads. Multiple leads are used for arrhythmia processing. 1. Assess the patient. 2. Check the ECG signal acquired from the patient. 3. View all ECG leads to assess the amplitude of the QRS complexes. To ensure correct HR readings, a 0.5 mV QRS amplitude is recommended for a normal ECG signal. If the QRS amplitude drops below 0.5 mV or an abnormal QRS width occurs (more than 120 ms), QRS detection may be reduced, leading to false ***Asystole*** alarms. 4. Relearn arrhythmia. It is important to relearn the patient's ECG pattern any time the electrode configuration is adjusted. 5. The ECG size settings affect the arrhythmia detection and heart rate calculation. Increase the ECG size by selecting a value from the ***Size*** list.
Why is the monitor calling V Tach when the patient is not in V Tach?	The monitoring system may be detecting a wider QRS complex or artifact in some of the analyzed ECG waveforms. In addition, the V leads may be exhibiting polarity changes, which may occasionally cause an inaccurate call. 1. Assess the patient. 2. Check the ECG signal acquired from the patient. • View all ECG leads to assess the width of the QRS complexes in the analyzed leads. • If artifact exists in any of the analyzed leads, reprep the patient's skin, replace electrodes, and adjust the electrode placement. • It may be beneficial to move V lead electrodes (chest lead) to alternate precordial electrode placements to improve detection.

Problem	Solution
	3. Relearn arrhythmia. It is important to relearn the patient's ECG pattern any time the electrode configuration is adjusted.

ST detection

About the ST analysis

If enabled, ST analysis starts automatically after the ECG leads have been connected and QRS detection has started. Once the program has completed the learning phase, ST values are updated every 10 seconds, QRS complexes every 40 seconds.

During the learning period, the algorithm uses the isoelectric reference and the J+ reference points to calculate the ST values. The algorithm automatically searches for the J and ISO points. These settings can be adjusted for the current patient.

In order to get the better ST analysis, it is recommended to setup ***Diagn*** for ***Waveform Filter***.

- Select the ECG digit field > ***Advanced*** tab > ***Waveform Filter*** > ***Diagn***.

ST detection measurement limitations

- ST values may be affected by such factors as some drugs or metabolic and conduction disturbances.
- Since ST is often calculated with a fixed delay from the J point, changes in heart rate may affect ST.
- The ST algorithm has been tested for accuracy of the ST segment data. The significance of the ST segment changes needs to be determined by a physician.

ST detection points to note

ST segment deviations are not displayed for patients with ventricular pacemakers or if the rhythm is considered as from ventricular origin.

Adjusting the ST point manually

- The device automatically set the ST point according to the heart rate. Manual adjustments may be required if the following automatic settings are not adequate for example when QT time is short:
  - If the heart rate is greater than or equal to 120 bpm, then the ST point is set to J + 60 ms.
  - If the heart rate is less than 120 bpm, then the ST point is set to J + 80 ms.

Manually adjusting the ST Point, ISO Point, or J Point overrides the automatic detection of the ST point. As a result, you are responsible for monitoring the patient ST levels with new adjustments and required to make further setting adjustments as necessary according to changes in the patient's rhythm.

1. Select the ST digit field > ***ST*** tab > ***Adjust ST*** vertical tab.
2. Select a value from the ***ST point*** list.

Adjusting the isoelectric measurement (ISO) point

The device automatically set the isoelectric point. Manual adjustments may be required if, for example, a P-wave is attached to the QRS-wave.

1. Select the ST digit field > ***ST*** tab > ***Adjust ST*** vertical tab.
2. Click ***Set ISO point***, adjust the bar with the arrows.

   When the ISO point is adjusted, also the ST point changes accordingly and its automatic setting is stopped.

Adjusting the J point

1. Select the ST digit field > ***ST*** tab > ***Adjust ST*** vertical tab.
2. Click ***Set J point***, adjust the bar with the arrows.

   When the J point is adjusted, also the ST point changes accordingly.

Setting alarm limits for lead groups

1. Select the HR digit field > ***ST*** tab.
2. Select ***Lat. Alarm***, ***Inf. Alarm***, or ***Ant. Alarm*** tab for an ECG lead group.
3. Check that the ***Alarm*** is turned on.
4. Adjust the alarm limits with the arrows for Lateral, Inferior or Anterior alarms.

NOTE If you wish the alarm off, select from the related ***Alarm*** list.

9

Impedance respiration

Respiration safety precautions

Respiration warnings

WARNING Make sure that the leadwire set clips or snaps do not touch any electrically conductive material including ground.

WARNING The impedance respiration measurement is inherently very sensitive as it measures very small physiological signals (changes of impedance of the patient's chest area). Electromagnetic interference may cause erroneous measurements at various frequencies, for example interference with the signal/ waveform, leading to respiration rate readings inconsistent with the patient's true respiration rate. If you notice this, use another form of respiration monitoring, for instance end-tidal CO_2.

WARNING When using an electrosurgery unit, note that the measurement cables do not incorporate means to protect against burns in case of a defective ESU return electrode. To avoid burns at the monitor measurement sites, ensure the following:

- Proper contact of the ESU return electrode to the patient.
- ESU return electrode near the operating area.
- Measurement electrodes, leadwires and probes far from the surgical site and the ESU return electrode.

WARNING APNEA EVENTS. The device may not detect all episodes of inadequate breathing, nor does it distinguish between central, obstructive, and mixed apnea events.

WARNING DEFIBRILLATOR PRECAUTIONS. Patient signal inputs labeled with the CF and BF symbols with paddles are protected against damage resulting from defibrillation voltages. To ensure proper defibrillator protection, use only the recommended cables and leadwires.

WARNING ELECTRODE CONFIGURATION. Impedance respiration monitoring is not reliable when ECG electrodes are placed anywhere but on the chest.

WARNING ELECTRODES. Whenever patient defibrillation is a possibility, use non-polarizing (silver/silver chloride construction) electrodes for ECG monitoring. Polarizing electrodes (stainless steel or silver constructed) may cause the electrodes to retain a residual charge after defibrillation. A residual charge will block acquisition of the ECG signal.

Respiration cautions

CAUTION The impedance respiration measurement may cause rate changes in Minute Ventilation Rate Responsive Pacemakers. Turn off the impedance respiration measurement on the monitor.

Respiration measurement limitations

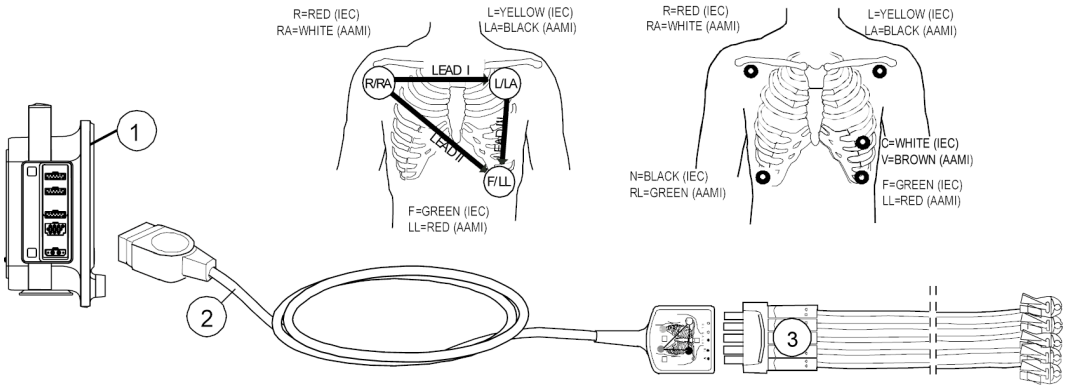
- For FDA countries — The impedance respiration measurement are not suitable for use with neonatal patients.
- Electrical devices, such as electrosurgery units and infrared heaters, that emit electromagnetic disturbance, may cause artifacts or disable the respiration measurement completely.
- Movement artifacts, shivering, and interference from the heart may interfere with the respiration measurement.

Respiration points to note

- This equipment is suitable for use in the presence of electrosurgery, as tested according to IEC 60601-2-49 clause 202.6.2.101 Electrosurgery interference.
- Do not place electrodes on obvious layers of fat, or major muscles.
- Make sure the electrode gel is moist.
- Make sure electrodes have good skin contact.
- Since respiration monitoring is so closely linked with ECG monitoring, patient preparation and electrode placement are important.
- Intermittent mechanical ventilation: During spontaneous breathing the ventilator may at times support the patient's ventilation with an extra inspiration. If these ventilator inspirations are substantially larger than the spontaneous breaths, the respiration calculation may mistakenly count only the inspirations and expirations produced by the ventilator.

Respiration measurement setup

Respiration equipment to patient connection



1. The monitor
2. Multi-Link 3/5-lead ECG cable
3. 3-leadwire, 5-leadwire set

Preparing the patient's respiration electrode sites

Excessive body hair or skin oil reduces electrode contact with the skin and decreases the quality of electrode signal.
When preparing the electrode sites, avoid obvious layers of fat and major muscles.

1. Shave any hair from the electrode site.
2. Gently rub the surface of the skin to increase capillary blood flow.
3. Clean the skin with alcohol or a mild soap and water solution to remove skin oil and dead or abraded skin cells.
4. Dry the skin completely before applying the electrodes.

Respiration measurement checks

1. Check that the waveform and parameter value are displayed when the cable is connected to the patient.

NOTE There may also be a respiration rate value displayed in the CO_2 digit field. Only the value in the respiration digit field is measured from the impedance respiration source.

Using the respiration measurement

Setup the parameter to main screen if need: > ***Screen Setup***.

Turning on the respiration measurement

If the respiration measurement does not start automatically, you need to select it on.

1. Select the impedance respiration digit field.
2. Select ***ON*** from the ***Measurement*** list.

Selecting the respiration waveform size

1. Select the impedance respiration digit field.
2. Select a value from the ***Size*** list.

The greater the value, the larger the waveform size.

Selecting the detection limit

To ensure the correct respiration rate, adjust the detection limits. Normally, the ***AUTO*** detection limit is recommended. However, in some specific cases user may wish to adjust the limits manually.

- When the respirations are weak: adjust the detection limits closer to each other to make sure that all respirations are included in the RR value. In this case, the dotted line represent the absolute detection limits.
- There is a lot of artifact: adjust the detection limits further apart to separate smaller artifacts from the larger true peaks. The small peaks fall within the grids and are not calculated, the bigger peaks cross the grids and are calculated as true respirations.

1. Select the impedance respiration digit field.
2. Select a value from the ***Detection Limit*** list.

The greater the value, the further apart.

Selecting the waveform speed

1. Select the impedance respiration digit field.
2. Select a value from the ***Sweep Speed*** list.

   Choices are:

   - ***6.25 mm/s***
   - ***0.625 mm/s***

Selecting the respiration rate source

NOTE This setting adjusts the respiration rate source for both of the impedance respiration and CO_2 parameters.

1. Select the impedance respiration digit field.
2. Select a value from the ***Resp Rate Source*** list.

   The choices are:

   - ***AUTO***: the monitor selects the respiration rate source from the available sources. The first priority is CO_2. When the CO_2 measurement is not available, the impedance respiration is used.
   - ***CO2***: available only if there is a CO_2 source.
   - ***Imped.***: available only if there is an ECG source.

Setting the No Breath alarm delay for neonatal

This menu is not available for FDA countries.

This menu is shown only in the NEONATAL mode. You can choose how many seconds for the ***No Breath*** alarm delay.

1. Select the impedance respiration digit field.
2. Select a value from the ***No Breath Time (s)*** list.

Setting the respiration alarm limits

1. Select the impedance respiration digit field.
2. Select the ***Alarms*** tab.
3. Check that ***Alarm*** is turned on.
4. Adjust the alarm limits with arrows.

NOTE If you want the alarm off, select from the ***Alarm*** list.

Turning off the respiration measurement

1. Select the impedance respiration digit field.
2. Select ***OFF*** from the ***Measurement*** list.

Respiration measurement description

When starting respiration monitoring, the system "learns" the patient's respiration pattern. The respiration rate is calculated from impedance changes and a respiration waveform is displayed.

With impedance respiration ***Detection Limit*** set to ***AUTO***, two breaths are averaged and the average amplitude of the respiration waveform is found. Detection sensitivity is automatically set at one half of the average amplitude. Sensitivity dotted lines displayed on the waveform show the minimum detection range which is 25%. The percentage is the ratio to the reference bar on the left in the waveform display, which corresponds to 100%. The user can manually set the impedance respiration ***Detection Limit*** to ***20%***, ***40%***, ***80%***, or ***100%*** and the sensitivity dotted lines displayed on the waveform will show the selected detection range. The percentage is shown with a reference bar that corresponds to 100%, meaning that the ***100%*** selection uses the whole drawing area. The bar is on the left in the waveform display.

Respiration troubleshooting

Problem	Solution
What can I do if the respiration measurement fails?	• Check electrode quality and positioning. • Adjust the breath detection limits. During ventilator-supported breathing, the respiration calculation may count only ventilator-produced inspirations and expirations. • Other electrical devices may interfere with the measurement.
Why does the waveform have a combination of shallow and deep breaths, but the monitor is not detecting the shallow breaths?	If breath detection sensitivity threshold is too high, shallow breaths will not be detected. • Decrease the detection limit percentage until the markers correctly identify each inspiration and expiration or set to ***AUTO***. If the detection limit is ***AUTO***, the grid line represent the minimum limits.

Problem	Solution
	Respiration detection is not dependent on the size of the waveform. Size is for visual purposes only.
Why is the monitor detecting cardiac artifact as breaths?	The breath detection sensitivity threshold is too low. • Increase the detection limit percentage until the markers correctly identify each inspiration and expiration.

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Pulse oximetry

SpO_2 safety precautions

SpO_2 warnings

WARNING DEFIBRILLATOR PRECAUTIONS. Patient signal inputs labeled with the CF and BF symbols with paddles are protected against damage resulting from defibrillation voltages. To ensure proper defibrillator protection, use only the recommended cables and leadwires.

WARNING The operator is responsible for checking the compatibility of the pulse oximetry device, sensor, and patient cable prior to use. Incompatible components can result in degraded performance and/or device malfunction.

WARNING If the accuracy of any measurement does not seem reasonable, first check the patient's vital signs, then check for conditions that may cause inaccurate SpO_2 readings. If the problem is still not resolved, check the monitor and the SpO_2 module, cable, or sensor for proper functioning.

WARNING A pulse oximeter should not be used as an apnea monitor. A pulse oximeter should be considered an early warning device. As a trend toward patient deoxygenation is indicated, blood samples should be analyzed by a laboratory CO-oximeter to completely understand the patient's condition.

WARNING Check that the pulse oximetry waveform is physiological in shape to ensure waveform quality and minimize noise spikes caused by motion conditions. (Not applicable when monitoring SpO_2 with Masimo SET technology.)

WARNING To prevent erroneous readings, do not use physically damaged sensors, cables or modules. Discard a damaged sensor or cable immediately. Never repair a damaged sensor or cable; never use a sensor or cable repaired by others.

WARNING Pulse rate measurement is based on the optical detection of a peripheral flow pulse and therefore may not detect certain arrhythmias. The pulse oximeter should not be used as a replacement or substitute for ECG-based arrhythmia analysis.

WARNING Cable/sensor after care:

- Do not reuse sensors intended for single patient use.
- Do not sterilize sensors or patient cables by irradiation, steam, or ethylene oxide.
- Clean the surface of the probe before and after each patient use.
- Allow sensor and cable to dry completely after cleaning. Moisture and dirt on the connector can affect the measurement accuracy.
- If a probe is damaged in any way, discontinue use immediately.
- Inaccurate SpO_2 data can result if a sensor is past its useful life. Therefore, re-evaluate the measurement periodically by performing additional assessment of the patient and equipment, including consideration of use of alternate monitoring methods such as direct measurement of arterial oxyhemoglobin saturation (SaO_2).
- A damaged sensor may cause burns during electrosurgery.

WARNING Oximetry performance may be impaired when patient perfusion is low or signal attenuation is high.

WARNING NEONATAL. The display of inaccurate pulse oximetry (SpO_2) values has been linked to the presence of poor signal strength or artifact due to patient motion during signal analysis. This condition is most likely to be encountered when the monitor is used on neonates or infants. These same conditions in adults do not impact the SpO_2 values to the same extent.

We recommend the application of the following criteria when using the pulse oximetry function on neonates and infants:

- The peripheral pulse rate (PPR) as determined by the SpO_2 function must be within 10% of the heart rate, and
- The SpO_2 signal strength should be adequate. This is indicated by the display of two or three asterisks or the absence of the ***Low signal quality*** message.

Procedures or devices previously applied in your facility for SpO_2 monitoring should be used in the event the SpO_2 value from the monitor cannot be validated by the above criteria.

WARNING Many factors may cause inaccurate readings and alarms, decreased perfusion, and or low signal strength:

- Interfering substances:
  - Carboxyhemoglobin may erroneously increase SpO_2 reading.
  - Methemoglobin (MetHb) usually represents less than 1% of the total Hb, but in the case of methemoglobinemia that can be congenital or induced by some IV dyes, antibiotics (such as sulphas), inhaled gases, etc., this level increases sharply and thus can cause inaccuracies in the SpO_2 reading.
  - Intravascular dyes (such as indocyanine green, methylene blue, etc.)

- Physiological characteristics:
  - Cardiac arrest
  - Hypotension
  - Shock
  - Severe vasoconstriction
  - Severe anemia
  - Hypothermia
  - Venous pulsations
  - Darkly pigmented skin
  - Ventricular septal defects (VSDs)
- Environmental conditions:
  - Excessive ambient light
  - Electrical interference
  - Electrosurgery
  - Defibrillation - May cause inaccurate reading for a short amount of time.
  - Excessive patient/sensor motion. Artifact can simulate an SpO_2 reading, so that the device fails to sound an alarm. In order to ensure reliable patient monitoring, the proper application of the probe and the signal quality must be checked at regular intervals.
- Sensor placement:
  - Incorrect sensor placement - prolonged monitoring or incorrect sensor application can cause skin irritation or impaired circulation. It is recommended that you check the probe site every four hours (more frequently for poor perfusion or for neonates). Refer to the instructions supplied with the sensor.
  - Sensor placement on the same extremity as a blood pressure cuff, arterial catheter or intravascular line; or arterial occlusion proximal to the sensor.
  - Poor sensor fit or sensor applied too tightly.
  - Do not allow tape to block the sensor light emitter and detector.

WARNING FAILURE TO DETECT LETHAL ARRHYTHMIA. Always monitor ECG for arrhythmia detection purposes. HR calculated from pulsatile SpO_2 waveform may differ significantly from ECG HR measured values. Users should be aware that the ***SpO2 probe off*** and ***No SpO2 pulse*** alarms escalate no higher than a Medium priority.

WARNING FAILURE TO DETECT LETHAL ARRHYTHMIA. The SpO_2 parameter pulsatile heart rate measurement is based on the optical detection of a peripheral flow pulse and therefore may not detect certain arrhythmias. The pulse oximetry parameter should not be used as a replacement or substitute for ECG based arrhythmia analysis.

WARNING Using the ***Maximum*** sensitivity setting can reduce the ***SpO2 probe off*** detection alarm. It is recommended to use the ***Maximum*** sensitivity setting in care areas where the application site is inspected frequently.

WARNING With deactivated ***SpO2 probe off*** alarm, keep the patient under close surveillance.

WARNING MISSED ALARM. Check the SpO_2 measurement when switching the SpO_2 measurement sources to avoid missed SpO_2 alarms.

WARNING Prolonged monitoring or incorrect sensor application can cause skin irritation or impaired circulation. It is recommended that you check the probe site every four hours (more frequently in case of poor perfusion or neonatal patients). Refer to the instructions supplied with the sensor.

SpO_2 cautions

CAUTION A damaged sensor or a sensor soaked in liquid may cause burns during electrosurgery.

SpO_2 measurement limitations

- The pulse oximeter cannot distinguish between oxyhemoglobin and dyshemoglobins.
- Poor perfusion may affect the accuracy of measurement, especially when using an ear sensor.
- To avoid erroneous measurements, do not use a blood pressure cuff on the same limb as the SpO_2 sensor.
- There are several factors that may cause inaccurate readings and alarms. Familiarize yourself with the SpO_2 safety precautions so that you are aware of these factors and can take them into consideration.

SpO_2 points to note

- This equipment is suitable for use in the presence of electrosurgery, as tested according to IEC 60601-2-49 clause 202.6.2.101 Electrosurgery interference.
- GE sensors are not made with natural rubber latex.
- Use dry and clean sensors only.
- Do not use damaged sensors.
- Check that you are not re-using a disposable sensor or other disposable accessories.
- Always check the patient and the sensor site if the accuracy of the SpO_2 values is questionable.
- There are three supported pulse oximetry technologies:
  - Masimo SET
  - Nellcor OxiMax
  - GE TruSignal

- Refer to the sensor's instruction for user for the recommended maximum application times for different sensor types.
- With Masimo SET technology, the pulse oximetry waveform is a normalized waveform. It is not normalized with GE TruSignal technology. GE TruSignal technology provides the actual IrMod% values.

SpO_2 measurement guidelines

GE TruSignal technology and sensor measurement guidelines

The following measurement guidelines apply to GE TruSignal SpO_2 technology:

- The time period for acquiring a measurement average is adjustable.
- The SpO_2 waveform corresponds to (but is not proportional to) the arterial pressure waveform.
- Only TruSignal sensors are supported.
- Use the following guidelines when using TruSignal sensors and cables:
  - Read the sensor instructions for use of the SpO_2 sensor before using it.
  - Periodically inspect extension cables and sensors for damage.
  - Do not use damaged sensors.
  - Refer to the cleaning instructions in the instructions for use of reusable TruSignal sensors.
  - Do not use NIBP or constricting instruments on the same appendage as the SpO_2 sensor.

Masimo SET technology and sensor measurement guidelines

With motion, the plethysmographic waveform (or SpO_2 waveform) is often distorted and may be obscured by the artifact. With Masimo SET technology, the plethysmographic waveform is not an indication of signal quality or validity. Even with a waveform obscured by artifact, Masimo SET technology is able to read through the noise and locate the arterial pulsation.

Although Masimo SET technology processes SpO_2 measurements differently than other SpO_2 technologies, the function and appearance is essentially the same as other technologies. The following measurement guidelines apply to Masimo SET technology only:

- The time period for acquiring a measurement average is adjustable.
- Only Masimo RD SET, M-LNCS, LNCS, and LNOP sensors are supported. Masimo RD SET, M-LNCS, LNCS, or LNOP sensors non-invasively measure pulse rate and the amount of oxygenated hemoglobin. Use the following guidelines when using Masimo RD SET, M-LNCS, LNCS, or LNOP sensors:
  - Read the sensor directions before use.
  - Only use sensors with Masimo SET technology.
  - Do not use damaged sensors.
  - Do not use an sensor with exposed optical components.

- Refer to the cleaning instructions in the directions for use for reusable Masimo RD SET, M-LNCS, LNCS, or LNOP sensors.

Additional information for Masimo technology

NO IMPLIED LICENSE: Possession or purchase of this device does not convey any express or implied license to use the device with unauthorized replacement parts which would, alone, or in combination with this device, fall within the scope of one or more of the patents relating to this device. Sensors that are designated for single use are licensed for use on a single patient only, and are not sold. There is no license, implied or otherwise, that would allow use of single use Masimo sensors beyond their intended single use. After use of single use Masimo sensors, the license is exhausted, there is no further license granted by Masimo, and they must be discarded.

This device is covered under one or more patents as set forth at http://www.masimo.com/patents.htm.

We recommend the use of Masimo SET sensors for use with Masimo technology.

Masimo warnings

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

WARNING Do not place the pulse oximetry device or accessories in any position that might cause it to fall on the patient.

WARNING Do not start or operate the pulse oximetry device unless the setup was verified to be correct.

WARNING Do not use the pulse oximetry device during magnetic resonance imaging (MRI) or in an MRI environment.

WARNING Do not use the pulse oximetry device if it appears or is suspected to be damaged.

WARNING Explosion hazard: Do not use the pulse oximetry device in the presence of flammable anesthetics or other flammable substance in combination with air, oxygen-enriched environments, or nitrous oxide.

WARNING To ensure safety, avoid stacking multiple devices or placing anything on the instrument during operation.

WARNING To protect against injury, follow the directions below:

- Avoid placing the device on surfaces with visible liquid spills.
- Do not soak or immerse the device in liquids.
- Do not attempt to sterilize the device.
- Use cleaning solutions only as instructed in operator's manual.
- Do not attempt to clean the device while monitoring a patient.

WARNING To protect from electric shock, always remove the sensor and completely disconnect the pulse oximetry device before bathing the patient.

WARNING If any measurement seems questionable, first check the patient's vital signs by alternate means and then check the pulse oximetry device for proper functioning.

WARNING Inaccurate SpO_2 readings may be caused by:

- Improper sensor application.
- Elevated levels of COHb or MetHb: High levels of COHb or MetHb may occur with a seemingly normal SpO2. When elevated levels of COHb or MetHb are suspected, laboratory analysis (co-Oximetry) of a blood sample should be performed.
- Intravascular dyes, such as indocyanine green or methylene blue.
- Externally applied coloring and texture, such as nail polish, acrylic nails, glitter, etc.
- Elevated levels of bilirubin.
- Severe anemia.
- Low arterial perfusion.
- Motion artifact.

WARNING Interfering Substances: Dyes or any substance containing dyes that change usual blood pigmentation may cause erroneous readings.

WARNING The pulse oximetry device should not be used as the sole basis for medical decisions. It must be used in conjunction with clinical signs and symptoms.

WARNING The pulse oximetry device is not an apnea monitor.

WARNING The pulse oximetry device may be used during defibrillation, but this may affect the accuracy or availability of the parameters and measurements.

WARNING The pulse oximetry device may be used during electrocautery, but this may affect the accuracy or availability of the parameters and measurements.

WARNING The pulse oximetry device should not be used for arrhythmia analysis.

WARNING SpO_2 is empirically calibrated in healthy adult volunteers with normal levels of carboxyhemoglobin (COHb) and methemoglobin (MetHb).

WARNING Do not adjust, repair, open, disassemble, or modify the pulse oximetry device or accessories. Injury to personnel or equipment damage could occur. Return the pulse oximetry device for servicing if necessary.

Masimo cautions

CAUTION Do not place the pulse oximetry device where the controls can be changed by the patient.

CAUTION Electrical shock and flammability hazard: Before cleaning, always turn off the instrument and disconnect from any power source.

CAUTION When patients are undergoing photodynamic therapy they may be sensitive to light sources. Pulse oximetry may be used only under careful clinical supervision for short time periods to minimize interference with photodynamic therapy.

CAUTION Do not place the pulse oximetry device on electrical equipment that may affect the instrument, preventing it from working properly.

CAUTION If the SpO2 values indicate hypoxemia, a laboratory blood sample should be taken to confirm the patient's condition.

CAUTION If the Low Perfusion message is frequently displayed, find a better perfused monitoring site. In the interim, assess the patient and, if indicated, verify oxygenation status through other means.

CAUTION Change the application site or replace the sensor and/or patient cable when a persistent poor signal quality message (such as "Low SIQ") is displayed on the host monitor. These messages may indicate that patient monitoring time is exhausted on the patient cable or sensor.

CAUTION If using pulse oximetry during full body irradiation, keep the sensor out of the radiation field. If the sensor is exposed to the radiation, the reading might be inaccurate or the instrument might read zero for the duration of the active irradiation period.

CAUTION To ensure that alarm limits are appropriate for the patient being monitored, check the limits each time the pulse oximetry device is used.

CAUTION Variation in hemoglobin measurements may be profound and may be affected by sampling technique as well as the patient's physiological conditions. Any results exhibiting inconsistency with the patient's clinical status should be repeated and/or supplemented with additional test data. Blood samples should be analyzed by laboratory instruments prior to clinical decision making to completely understand the patient's condition.

CAUTION Do not submerge the pulse oximetry device in any cleaning solution or attempt to sterilize by autoclave, irradiation, steam, gas, ethylene oxide or any other method. This will seriously damage the pulse oximetry device.

CAUTION Electrical Shock Hazard: Carry out periodic tests to verify that leakage currents of patient-applied circuits and the system are within acceptable limits as specified by the applicable safety standards. The summation of leakage currents must be checked and in compliance with IEC 60601-1 and UL60601-1. The system leakage current must be checked when connecting external equipment to the system. When an event such as a component drop of approximately 1 meter or greater or a spillage of blood or other liquids occurs, retest before further use. Injury to personnel could occur.

CAUTION Disposal of product - Comply with local laws in the disposal of the instrument and/or its accessories.

CAUTION To minimize radio interference, other electrical equipment that emits radio frequency transmissions should not be in close proximity to the pulse oximetry device.

CAUTION Replace the cable or sensor when a replace sensor or when a low SIQ message is consistently displayed while monitoring consecutive patients after completing troubleshooting steps listed in this manual.

Masimo points to note

- A functional tester cannot be used to assess the accuracy of the pulse oximetry device.
- High-intensity extreme lights (such as pulsating strobe lights) directed on the sensor, may not allow the pulse oximetry device to obtain vital sign readings.
- When using the Maximum Sensitivity setting, performance of the Sensor Off detection may be compromised. If the instrument is in this setting and the sensor becomes dislodged from the patient, the potential for false readings may occur due to environmental “noise” such as light, vibration, and excessive air movement.
- Do not loop the patient cabling into a tight coil or wrap around the device, as this can damage the patient cabling.
- Additional information specific to the Masimo sensors compatible with the pulse oximeter, including information about parameter/measurement performance during motion and low perfusion, may be found in the sensor's directions for use (DFU).
- Cables and sensors are provided with X-Cal™ technology to minimize the risk of inaccurate readings and unanticipated loss of patient monitoring. Refer to the Cable or Sensor DFU for the specified duration of the patient monitoring time.

Nellcor OxiMax technology and sensor measurement guidelines

The following measurement guidelines apply to Nellcor OxiMax:

- The SpO_2 waveform corresponds to (but is not proportional to) the arterial pressure waveform.
- Only Nellcor OxiMax sensors are supported. Use the following guidelines when using OxiMax SpO_2 accessories and sensors:

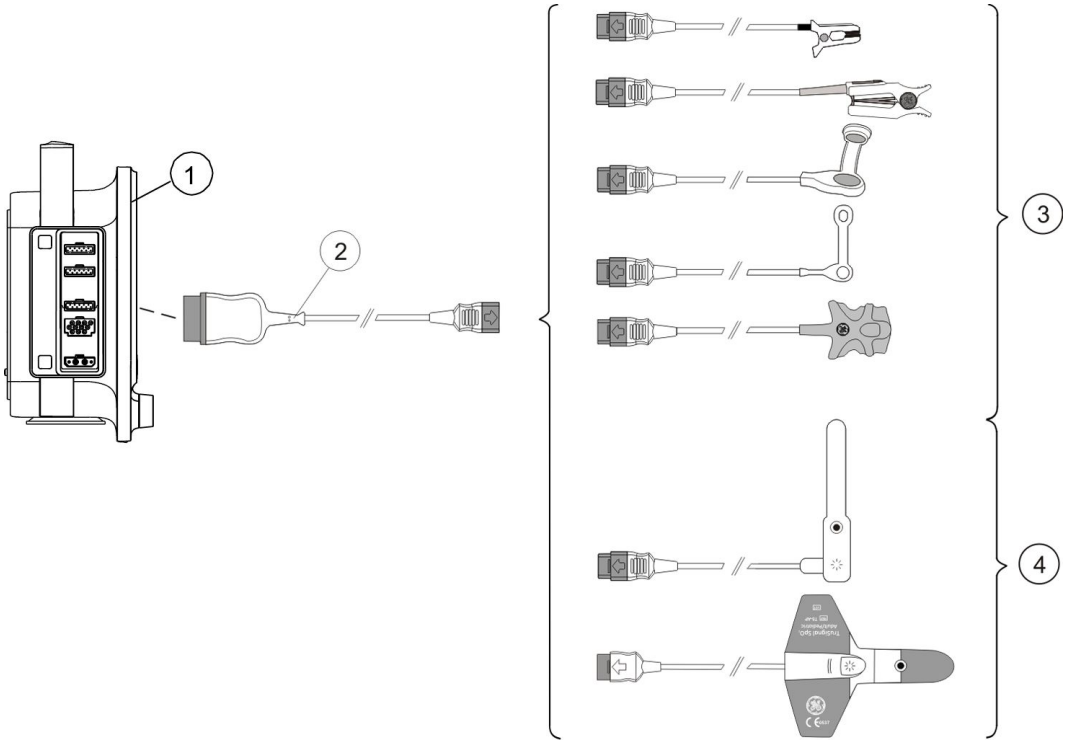
- Periodically inspect extension cables and sensors for damage and discontinue use if damage is found.
- Do not immerse sensors.
- Do not use NIBP or constricting instruments on the same appendage as the SpO_2 sensor.

Additional information for Covidien technology

NOTICE: Purchase of this instrument confers no express or implied license under any Covidien patent to use this instrument with any oximetry, level of consciousness, regional oxygen saturation and respiration rate, as applicable Sensor that is not manufactured or licensed by Covidien.

SpO_2 measurement setup

SpO_2 equipment to patient connection



1. The monitor
2. Interconnect cable
3. Reusable sensors
4. Disposable sensors

Preparing the SpO_2 connection

1. Connect the adapter cable to the SpO_2 connector.
2. Clean the surface of reusable sensors.
3. Prepare the application site.

4. Remove nail polish and earrings.
5. Follow the sensor manufacturer's instructions to position the sensor.
6. Attach the sensor to the patient.
7. Stabilize the sensor cable to minimize sensor movement.

Checking the SpO_2 measurement

1. Check that the red light is lit in the sensor.
2. Check that the waveforms and parameter values are displayed when the sensor is connected to the patient.

SpO_2 functional testers

You can verify the functionality of pulse oximeter sensor and monitor with a functional SpO_2 tester but you cannot evaluate their accuracy with such a device. For more information, refer to the standard ISO 80601-2-61 Annex FF (Simulators, calibrators and functional testers for pulse oximeter equipment).

Using the SpO_2 measurement

Setup the parameter to main screen if need: > ***Screen Setup***.

Changing the SpO_2 waveform scale

1. Select the SpO_2 digit field.
2. Select the scale from the ***Pleth Scale*** list:
   - For GE TruSignal technology and sensor, the options are:
     - ***AUTO***: The scale is automatically selected according to the IrMod % (infrared modulation percentage) received from the measurement source.
     - Other scale options are ***2***, ***5***, ***10***, ***20***, or ***50***.
   - For Masimo or Nellcor technology and sensor, the options are: ***1X***, ***2X***, ***4X***, or ***8X***.

Selecting the GE TruSignal SpO_2 response averaging time

NOTE GE TruSignal technology and sensors only.

You can have an average of the SpO_2 measurement on screen instead of the beat to beat values. You can select the average time for response.

1. Select the SpO_2 digit field.
2. Select the average time from ***SpO2 Response*** list. Choices are:
   - ***Normal***: 12 seconds
   - ***Fast***: 3 seconds

Selecting the Masimo SpO_2 averaging time

NOTE Masimo technology and Masimo sensors only.

You can have an average of the SpO_2 measurement on screen instead of the beat to beat values, and you can select how many seconds are used for this averaging: ***2s***, ***4s***, ***8s***, ***10s***, ***12s***, ***14s***, or ***16s***.

1. Select the SpO_2 digit field.
2. Select the number of seconds from the ***Averaging*** list.

Selecting the Masimo SpO_2 sensor sensitivity level

NOTE Masimo technology and Masimo sensors only.

1. Select the SpO_2 digit field.
2. Select the appropriate option from the ***Sensitivity*** list:
   - Use the ***Normal*** sensitivity setting for normal patient monitoring purposes.
   - Use the ***Maximum*** sensitivity setting for improved poor perfusion performance and for faster tracking of rapid SpO_2 saturation changes.
     Using the ***Maximum*** sensitivity setting delays the ***Probe Off*** detection alarm.
   - Use the ***APOD*** (Adaptive Probe Off Detection) sensitivity settings for better probe off detection.

Selecting the SpO_2 as the primary heart rate source

The primary heart rate can be calculated from the ECG leads, SpO_2 measurement, or invasive pressure waveform.

NOTE This setting adjusts the primary heart rate source for all of the hemodynamic parameters.

1. Select the SpO_2 digit field.
2. Select the heart rate source from the ***Primary HR Source*** list.

Adjusting the SpO_2 pulse beep tone volume

The beat tone is depends on HR source to calculate. When the source is SpO_2, a variable pitch beep tone rises in pitch with increasing oxygen saturation or falls in pitch with decreasing oxygen saturation.

1. Select the SpO_2 digit field.
2. Adjust the volume with the ***Beat Volume*** arrows.

Setting the SpO_2 alarm limits

1. Select the SpO_2 digit field.
2. Select the ***Alarms*** tab.
3. Check that the ***Alarm*** is turned on.
4. Adjust the alarm limits with the arrows.

NOTE If you want the alarm turn off, select from the ***Alarm*** list.

Setting the Masimo SpO_2 alarm delay

NOTE Masimo technology and Masimo sensors only.

The alarm delay time for ***SpO2 low*** alarm can be selected. But if the SpO_2 value drops below the alarm limit by more than 5%, the ***SpO2 low*** alarm will be triggered immediately, regardless of the alarm delay setting.

1. Select the SpO_2 digit field.
2. Select the ***Alarms*** tab.
3. Select the seconds from the ***Alarm Delay*** list. The choices are: ***0s***, ***5s***, ***10s***, or ***15s***.

Stopping the SpO_2 measurement

1. Remove the SpO_2 sensor from the patient.
2. Disconnect the sensor from the sensor cable.
3. Disconnect the sensor cable from the host.
4. Select  to acknowledge the ***SpO2 probe off*** alarm.
5. Discard single-use sensors.
   - Always disconnect the sensor from the cable before repositioning the sensor. Reconnect the cable to the sensor after the sensor has been repositioned.
   - Use only sensors and cables listed in the Suppliers and accessories.

SpO_2 measurement description

Masimo SET data averaging and updating

For Masimo SET technology, when using the default averaging time of 8 seconds, there is a maximum data-averaging signal processing time of 10 seconds from real time plus an additional delay of 2 seconds to update the displayed waveform.

Nellcor OxiMax data averaging and updating

The Nellcor OxiMax algorithm automatically extends the amount of data required for measuring SpO_2 and pulse rate depending on the measurement conditions. During normal measurement conditions in the normal response mode, the averaging time is 6 to 7 seconds.

During difficult measurement conditions, which can be caused by low perfusion, motion, ambient light, electrocautery, other interference, or a combination of these factors, the OxiMax algorithm automatically extends the dynamic averaging time required beyond 7 seconds.

As the measurement conditions become even more difficult, the amount of data required continues to expand. If dynamic averaging time reaches 40 seconds, the pulse timeout condition will be set and the module will report a zero saturation indicating a loss-of-pulse condition.

How to interpret the SpO_2 values

SpO_2 signal strength

- For Masimo technology.

The signal strength indicator refers to Masimo's proprietary measurement, Signal Identification and Quality (Signal IQ) indicator. The Signal IQ provides an indicator of the assessment of the confidence in the displayed SpO_2 value.

- For GE TruSignal technology.
  Signal strength is indicated with asterisks in the digit field. The signal strength indicator refers to the amplitude of plethysmographic waveform, not the quality of the waveform. Three asterisks indicate strong pulsation.

  The signal strength indicator is also displayed as the infrared modulation percentage in the waveform.

SpO_2 waveform quality

NOTE Not for Masimo SET technology.

Under normal conditions, the SpO_2 waveform corresponds to (but is not proportional to) the arterial pressure waveform. The typical SpO_2 waveform can help the user find a sensor location with the fewest noise spikes.

Normal waveform

If noise (artifact) is seen on the waveform because of poor sensor placement, the photodetector may not be flush with the tissue. Check that the sensor is secured and the tissue sample is not too thick. Pulse rate is determined from the SpO_2 waveform, which can be disrupted by hemodynamic pressure disturbances. Motion at the sensor site is indicated by noise spikes in the normal waveform.

Abnormal waveform

SpO_2 waveform stability

The stability of the displayed SpO_2 values can also be used as an indication of signal validity. To aid you in successful SpO_2 monitoring, messages are provided in the SpO_2 digit field.

SpO_2 wavelengths and optical output power

GE TruSignal, Masimo SET and Nellcor OxiMax pulse oximetry are calibrated to display functional saturation.

This information may be useful to clinicians such as those performing photodynamic therapy:

- Nellcor OxiMax pulse oximetry sensors contain LEDs that emit red light at a wavelength of approximately 660 nm and infrared light at a wavelength of approximately 900 nm. The total optical output power of the sensor LEDs is less than 15 mW.
- Masimo SET pulse oximetry sensors contain LEDs that emit red light at a wavelength of approximately 660 nm and infrared light at a wavelength of approximately 905

nm for LNOP and LNCS, and approximately 663 nm and 880 nm for LNOP and LNCS tip clips. The total optical output power of the LEDs is less than or equal to 15 mW.

- GE TruSignal SpO_2 for use with TruSignal sensors only: GE pulse oximetry sensors contain LEDs that emit red light at a wavelength of approximately 663 nm and infrared light at a wavelength of approximately 890 or 940 nm. The maximum optical output power for each LED is less than 15mW.

SpO_2 measurement and interference

These types of interference can influence the function of SpO_2:

- Incorrect sensor application, e.g., sensor placement on an extremity with a blood pressure cuff, arterial catheter, or intravascular line, sensor applied too tightly.
- Intravascular dyes, such as idocyanine or methylene blue.
- Externally applied coloring agents with opaque materials in high ambient light conditions, e.g., conditions created from one or more of the following sources:
  - Surgical lights, especially xenon light sources
  - Bilirubin lamps
  - Fluorescent lights
  - Infrared heating lamps
  - Direct sunlight
- Excessive patient activity
- Venous pulsation
- Dysfunctional hemoglobin
- Poor (low) peripheral perfusion
- Arterial occlusion proximal to the sensor
- Loss of pulse (cardiac arrest)
- Electromagnetic interference (EMI)
- Ventilator-induced pressure change

SpO_2 troubleshooting

Problem	Solution
SpO_2 signal is poor	• Check the sensor and sensor position. • Make sure the patient is not shivering, moving, or does not have tremors. • The patient's pulse may be too low to measure.
Why does the pulse oximeter sometimes read differently than a blood gas analyzer?	Blood gas analyzers calculate the O_2 saturation based on normal values for pH, $PaCO_2$, Hb, temperature, etc. (i.e., a normal oxyhemoglobin dissociation curve). Depending on the patient's physiologic and metabolic status, this curve and all values may be shifted away from normal. Thus the oximeter, which measures O_2 saturation, may not agree with the blood gas.
What effect can ambient light have on pulse oximetry monitoring?	Light sources such as surgical lamps, bilirubin lamps, fluorescent lights, infrared heating lamps, and sunlight can cause poor waveform quality and inaccurate readings. Error messages are possible. Shielding the sensor with opaque tape, the posey wrap, or other dark or opaque material can increase oximetry accuracy, verified by good waveform and signal strength.

Problem	Solution
What does electrosurgical interference look like and how can it be minimized?	Electrosurgical interference is most obvious on the displayed waveform. It is a very spiky, erratic looking waveform caused by the electrosurgical unit's overwhelming interference. It can result in grossly inaccurate pulse oximeter results. Electrosurgical interference can be minimized by: • Making sure the pulse oximeter sensor is as far away from the return pad and operating site as possible. • Making sure the sensor is not between the return pad and operating site. • Keeping the power cord and sensor cable away from the power cord of the electrosurgical unit. • Plugging the electrosurgery unit into a separate set of outlets from the monitor.
What does motion artifact look like, what problems can it cause, and how can it be corrected?	For the device using Nellcor OxiMax technology, the main problem motion artifact can cause is erroneous SpO_2 readings. Motion artifact occurs with excessive motion of the sensor, the cable leading to the sensor, or the cable/sensor junction. In other words, anything that causes any of these things to move, like the patient moving his hands, or the cable lying across the ventilator tubing and being moved with every cycle, can cause motion artifact. A non-arterial, often erratic looking waveform and a pulse rate that does not coincide with the heart rate on the ECG will result. Motion artifact can be reduced, if not eliminated, by selecting a "quieter" site on the patient. An ear sensor if the hands do not remain still, an adhesive sensor on the toe, or an adhesive sensor on the little finger for an adult or on the sole of the foot in a newborn can help greatly. Cable movement can be reduced by applying the sensor with the cable leading toward the patient, then taping the cable to the side of the hand or foot. The cable and sensor can also be stabilized with a stress loop near the sensor. Tape the stress loop to the patient (excluding children). In the case of the butterfly sensor, the tape was designed to secure the cable to the finger. It has been noted that letting the patient view the SpO_2 waveform enables the patient to assist in reducing motion artifact.
Why is the digit field not displayed on the monitor after connecting the SpO_2 interface cable and sensor?	No SpO_2 data is displayed due to hardware failure or an unrecognized or defective sensor. • Make sure the accessories are compatible with the monitor. • Make sure the sensor is attached to the interface cable and the cable is connected to the monitor. • Change the sensor. • Change the cable. If the problem persists, contact authorized service personnel.

11

Non-invasive blood pressure

NIBP safety precautions

NIBP warnings

WARNING The NIBP parameter will not measure blood pressure effectively on patients who are experiencing seizures or tremors.

WARNING Arrhythmias will increase the time required by the NIBP parameter to determine a blood pressure and may extend the time beyond the capabilities of the parameter.

WARNING Do not apply external pressure against the cuff while monitoring. Doing so may cause inaccurate blood pressure values. Use care when placing the cuff on an extremity used to monitor other patient parameters.

WARNING NIBP cuff inflation/deflation may lead to inaccurate values from other monitored patient parameters that are measured distally from the NIBP measurement site at the same extremity.

WARNING Continuous cuff pressure caused by the kinking of the connection tubing can interfere with the blood flow and cause injury to the patient.

WARNING Do not place the cuff over a wound as this may cause further injury.

WARNING GE NIBP devices are designed for use with dual-hose cuffs and tubing. The use of single-hose cuffs with dual hose tubing can result in unreliable and inaccurate NIBP data.

WARNING PATIENT SAFETY. To prevent injury to the patient, do not place the cuff on a limb being used for A-V fistulas, intravenous infusion or on any area where circulation is compromised or has the potential to be compromised. To avoid this risk, use another limb if possible.

WARNING Accuracy of NIBP measurement depends on using a cuff of the proper size. It is essential to measure the circumference of the limb and choose the proper size cuff.

WARNING NIBP READINGS MAY TIME OUT WHEN USING IABP. An IABP creates non-physiological arterial waveforms. These waveforms create an oscillometric signal that may not be interpreted by the NIBP algorithm, causing NIBP to time out. The patient blood pressure can be monitored from the balloon pump device.

WARNING The NIBP cuff size must be correctly selected in the NIBP ***Setup*** window to obtain reliable NIBP data and to prevent excessive cuff pressure during infant (neonate) or child (pediatric) use.

WARNING If a patient's beat-to-beat pulse amplitude varies significantly (e.g., because of pulsus alternans, atrial fibrillation, or the use of a rapid-cycling artificial ventilator), blood pressure and pulse rate readings can be erratic, and an alternate measuring method should be used for confirmation.

WARNING When using an electrosurgery unit, note that the measurement cables do not incorporate means to protect against burns in case of a defective ESU return electrode. To avoid burns at the monitor measurement sites, ensure the following:

- Proper contact of the ESU return electrode to the patient.
- ESU return electrode near the operating area.
- Measurement electrodes, leadwires and probes far from the surgical site and the ESU return electrode.

WARNING Devices that exert pressure on tissue have been associated with purpura, skin avulsion, compartmental syndrome, ischemia, and/or neuropathy. To minimize these potential problems, especially when monitoring at frequent intervals or over extended periods of time, make sure the cuff is applied appropriately and examine the cuff site and the limb distal to the cuff regularly for signs of impeded blood flow. Periodically check patient limb circulation distal to the cuff. Check frequently when using auto NIBP in 1 and 2 minute intervals. The 1 and 2 minute intervals are not recommended for extended periods of time.

NIBP cautions

CAUTION The device sets the inflation pressure automatically according to the previous measurement. Discharge patient to reset the inflation limits before measuring NIBP on a new patient.

NIBP measurement limitations

- A patient's vital signs may vary dramatically during the use of cardiovascular agents such as those that raise or lower blood pressure or those that increase or decrease heart rate.
- The NIBP measurement has not been validated for use with pregnant patients.
- Although automated NIBP is generally safe and accurate, it has some limitations. It may be difficult to obtain reliable readings under the following circumstances:
  - Shock accompanied by low blood pressure and pulse.

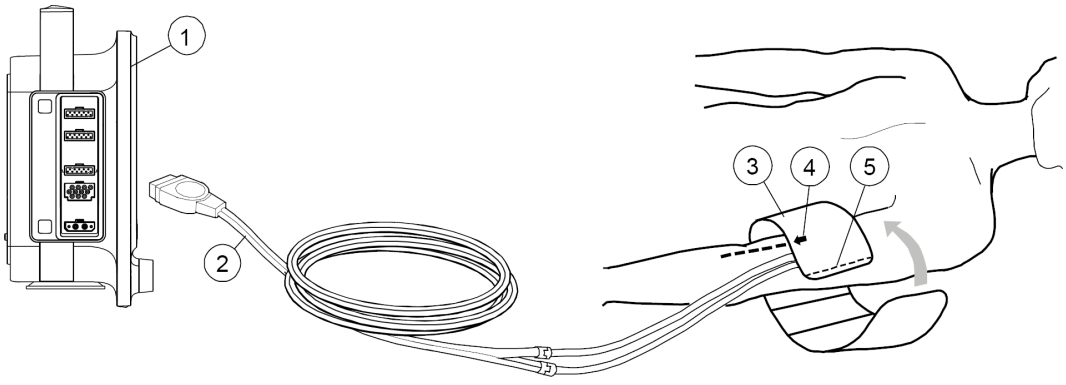
  - Variations in blood pressure and pulse rate.
  - In patients with anatomic abnormalities, such as calcified (hardened) arteries or subclavian compression.
  - Compression of the cuff caused by shivering, seizures, arm movement, or bumping against the cuff.
- Proper sizing and position of the cuff are essential to obtaining reliable readings:
  - Too large a cuff is better than too small a cuff, which may yield falsely high readings.
  - The cuff should also fit properly over the brachial artery (or whatever artery is being used) so that the cuff is sufficiently sensitive to vibrations in the artery.

NIBP points to note

- This equipment is suitable for use in the presence of electrosurgery, as tested according to IEC 60601-2-49 clause 202.6.2.101 Electrosurgery interference.
- Blood pressure measurements determined with this device are equivalent to those obtained by an intra-arterial blood pressure measurement device, within the limits prescribed by the standard.
- Use the appropriate size NIBP cuff for the patient (adult, child, or infant).
- The measurement site, patient's position (standing, sitting, lying down), exercise, or physiologic condition can affect the NIBP readings.
- With mobile patients and when taking routine resting blood pressure, ensure that:
  - The patient is comfortably seated, with their legs uncrossed and feet flat on the floor.
  - The patient's arms and back are supported.
  - The middle of the cuff is at the level of the right atrium of the patient's heart.
- Also consider the following recommendations:
  - Allow 5 minutes to pass before taking the first measurement.
  - Ensure that the patient is relaxed and does not talk during the measurement.

NIBP measurement setup

NIBP equipment to patient connection



1. The monitor

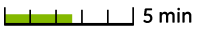
2. Cuff hose
3. Cuff of correct size
4. Brachial artery arrow (printed on cuff)
5. Cuff index line (printed on cuff)

Preparing the NIBP patient connection

1. Select an appropriate NIBP cuff size for the patient.
2. Connect the NIBP cuff hose to the NIBP connector.
3. Position the NIBP cuff on the patient:
   - Place the cuff arrow over the brachial artery (or whatever artery is being used).
   - Make sure that the cuff index line falls within the range markings on the cuff.
   - Wrap the cuff around the limb.
4. Make sure that the NIBP cuff tubes are not kinked, compressed, or stretched.
5. Verify or select the correct ***Cuff Size*** from the NIBP menu.

NIBP measurement on screen

- ***NIBP Manual***:
  - During measurement, the text ***Manual*** displays in the NIBP digit field.
  - 1 minute after measurement, the text ***x min ago*** displays in the NIBP digit field, indicate how long time for the displayed value are.
- ***NIBP Auto***:
  During measurement, a time progress bar displays in the NIBP digit field:

  If the ***Cycle Time*** is selected to ***Custom***, ***S1***, ***S2***, ***S3***, or ***S4*** will display in front of time progress bar.
- ***STAT***:
  During 5 minutes continuous measurement, the text ***STAT*** displays in the NIBP digit field.

The cuff size displays in the NIBP digit field.

During cuff inflation and deflation phases, the cuff inflation pressure will be labeled as ***Cuff*** to display on digit field. Within a wide or large digit field, the value shows after MAP. Within a base digit field, the value replace MAP.

More than 60 minutes after previous measurement, the NIBP value will become gray.

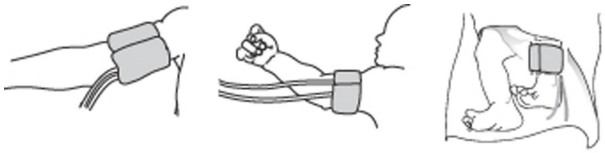
More than 4 hours if no new NIBP data is received, the NIBP value will be replaced by "– – –".

NIBP cuffs

NIBP cuff selection and placement

Always choose the appropriate blood pressure measurement site. In adult and pediatric patients, the upper arm is preferred for convenience and because normative values are generally based on this site. When factors prohibit use of the upper arm,

the clinician must plan patient care accordingly, taking into account the patient's cardiovascular status and the effect of an alternative site on blood pressure values, proper cuff size, and comfort.



Adult and pediatric Neonatal

Always measure patient's limb and select appropriately sized cuff according to size marked on cuff or cuff packaging. When cuff sizes overlap for a specified circumference, choose the larger size cuff.

If patient is standing, sitting, or inclined, ensure that cuffed limb is supported to maintain the cuff at level of patient's heart. If the cuff is not at heart level, the difference in the measured pressure values due to hydrostatic effect must be considered.

Selecting NIBP cuff size

You must first select the NIBP cuff size before starting a NIBP measurement.

1. Select the NIBP digit field.
2. Select ***Adult/Child***, or ***Neonatal*** from the ***Cuff Size*** list.

NOTE If the ***Cuff Size*** is set to ***(Not Selected)***, when starting a NIBP measurement, this menu will pop up and require you to setup manually.

Initial NIBP cuff inflation pressure

The default value for initial NIBP cuff inflation pressure corresponds to ***Cuff Size*** selected. You can adjust the inflation pressure, if not wish to use the default value.

Default inflation pressure

Cuff Size	**Initial inflation pressure**
Adult/Child	135 mmHg (18 kPa)
Neonatal	100 mmHg (13.3 kPa)

Selecting the auto initial NIBP cuff inflation pressure

You can determine the cuff inflation pressure automatically based on the ***Cuff Size***.

1. Select the NIBP digit field.
2. Select ***Use Default Inflation Pressure***.

Setting the target NIBP inflation pressure

You can manually change the target inflation pressure for the first NIBP measurement.

1. Select the NIBP digit field.
2. Check that ***Use Default Inflation Pressure*** is not selected.
3. Select a value from the ***Infl. Press.*** list.

Using the NIBP measurements

Setup the parameter to main screen if need: > ***Screen Setup***.

Manual NIBP measurements

Starting or stopping a single NIBP measurement from the NIBP menu

1. Select the NIBP digit field > ***Setup*** tab.
2. Start the measurement by selecting ***Start Manual*** for ***NIBP Manual***.
3. Stop the measurement by selecting ***Stop*** for ***NIBP Manual***.

Starting for stopping a single NIBP measurement from the keypad key

1. Start the measurement by pressing from keypad.
2. Stop the measurement by pressing from keypad.

Automatic NIBP measurements

NIBP Auto mode

The NIBP Auto mode initiates repeated measurements for the selected ***Cycle Time***. There will be at least a 30 second delay between two consecutive NIBP measurements during auto cycling.

Setting the cycle time between NIBP measurements

To automatically measure NIBP at set time intervals, you must first set the cycle time.

1. Select the NIBP digit field.
2. Select the cycle time from the ***Cycle Time*** list.

Setting the custom series for NIBP measurement

You can set a custom series for NIBP automatic measurement.

1. Select the NIBP digit field.
2. Select the ***Custom Series*** tab.
3. Set up time interval from ***x BP Series*** list. Set up repeat times from the ***repeat*** arrows.

To use the custom mode for NIBP automatic measurement, you should set ***Cycle Time*** to ***Custom*** in NIBP setup menu.

Starting or stopping an Auto NIBP measurement from the NIBP menu

1. Select the NIBP digit field > ***Setup*** tab.

2. Select ***Start Cycling*** for ***NIBP Auto***.
3. Stop the measurement by selecting ***Stop Cycling***.

Starting or stopping an Auto NIBP measurement from the main menu

1. Start the measurement by selecting  .
2. Stop the measurement by selecting  .

NIBP STAT mode

The ***STAT*** mode initiates a continuous cycle of measurements for five minutes. A new NIBP measurement starts after the previous measurement completes. The early systolic value is measured and displayed until the final result is available. After five minutes, the monitor automatically returns to the previously selected cycling interval or manual mode.

Stat NIBP measurement is deactivated when ***Cuff Size*** is set to ***Neonatal***.

Starting or stopping a Stat NIBP measurement

You can set the NIBP measurement to continue for five consecutive minutes.

1. Select the NIBP digit field.
2. Select ***Start STAT***.
3. Stop the measurement by selecting ***Stop STAT***.

NIBP volume and display settings

Adjusting the NIBP measurement completion tone volume

1. Select the NIBP digit field > ***Setup*** tab.
2. Set the ***Completed NIBP Volume***.

   The lower the value, the softer the tone.

Selecting the blood pressure unit of measurement

The units of measurement settings required a password. For more information, see the supplemental information manual.

1. Select the ***Service*** > ***Units***.
2. Select the units for blood pressure.

NOTE This setting adjusts the blood pressure unit for NIBP and IBP parameters.

Selecting the NIBP color

The color settings required a password. For more information, see the supplemental information manual.

1. Select the ***Service*** > ***Colors***.

2. Select the ***NIBP Color***.

NIBP alarms

Setting the NIBP alarm limits

1. Select the NIBP digit field.
2. Select the ***Alarms*** tab.
3. Select ***SYS***, ***MAP***, ***DIA*** tab for each alarm.
4. Check that the ***Alarm*** is turned on.
5. Select alarm limits with arrows.

NOTE If you wish the each NIBP alarm off, select from the ***Alarm*** list for each alarm.

NIBP alarms' deactivation with pause audio key

Unlike the continuously monitored parameters, NIBP is measured periodically, and its physiological alarms can be deactivated with the pause audio key. Deactivating a physiological NIBP alarm will clear that active alarm until the next NIBP measurement is taken. If the new measurement is outside the alarm limits, the alarm is activated again.

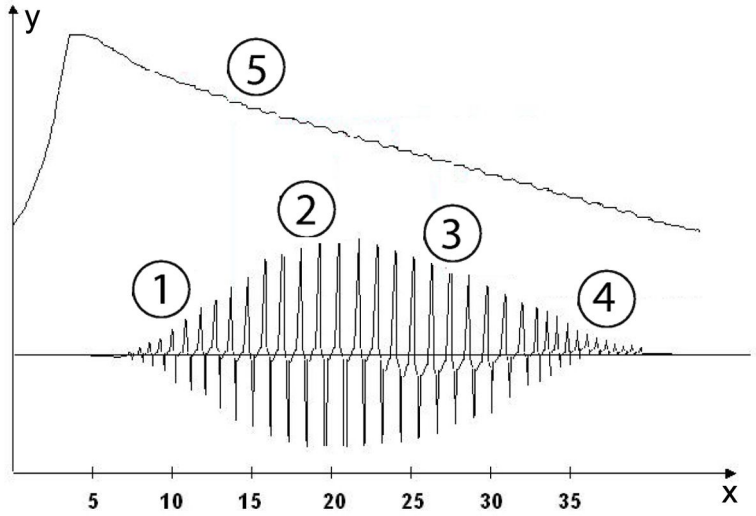
NIBP recheck after alarm violation

If the NIBP value exceeds the alarm limits, a beep will be given, a new measurement takes place automatically and ***Control measurement*** text show in digit field. If the NIBP measurement is taken manually, the recheck measurement is taken immediately after the first measurement. When the NIBP measurement is taken automatically, the recheck measurement is delayed by 30 seconds before the second measurement is taken.

NIBP measurement description

NIBP is acquired using oscillometric technology. Oscillometry is the most commonly used means of indirect blood pressure measurement in automated devices. It is based on the principle that pulsatile blood flow through an artery creates oscillations of the arterial wall.

Oscillometric devices use a blood pressure cuff to sense these oscillations that appear as tiny pulsations in cuff pressure. By measuring and analyzing at various cuff pressures, the amplitude (which changes based on the pressure within the cuff) and the frequency of these pulsations (which is dependent on the patient's heart rate), oscillometric devices can non-invasively determine blood pressure.



- x = Time(s)
- y = Pressures

1. Systolic
2. Mean
3. Diastolic
4. Extracted pulse wave
5. Cuff pressure

DINAMAP SuperSTAT NIBP technology

The DINAMAP SuperSTAT technology estimates the systolic, mean arterial, and diastolic values by evaluating all cuff pressure data gathered during an NIBP determination. During irregular rhythms, only pulses from the current determination are used in calculating the blood pressure values may cause to artifact rejection.

The first determination initially pumps up to a default target cuff pressure of about 135 mmHg for adults/pediatric, or 100 mmHg for neonatal. To allow for rapid setting of cuff pressure, the monitor will momentarily inflate to a higher pressure, then immediately deflate to the target pressure.

As a determination is taken, the pattern of the patient's oscillation size is stored as a function of pressure. In any subsequent determination, as few as four pressure steps may be necessary to complete the process. When employing fewer pressure steps, the system uses the stored information from the previous blood pressure determination to decide the best pressure steps to take. The consistency of pulse sizes are measured to tell if the oscillations taken at a step are good and if more steps are needed.

If the current blood pressure reading is similar to the previous reading, some information from the previous blood pressure may be used in the current determination. The data is constantly evaluated during a measurement to try to perform a blood pressure determination in the shortest possible time, providing greater comfort to the patient.

If it has been 16 minutes or less since the last determination and the current blood pressure is similar to the previous reading, the monitor will try to make an accelerated determination of blood pressure.

NIBP calibration

NIBP calibration procedure is explained in the Technical Manual. The calibration procedure is password protected.

NIBP troubleshooting

Problem	Solution
NIBP measurement does not work or the values seem unstable.	• Check that the cuff tubing is not bent, stretched, compressed, or loose. • Check the cuff position and cuff tube connection. • Prevent motion artifact. • Use NIBP cuffs of correct size.
Why does the mean value display while the associated systolic and diastolic values display as - - -?	Assess the patient and perform a visual inspection of the equipment to ensure system integrity. The following conditions may cause the mean value to display in the NIBP digit field while the associated systolic and diastolic values display as - - -: • Very low systolic and diastolic amplitude fluctuations (e.g., patient in shock). • Very small difference between the mean and systolic pressure or the mean and diastolic pressure. • Loss of system integrity (e.g., loose connections or worn parts)
Why is the monitor re-inflating the cuff automatically?	The cuff target pressure must be higher than the patient's systolic pressure to obtain an accurate systolic and diastolic measurement. If a systolic blood pressure cannot be found, a systolic reading is searched by re-inflating the cuff to a higher pressure. During a systolic search, the maximum cuff inflation pressure will not exceed the normal pressure range of the cuff. For more information, refer to the technical specifications. A control measurement may be taking place. If the measured NIBP value exceeds the alarm limits, a single low priority alarm sounds and a new measurement is automatically taken. If the new value (the control measurement) also exceeds the alarm limits the alarm priority escalates to medium. In Manual mode and STAT mode there are at least four seconds between the first measurement and the control measurement for Adult and Pediatric cuffs, eight seconds for Neonatal cuffs. In Auto mode there are at least 30 seconds between the first measurement and the control measurement.

12

Invasive blood pressure

Invasive blood pressure safety precautions

Invasive pressure warnings

WARNING DEFIBRILLATOR PRECAUTIONS. Patient signal inputs labeled with the CF and BF symbols with paddles are protected against damage resulting from defibrillation voltages. To ensure proper defibrillator protection, use only the recommended cables and leadwires.

WARNING All invasive procedures involve risks to the patient. Use aseptic technique. Incorrect use of the catheter can lead to vessel perforation. Follow catheter manufacturer's instructions.

WARNING Make sure that no part of the patient connections touches any electrically conductive material including ground.

WARNING Mechanical shock to an invasive blood pressure transducer may cause severe shifts in the zero balance and calibration, and cause erroneous readings.

WARNING Repositioning the patient after a completed zeroing procedure may cause incorrect measurement values.

WARNING When using an electrosurgery unit, note that the measurement cables do not incorporate means to protect against burns in case of a defective ESU return electrode. To avoid burns at the monitor measurement sites, ensure the following:

- Proper contact of the ESU return electrode to the patient.
- ESU return electrode near the operating area.
- Measurement electrodes, leadwires and probes far from the surgical site and the ESU return electrode.

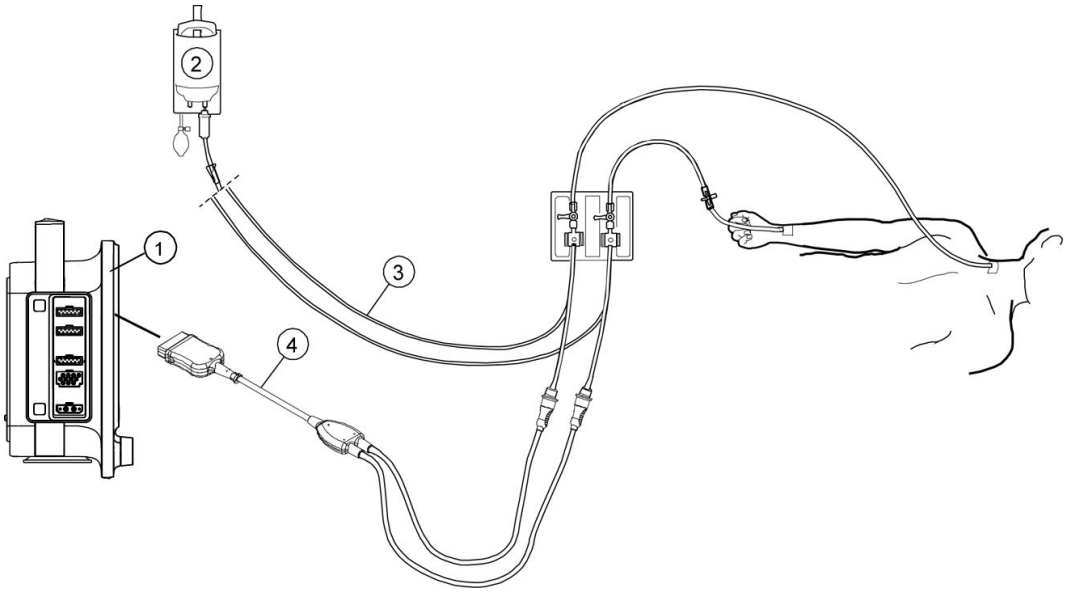
Invasive pressure points to note

- This equipment is suitable for use in the presence of electrosurgery, as tested according to IEC 60601-2-49 clause 202.6.2.101 Electrosurgery interference.
- A pressure channel is activated when a pressure transducer interface cable is connected to the monitor.

- A pressure channel is deactivated when the pressure transducer interface cable is disconnected from the monitor.

Invasive blood pressure measurement setup

Invasive pressure equipment to patient connection



1. The monitor
2. Fluid bag with pressure infusor
3. Transducer setup
4. Invasive blood pressure adapter cable; single or dual cable (optional)

Connecting the invasive pressure transducer and cable

1. Prepare the transducer kit according to the manufacturer's instructions.
2. Connect the pressure transducer to the transducer cable.
3. Remove entrapped air from within the transducer setup by tapping the setup and by turning it into different positions.
4. Connect the transducer cable to the invasive pressure connector.
5. Connect the transducer to the patient line.

Checking the invasive pressure measurement

1. Check that the monitor recognizes cable connections (activates the display) for all the pressure channels used and the pressure values and appropriate waveforms are displayed.
2. Make sure that all the transducers are zeroed correctly.

Invasive pressure measurement on the monitor screen

The invasive pressure channel labels are as follows:

Label	Description
Art	Arterial pressure
ABP	Arterial blood pressure
PA	Pulmonary arterial pressure
CVP	Central venous pressure
LAP	Left atrial pressure
RAP	Right atrial pressure
ICP	Intracranial pressure
RVP	Right ventricular pressure
UAC	Umbilical arterial pressure
UVC	Umbilical venous pressure
IBP1, ***IBP2***	Non-specific pressure channel labels
NOTE	***UAC*** and ***UVC*** invasive pressure channels are only available in the ***NEONATAL*** mode.

Using the invasive blood pressure measurement

Setup the parameter to main screen if need: > ***Screen Setup***.

About zeroing the invasive pressure transducers

- Prior to monitoring, zero transducers at the patient's phlebostatic axis. Zeroing the pressure transducers is very important for accurate pressure measurements. To avoid inaccurate measurements, you must zero the pressure transducers:
  - Before measuring invasive pressures.
  - Before initiating treatment changes reliant upon pressures data.
  - When using a new transducer or tubing.
  - After reconnecting the transducer cable to the acquisition device.
  - Whenever the patient's position is changed.
  - Whenever the pressure reading is questionable.
- Pressures can be zeroed individually by selecting ***Zero*** on the invasive pressure menu.
- You can zero all active transducers except ICP by selecting > ***IBP Zero***.

NOTE The monitor record a time stamp of the last successful zeroing for each invasive blood pressure channel.

Zeroing the invasive pressure transducers

1. Level the transducer following your care unit's policy (usually level of the phlebostatic axis).
2. Close the transducer stopcock to the patient and open the venting stopcock to air.

3. You can zero all connected pressure transducers simultaneously by selecting > ***IBP Zero***. Or, you can zero a single active pressure transducer by selecting the invasive pressure digit field > ***Zero***.
4. Check that a zero reference has been established. Watch the pressure digit field for messages.
5. Close the venting stopcock to air and open the transducer stopcock to the patient.
6. Check that pressure numerics display on screen.

NOTE The ***IBP Zero*** does not zero a connected ICP channel. The ICP channel must be zeroed separately. When the ***Zero ICP separately*** message displays, you can zero the ICP channel separately.

Selecting an invasive pressure channel label

One channel label can only be mapped to one channel at a time. If you select a channel label that is already mapped to another channel, the other channel's label will change to the default value.

1. Select the invasive pressure digit field.
2. Select a channel label from the ***Label*** list.

Selecting the size of the invasive pressure waveform

1. Select the invasive pressure digit field.
2. Set the waveform scale with the ***Scale*** arrows.

   The larger the scale value, the smaller the waveform size.

Selecting the hemodynamic waveform sweep speed

NOTE This setting adjusts the waveform speed for all of the hemodynamic parameters.

1. Select the invasive pressure digit field.
2. Select a numeric value from the ***Hemodynamics Sweep Speed*** list.

   The smaller the value, the slower the sweep speed.

Selecting the displayed invasive pressure format

You can choose to display systolic, diastolic or mean pressure values in different formats.

1. Select the invasive pressure digit field.

2. Select the format from the ***Digit Format*** list:
   - ***Mean***: All values are shown, but the mean value is shown in a bigger font.
   - ***S/D***: All values are shown, but the sys/dia values are shown in a bigger font.
   - ***S/D/M***: All values are shown in an equally big font.
   - ***CPP***: All values are shown, with additional CPP value.

   NOTE This option is available only when the label is ***ICP***.

Selecting invasive pressure as the primary heart rate source

The primary heart rate can be calculated from the ECG leads, SpO_2 measurement, or invasive pressure waveform.

NOTE This setting adjusts the primary heart rate source for all of the hemodynamic parameters.

NOTE This setting is available for ***Art***, ***ABP***, or ***UAC*** invasive pressure channels only.

1. Select the invasive pressure digit filed.
2. Select the heart rate source from the ***HR Source*** list.

Selecting the ventilation mode

This setting affects the respiration filter.

1. Select the invasive pressure digit field.
2. Select the mode from ***Ventilation Mode*** list. Choices are:
   - ***Spont***: Spontaneous respiration.
   - ***Contrl***: Controlled ventilation.

NOTE The ventilation mode is shown on the digit field for labels ***IBP2***, ***CVP***, ***PA***, ***RAP***, ***RVP***, and ***LAP***.

Selecting the invasive pressure response time

1. Select the invasive pressure digit field.
2. Select ***Advanced*** tab.
3. Select the invasive blood pressure response time from the ***Response*** list. Choices are:
   - ***Normal***: Normal averaging time is used.
   - ***B-TO-B*** (beat-to-beat): The last detected pulse is displayed, values can change up to three times per second. This feature is useful when it is necessary to detect fast pressure changes.

Selecting the blood pressure unit of measurement

The units of measurement settings required a password. For more information, see the supplemental information manual.

1. Select the  ***Service*** > ***Units***.

2. Select the units for blood pressure.

NOTE This setting adjusts the blood pressure unit for NIBP and IBP parameters.

Selecting the invasive pressure noise reduction filter

Measured signal is filtered to remove noise and artifacts.

1. Select the invasive pressure digit field.
2. Select the ***Advanced*** tab.
3. Select a numeric value from the ***Filter Frequency Hz*** list.

   The smaller the filter value, the greater the degree of filtering that occurs.

Setting invasive pressure alarm limits

1. Select the invasive pressure digit field.
2. Select the ***Alarms*** horizontal tab.
3. Select the desired alarms vertical tab.
4. Check that the ***Alarm*** is turned on.
5. Adjust the alarm limits with the arrows.

NOTE If you want the alarm turn off, select from the ***Alarm*** list.

Invasive pressure calibration

The invasive pressure calibration requires specific tools and setup. For detailed instructions, see the Technical Manual.

Invasive blood pressure practicalities

Invasive pressure parameters

The measured invasive pressure parameters are systolic, diastolic, and mean. Pulse rate can be monitored with any arterial site. CPP is a calculated value that requires a valid ICP value and a valid arterial site value.

The graphical trends can display following values: systolic, diastolic, mean, CPP (if channel has been labeled to ***Art***), pulse rate (if channel has been labeled to ***Art***, ***ABP***, or ***UAC***).

The numerical trends can display following values: systolic, diastolic, mean, pulse rate (if channel has been labeled to ***Art***, ***ABP***, or ***UAC***).

NOTE The source of the pulse rate is not indicated in the trends.

Invasive pressure troubleshooting

Problem	Solution
Invasive pressure readings seem unstable.	• Make sure there are no air bubbles in the transducer systems. • Flush and zero. • Place the transducer on the patient's phlebostatic axis.
Invasive pressure waveform is displayed but no numeric values are displayed.	• Zero the channel. Invasive pressure numeric values are displayed only for successfully zeroed channels.
Zeroing of invasive pressure channel(s) fails.	• Ensure that the channels are open to air.
Why are displayed pressure values different than expected?	• Check the patient. Values could be valid, the patient could be lying on the tubing, or the tubing could be kinked. • Check tubing for bubbles. • Remove excess tubing. • Check phlebostatic axis placement of transducer. • Rezero pressure.
Why are the arterial, non-invasive (oscillometric), and auscultated blood pressure readings indicating different values?	The three measurement methods use different technologies. Auscultation and oscillometric are both indirect methods of measuring blood pressure. In auscultation, changes in arterial sounds during cuff deflation are related to systolic and diastolic pressure. With oscillometric measurement, changes in measured pressure oscillations during cuff deflation are related to systolic, mean and diastolic pressures. Changes in the vascular tone of the arterial system can cause these two indirect methods to differ from one another and from direct arterial pressure measurements. Invasive arterial blood pressure is a direct method of measuring blood pressure. Differences between direct and indirect blood pressure measurements are expected. These differences occur because direct methods measure pressure and indirect methods measure flow. In addition, differences occur because the measurement location is not the same (e.g., brachial artery for NIBP vs. radial artery for invasive arterial pressure monitoring).
Why is the monitor alarming arterial line disconnect?	• Check the patient immediately in the event the catheter has been dislodged. • If the mean pressure falls below 10 mmHg, the monitor alarms. When zeroing a pressure line, start the zeroing process within 8 seconds. After that time the disconnect alarm is activated. • If zeroing, close the stopcock. Once the monitor detects the return of waveform and numeric data, the alarm will reset.

13

Temperature

Temperature safety precautions

Temperature warnings

WARNING DEFIBRILLATOR PRECAUTIONS. Patient signal inputs labeled with the CF and BF symbols with paddles are protected against damage resulting from defibrillation voltages. To ensure proper defibrillator protection, use only the recommended cables and leadwires.

WARNING When using an electrosurgery unit, note that the measurement cables do not incorporate means to protect against burns in case of a defective ESU return electrode. To avoid burns at the monitor measurement sites, ensure the following:

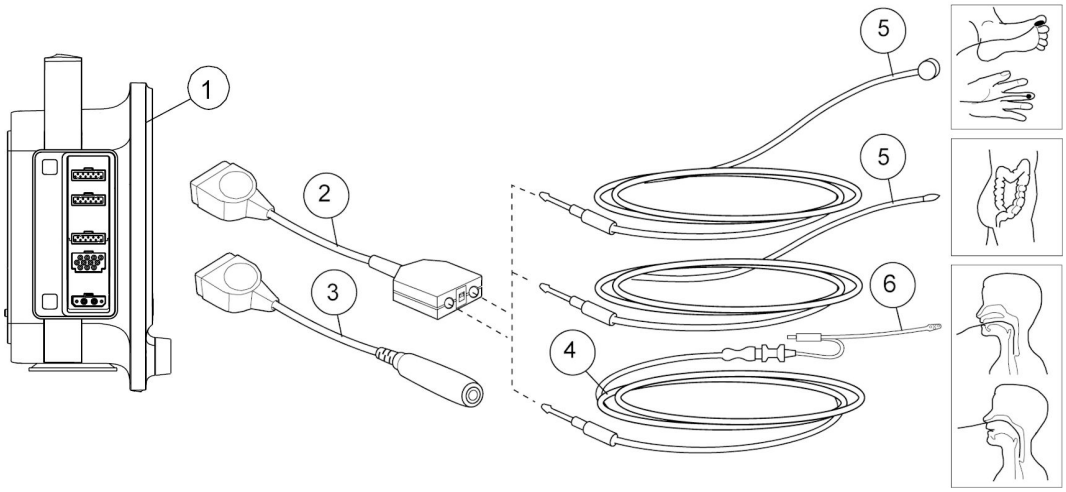
- Proper contact of the ESU return electrode to the patient.
- ESU return electrode near the operating area.
- Measurement electrodes, leadwires and probes far from the surgical site and the ESU return electrode.

Temperature points to note

- This equipment is suitable for use in the presence of electrosurgery, as tested according to IEC 60601-2-49 clause 202.6.2.101 Electrosurgery interference.
- Use only GE approved temperature accessories.
- For more detailed information regarding the temperature probes, refer to their own instructions for use.
- The temperature measurement uses direct mode. Displayed temperature values represent the probe temperature of the measurement site on the patient.
- A temperature channel is activated when the monitor detects a temperature probe.
- A temperature channel is deactivated when a temperature probe is detached.

Temperature measurement setup

Temperature equipment to patient connection



NOTE The temperature measurement site in above graphic is only for reference, please refer to the accessories' instruction for details.

1. The monitor
2. Dual temperature cable
3. Single temperature cable
4. Temperature interconnect cable for disposable temperature probes
5. Reusable temperature probe
6. Disposable temperature probe

Preparing the patient for temperature measurement

1. Follow the manufacturer's instructions for probe application.
2. Connect the temperature cable to the connector.

Checking the temperature measurement

1. Check that the temperature value is displayed when the probe is connected to a temperature cable.

Temperature measurement on the monitor screen

Up to two temperature measuring sites can be simultaneously measured and monitored. Temperature monitoring provides numerics only. No waveform is generated or displayed. The temperature measuring site labels are as follows:

T1, ***T2*** = general label	***AirW*** = airway
Eso = esophageal	***Room*** = room

Naso = nasal	***Myo*** = myocardial
Tymp = tympanic	***Core*** = core
Rect = rectal	***Surf*** = surface
Axil = axillary	***Blad*** = bladder
Skin = skin	

Using the temperature measurement

Setup the parameter to main screen if need: > ***Screen Setup***.

Changing the temperature site label

1. Select the temperature digit field.
2. Choose a site label from the ***T1 Label*** and ***T2 Label*** list.

Selecting the temperature unit

1. Select the temperature digit field.
2. Select the ***°C*** or ***°F*** from the ***Unit*** list.

Setting temperature alarms

1. Select the temperature digit field.
2. Select the ***Alarms*** tab.
3. Select the ***T1*** or ***T2*** tab for each label.
4. Check that the ***Alarm*** is turned on for each label.
5. Adjust the alarm limits with the arrows for each label.

NOTE If you wish the temperature alarm off, select from the ***Alarm*** list for each label.

Temperature practicalities

- Each temperature label can be changed to reflect the temperature measurement site.
- The dual temperature cable allows a two-channel measurement.
- The signal input is a high-insulation port to ensure patient safety and to protect the device during defibrillation and electrosurgery.
- The monitor automatically calibrates the temperature measurements at startup: every 10 minutes.

Temperature troubleshooting

Problem	Solution
Temperature measurement fails	• Check that the probe adapter is properly connected to the monitor. • Check that the probe is properly connected to the probe adapter. • Check that you are using the correct probe for the anatomical location being monitored. • Use a probe that is compatible with your system. • Try using a known good probe in case the sensor is damaged. • Check the patient connection. • If the problem persists, contact authorized service personnel.

14

Airway gases

Airway gases safety precautions

Airway gases warnings

WARNING Always inspect the airway adapter for a tight connection and proper operation before attaching it to the patient.

WARNING Leaks in the gas sampling circuit (water trap and sampling line) may cause inaccurate readings.

WARNING Remove the airway sampling line from the patient's airway while nebulized medications are being delivered.

WARNING Handle the water trap and its contents as you would any body fluid. Infectious hazard may be present.

WARNING Since sample gas may contain anesthetic agents, make sure that it is not released in the room. Connect exhaust to a scavenging system to prevent exposure to anesthetic agents.

WARNING Strong scavenging suction may cause excessive sample gas flow and inaccurate gas readings.

WARNING Route all tubing away from the patient's throat to avoid strangulation.

WARNING To avoid the spread of infectious disease, do not allow the exhaust to discharge in the direction of the patient or user.

WARNING $EtCO_2$ values may differ from blood gas readings.

WARNING A failure in zeroing or calibrating airway gases may cause inaccurate readings.

WARNING Since calibration gas contains anesthetic agents, always ensure sufficient ventilation of the room during calibration.

WARNING Do not wash, disinfect or open the water trap cartridge. Do not touch the water trap membrane. The hydrophobic membrane is damaged if any cleaning is attempted, and this may result in the contamination of the gas sensors.

WARNING To avoid the risk of patient cross-infection, do not return the sampled gas to the breathing system.

WARNING Always ensure the correct size and fit of accessories according to patient type and application, especially when monitoring pediatric and neonatal patients. The size and fit of accessories may impact the measured gas concentration values at low tidal volumes. It is recommended to have the gas sampling port close to the proximal end of the endotracheal tube. Excessive dead space in the circuit, including the accessories, may cause re-breathing of gases. Very low accessory dead space between the breathing circuit Y-piece and the gas sampling site may impact the measured gas concentration due to dilution of the sampled exhaled gas with fresh gas from the ventilator. To confirm accurate correlation with measured gases and blood, check arterial blood gas values to confirm a suitable setup is used.

WARNING E-miniC modules: Do not use this module on patients that cannot tolerate the removal of 150 ml/min from their total minute ventilation.

WARNING E-miniC: O_2, N_2O and anesthetic agent gases may interfere with $EtCO_2$ readings.

WARNING With deactivated ***Apnea*** alarm, keep the patient under close surveillance.

WARNING Make sure to compensate for the possible reduction of tidal volume caused by the 150 ml/min gas sample flow.

Airway gases cautions

CAUTION Do not apply pressurized air or gas to any outlet or tubing connected to the monitor. Pressure may destroy sensitive elements.

Airway gases measurement limitations

- E-miniC is not suitable for use with patients weighing less than 5 kg (11 lbs). In the NEONATAL mode, the CO_2 parameter is not display.

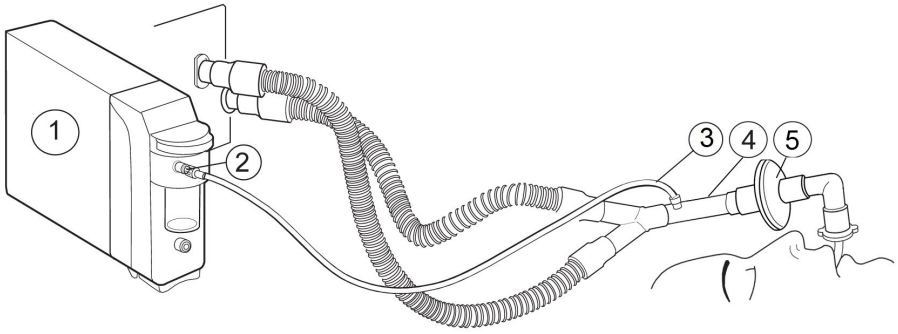
Airway gases points to note

- This equipment is suitable for use in the presence of electrosurgery, as tested according to IEC 60601-2-49 clause 202.6.2.101 Electrosurgery interference.
- Make sure that you are using a water trap that is compatible with the module:
  - E-miniC: Mini D-fend
- Empty the water trap container as soon as it is more than half full.
- Place the airway adapter between the HME and Y-piece.
- Place the airway adapter with all sampling ports upwards.
- Always check the tightness of all connections.

- Make sure that the gas sampling line is properly connected to the water trap and the water trap is properly connected to the airway gas module. Gas leaks in these connections may dilute the gas sample from the patient circuit, thus resulting in erroneous gas readings. During normal operation, all sampled gas flows out of the sample gas outlet. Room air is used as reference gas for the oxygen measurement and it is mixed with the sampled gas. The sampled gas is diluted by room air so that the fraction of room air in the exhaust gas is about 20%.
- E-miniC: The system automatically compensates for changes in barometric pressure over the atmospheric pressure range of 500 to 800 mmHg (66.7 to 106.7 kPa) over the specified atmospheric pressure ranges.

Airway gases measurement setup

Airway gases equipment to patient connections with E-miniC, critical care setup



1. E-miniC module
2. Sampling line connector on the water trap
3. Gas sampling line
4. Adapter with sampling line connector
5. Heat and moisture exchanger with filter (HMEF)

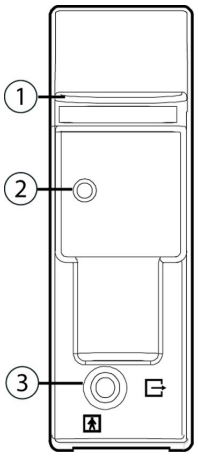
Setting up the airway gases measurement

1. Make sure that the water trap container is empty and properly attached.
2. Connect the gas sampling line to the sampling line connector on the water trap.
3. Connect the sample gas outlet to gas scavenging if N_2O or volatile agents are used.
4. Turn on the monitor or connect the module to the monitor. The monitor performs a self-check for the module when the module is connected.
5. Wait until the message ***Calibrating*** disappears.
6. Connect the sampling line to the airway adapter or the airway adapter to the ventilator circuit. Position the adapter with the sampling port upwards to minimize the amount of condensed water possibly entering the sampling line.
7. Check that the airway adapter connections are tight and that the adapter is operating properly.

NOTE Check that the sample line is connected to the water trap before connecting the module to the monitor or turning on the monitor.

NOTE To minimize the amount of dust drawn into the gas sampling system, always keep the water trap connected to the module. When gas measurement is not in use, you can disconnect the module from the monitor to eliminate the operating sound of the gas pump.

E-miniC module connectors



1. Water trap latch
2. Sampling line connector on the water trap
3. Sample gas outlet (gas exhaust)

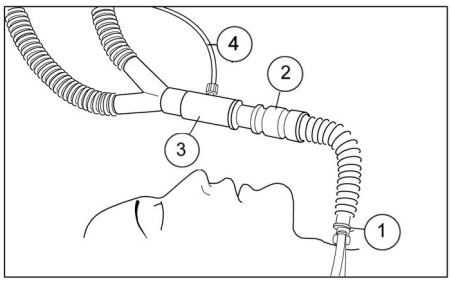
E-miniC indications for use

E-miniC and accessories are indicated for monitoring CO_2 and respiration rate of all hospital patients. E-miniC is indicated for monitoring patients weighing more than 5 kg (11 lbs). The device is indicated for use by qualified medical personnel only.

Airway gases alternative patient connections

- With E-miniC, use an airway adapter and a sampling line.

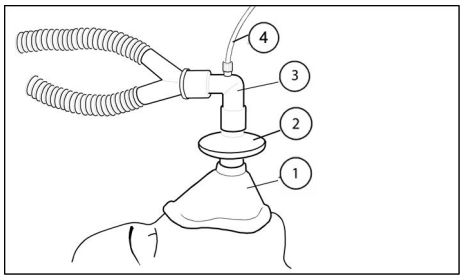
Tracheostomy



1. Tracheostomy tube with 15 mm connector
2. Heat and Moisture Exchanger (HME)
3. Airway adapter

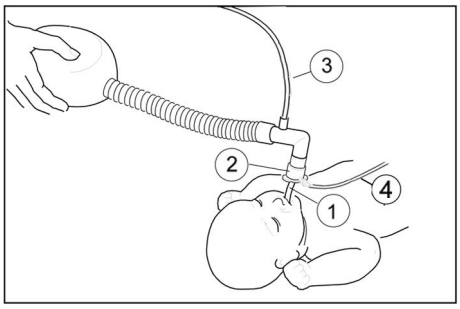
4. Sample line

Mask ventilation



1. Mask
2. Bacterial filter
3. Airway adapter
4. Sample line

Infant ventilation



1. Endotracheal tube
2. Pediatric airway adapter
3. Fresh gas inlet
4. Sample line

Checking the airway gases measurement

1. Check that the water trap container is empty.
2. Occlude the sampling line and check that the ***Sample line blocked*** message appears within 30 seconds and gas waveforms are showing zero at the same time.

Airway gases parameters

Airway gases parameters, E-miniC

Parameter	E-miniC
CO_2	support
O_2	n/a*
N_2O	n/a*
AA	n/a

Parameter	E-miniC
Agent ID	n/a
Additional measurements	
MAC	n/a
MACage	n/a
Balance gas	n/a
Gas exchange	n/a
Patient Spirometry	n/a
Respiration rate	support
Sampling method	
Sidestream	support
Mainstream	n/a
* The measured N_2O and O_2 value are not displayed. E-miniC requires manual selection from the monitor menu to compensate for N_2O and O_2.	

Using the E-module for CO_2 measurement

Setup the parameter to main screen if need: > ***Screen Setup***.

Turning on the CO_2 measurement

If ***Measurement off*** is shown on CO_2 waveform field or ***OFF*** is shown on CO_2 digit field, you need to select CO_2 measurement on.

1. Select the gas digit field.
2. Select ***ON*** from the ***Measurement*** list.

Selecting the CO_2 scale

If $EtCO_2$ is above 6% (45 mmHg), change the scale for capnogram.

1. Select the gas digit field.
2. Select an option from the ***Scale*** list.

Selecting the FiO_2 level

NOTE FiO_2 and N_2O compensations must be selected manually when E-miniC is used.

The presence of a large concentration of oxygen causes the CO_2 level appear lower than the actual value. Use this option to compensate for the presence of O_2.

1. Select the gas digit field.
2. Select an option from the ***FiO2 Level*** list.

Selecting the N_2O level

NOTE FiO_2 and N_2O compensations must be selected manually when E-miniC is used.

The presence of N_2O causes the CO_2 value to appear higher than the actual value. Use this option to compensate for the presence of N_2O.

1. Select the gas digit field.
2. Select an option from the ***N2O Level*** list.

Selecting the CO_2 sweep speed

This selection affects the waveform.

1. Select the gas digit field.
2. Select an option from the ***CO2 Sweep Speed*** list. The options are:
   - ***Fast***: 6.25 mm/s
   - ***Slow***: 0.625 mm/s

Selecting the CO_2 unit

1. Select the gas digit field.
2. Select the ***%***, ***kPa***, or ***mmHg*** from the ***Unit*** list.

Setting CO_2 limit alarms

1. Select the gas digit field.
2. Select the ***Alarms*** tab.
3. Select the ***EtCO2***, ***FiCO2***, or ***Resp Rate*** tab.
4. Check that the ***Alarm*** is turned on.
5. Adjust the related alarm limits with the arrows.

NOTE If you want the alarm off, select from the related ***Alarm*** list.

Preventing operating room pollution

When N_2O and volatile anesthetics are used, prevent operating room pollution by connecting the sample gas outlet (gas exhaust) of the module to the scavenging system.

Scavenging through the ventilator reservoir

1. Connect an exhaust line to the sample gas outlet (gas exhaust) on the module's front panel.
2. Attach the other end of the line to the ventilator reservoir. Make sure that the reservoir tube diameter is at least 2 to 3 times larger than the exhaust line.

Scavenging through the anesthesia gas scavenging system

Anesthesia machines are equipped with an anesthesia gas scavenging system (AGSS), and in some machines you can connect the sample gas outlet directly to it. See the

anesthesia machine's user documentation to find out where and how the sample gas can be connected.

Connecting directly to the scavenging system

1. Connect the exhaust line to the module's sample gas outlet.
2. Connect the exhaust line only to an open scavenging system where gas is removed at room pressure.

NOTE Do not connect the module directly to a strong vacuum scavenging system.

NOTE If the E-miniC is used, do not return sample gas to the patient circuit.

Stopping the airway gases measurement

1. Remove the added adapters from the patient's breathing circuit and gas scavenging.
2. Check the patient's breathing circuit.
3. Select the gas digit field > ***Measurement*** > ***OFF***.
4. Remove the gas module from the monitor when it is not used.

Calibrating airway gases

To ensure that the measurement accuracy remains within specifications follow the recommended calibration check intervals: every six months when used several hours a day on most days each week, and every two months in more continuous use, and whenever there are indications of errors in the gas readings.

NOTE Ensure that the calibration gas and regulator are functioning properly before calibration. Perform annual maintenance of the regulator as required.

NOTE Make sure that you are using a correct GE calibration gas, see the suppliers and accessories provided. Do not use any other calibration gases.

NOTE Calibration gas bottles with anesthetic agents must be disposed of in compliance with the guidelines regulating the disposal of products containing anesthetic agents.

1. Turn on the patient monitor. For maximum accuracy, let the monitor warm up for 30 minutes.
2. Attach a regulator to the calibration gas cylinder.
3. Attach a new sampling line to the water trap. Connect the other end of the sampling line to the regulator on the gas container.
4. Select the gas digit field > ***Calibration*** tab.
5. Wait until the messages ***Zero OK*** and ***{0s} Feed gas*** appear on the screen.
6. Open the regulator and feed gas until the adjust menu appears, then close the valve.

7. Check that the displayed values match the values on the calibration gas container. Adjust if necessary:
   a. Adjust the value with arrows until it matches the desired value on the gas container.
8. Confirm by selecting ***Accept***.
9. If the calibration is successful, the message ***{0s} OK*** is displayed and the last calibration time and date is updated for a few seconds. If the calibration fails, the message ***Calibr. Error*** appears instead. In this case, start a new calibration by selecting ***Recalibrate***.

If the message ***Zero error*** appears, repeat the calibration procedure. If the problem persists, contact authorized service personnel.

Basics of airway gases measurement

Airway gases measurement description, E-miniC

The E-miniC is designed for critical care environment to measure and monitor the expired and inspired CO_2 concentration ($EtCO_2$, $FiCO_2$) as well as the respiration rate (RR) up to 80 breaths per minute. E-miniC has a sample flow of 150 ml/min.

Respiration rate from the CO_2 parameter is counted from the frequency of end-tidal (peak) CO_2 measurements per minute. A sufficient respiration is defined as a difference of at least 1% (at least 7 mmHg) between the measured inspired fraction and end-tidal CO_2.

Total sample size volume during one respiratory cycle depends on the respiration rate. The following table shows different sample size volumes with a 150 ml/min sample flow and I:E ratio of 1:2.

Respiration rate	10	20	30	40
Duration of inspiration	2.0 seconds	1.0 seconds	0.7 seconds	0.5 seconds
Duration of expiration	4.0 seconds	2.0 seconds	1.3 seconds	1.0 seconds
Volume sampled during inspiration	5 ml	2.5 ml	1.67 ml	1.25 ml
Volume sampled during expiration	10 ml	5 ml	3.33 ml	2.5 ml
Total volume sampled	15 ml	7.5 ml	5 ml	3.75 ml

Sidestream gas sampling

The E-modules use a sidestream gas sampling method. It means that a sample of patient's respired gases from the sampling site is transported through a sampling line to the module for analysis.

A sidestream gas analyzer takes a constant sample from the patient airway adapter at the following sample rates:

- E-miniC: 150 ml/min

Total sample size volume during one respiratory cycle depends on the respiration rate.

The electronic sampling rate of the gas sensor signals is 25 Hz, equaling a new data point on the gas waveform traces every 40 ms.

Basics of CO_2 measurement

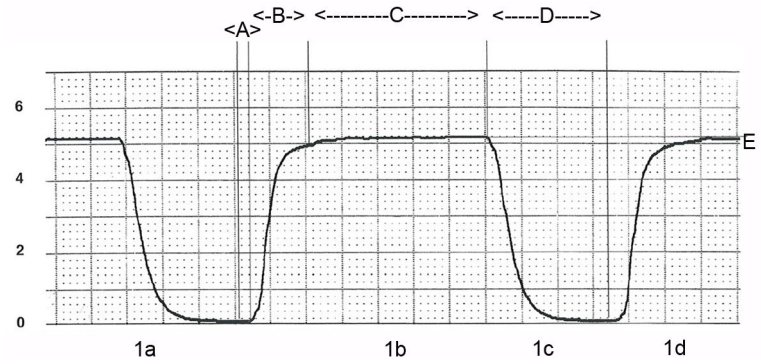
Normal CO_2 waveform

The CO_2 waveform is referred to as capnogram and it reflects the different stages in breathing. The capnogram of a healthy patient under controlled ventilation has a normal shape. Changes in the CO_2 waveform may indicate compromised patient respiratory and/or circulatory function or improper mechanical ventilator functionality.

The origin of the CO_2 waveform

The following illustration shows a normal capnogram. In this illustration, the letters indicate the following:

- A: The gas first exhaled is from the anatomical and apparatus dead-space. It contains no CO_2 because it has not been in the alveoli and no gas exchange has taken place.
- B: Briefly, the exhaled gas is a mixture of gas from the anatomical dead-space and gas from the alveoli.
- C: A plateau is reached when the gas exhaled is entirely from the alveoli. The end-tidal CO_2 ($EtCO_2$) concentration is measured at the end of this plateau.
- D: When the next inspiration starts the capnogram rapidly falls towards the baseline. The minimum level of CO_2 measured during the inspiratory phase is called the inspired CO_2 concentration (normally 0.0%).
- E: With a scale, the height of the capnogram tells you the end-tidal CO_2 concentration. The monitor automatically calculates and display the $EtCO_2$ in numbers. $EtCO_2$ approximates the alveolar CO_2 concentration because it is measured when the patient exhales virtually pure alveolar gas.



- 1a and 1c = inhalation
- 1b and 1d = exhalation

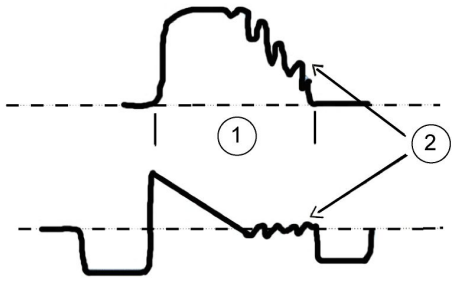
$EtCO_2$ value %	$EtCO_2$ value mmHg	Indicates
4.5% to 5.5%	34 mmHg to 41 mmHg	normocapnia
< 4%	< 30 mmHg	hypocapnia
> 6%	> 45 mmHg	hypercapnia

Dips in capnogram

The dips seen in the capnogram during expiration are related to the sidestream gas sampling, the continuous gas flow to the Y-piece, and patient's cardiac contractions, which cause intra-thoracic pressure changes and therefore flow variations.

The alterations in expired CO_2 waveform are cardiogenic movements of exhaled and circuit gas at the sidestream gas sampling site. When the respiratory gas flow drops below the gas sampling rate, a variable mixture of CO_2 free fresh gas and exhaled CO_2 rich gas is sampled. This causes variations in sampled CO_2 concentrations.

In the illustration below, CO_2 waveform is the one on top, and flow is the lower waveform.



1. Expiration
2. Cardiogenic oscillations

Cardiogenic oscillations appear when:

- A continuous fresh gas flow is fed into the patient Y-piece.
- Sidestream gas sampling is done at the Y-piece.
- The patient is ventilated with a long expiration time or low respiration times, and when there is a long zero flow at end-expiration for some other reason.

Oscillations can be eliminated by adding a spacer with a 5 ml dead space between the Y-piece and the airway adapter. Increased dead space creates a buffer volume between the Y-piece and the sampling point, preventing the inspiratory and expiratory air from mixing during gas sampling. Misinterpretation of $EtCO_2$ information can be avoided through identifying cardiogenic oscillation and understanding the reasons for it.

Airway gases practicalities

Ventilation management

Normoventilation (adequate alveolar ventilation of a patient) can be maintained by monitoring the end-tidal carbon dioxide and oxygen concentrations, and adequacy of ventilation can be maintained by monitoring airway pressures, volumes

and spirometry loops. Alveolar minute ventilation is usually adjusted to achieve normocapnia, where $EtCO_2$ is in the range of 4.5% to 5.5% (34 mmHg to 41 mmHg). This is called normoventilation as it is the normal situation in healthy people.

A low $EtCO_2$ concentration ($EtCO_2$ < 4% / 30 mmHg) indicates hyperventilation.

NOTE A low $EtCO_2$ value in itself is dependent from the ventilation volume vs. circulation status (lung perfusion). This means that in case of low blood pressure (e.g. shock) or shunting low $EtCO_2$ values may be observed while using a "normal" TV/MV.

Increased $EtCO_2$ concentration ($EtCO_2$ > 6.0% / 45 mmHg) indicates hypoventilation or ineffective alveolar ventilation, which will lead to hypercapnia and respiratory acidosis. Increased inspiratory CO_2 ($FiCO_2$) concentrations may also be caused by:

- Exhausted CO_2 absorber.
- Malfunction of the breathing system valves.
- Rebreathing when a rebreathing system without a CO_2 absorber is used with inadequate fresh gas flows.

NOTE During some surgical procedures, e.g. laparoscopy, CO_2 may be used to inflate the abdomen which may result in rise of $PaCO_2$ due to the absorption of CO_2 into the blood via the vascular wound bed. This may lead to an increase in the $EtCO_2$.

Prevention of the breathing system contamination

You can use a microbial filter between the endotracheal tube and the airway adapter. Change the filter for every patient. Change the patient circuit at intervals given in the circuit manufacturer's documentation, and according to your hospital protocols.

How to prevent effects of humidity

In anesthesia, the lower the fresh gas flow, the more rebreathed gas recirculates through the CO_2 absorber and the more humidity and heat is produced through the chemical CO_2 absorption process.

- If a moisture exchanger is used, place it between the endotracheal or intubation tube and the airway adapter. In intensive care, the moisture exchanger must be replaced at least every 24 hours.
- Place all airway adapter ports upwards with a 20° to 45° tilt to prevent condensed water from entering the sensor interior and the tubings.
- The airway adapter should be emptied of clearly visible water droplets, or replaced with a dry and clean adapter.
- If active humidification is used, extra water collectors may be placed between the ventilator's inspiratory and expiratory breathing tubings. They are also useful for condensed water collection during long-lasting anesthesia.

Airway gases troubleshooting

Problem	Solution
Airway gas values seem too low	• Check the sampling line and connectors for leakage. • Check the patient status. • Check the arterial blood gas values.
Airway gas values seem too high	• Check the sampling line for blockage. • Check the patient status. • Check the arterial blood gas values.
Module does not work	• Check and clean the filter if necessary. • Check the water trap and water trap connectors. Liquid may have entered the module. Replace the module and have it checked by authorized service personnel.
No airway gas values	• Check that the gas sampling line is connected to the water trap. • Check that the gas sampling line is connected to the patient.
Why can we see dips in the capnogram during expiration?	• The dips seen in the capnogram during expiration are related to the sidestream gas sampling, the continuous gas flow to the Y-piece, and patient's cardiac contractions, which cause intra-thoracic pressure changes and therefore flow variations.
Why can we see variations in the oxygram during inspiration?	• Changes in the fresh gas flow reate and oxygen concentrations affect the shape of the oxygram during inspiration. Rule out any potential clinical complications such as hypoventilation, hyperventilation, circuit hypoxia, disconnection.
Why is the $EtCO_2$ value considerably lower than the CO_2 partial pressure determined by blood gas analysis?	• The major clinical reasons are dead-space ventilation, ventilation/perfusion mismatch, a drop in cardiac output, alveolar shunts, and incomplete emptying of the alveoli. • Also check the following technical issues: integrity of the breathing circuit; blood-gas analysis corrected to a lower temperature in case of hypothermia.

15 Trends, snapshots, and alarm history

Patient data safety precautions

Patient data cautions

CAUTION System time changes will result in time differences between stored and realtime data.

CAUTION MISINTERPRETATION OF HISTORICAL DATA. Changing the date and time on one network device on the CARESCAPE Network will also update the date and time for all other devices on the same network. To avoid possible misinterpretation of historical data when viewing it, special attention should always be paid to the time and date information.

Patient data views

Different views display various types of patient data: graphical trends, numerical trends, snapshot, alarm history and OxyCRG.

The snapshot can be configured through > ***Service*** > ***Snapshot***. These selections are password protected.

For more information, see the supplemental information manual.

The graphic trends include a predefined set of parameters. The numeric trend selections include all parameters that can be used. If you are viewing trends for parameters for which you do not have a license, trend labels are shown, but no new data is collected. Therefore, no data is shown in the trend view or printouts.

NOTE The following parameters are not trended while apnea is deactivated: $EtCO_2$, $FiCO_2$.

Graphic trends

Viewing graphic trends

Graphic trends contain 168 hours (7 days) of trend data. They contain four trend pages, each having up to four fields with different parameters.

1. Select the  .
   - To see more parameters, select vertical tabs ***1*** to ***4***.
   - To see numeric values at a certain time, use **< >** at the bottom bar to that point of time. The numeric values are displayed next to the cursor.
   - To see more values for a previous time, use **<< >>** at the bottom bar.

Graphic trend symbols

In printouts the graphic presentation formats are replaced by symbols. The following are some examples of these.

	CO_2
	SpO_2
	Art (sys/dia/mean): The gap shows the blood pressure mean value.
	NIBP (sys/dia/mean): The gap shows the blood pressure mean value.

Changing the graphic trend scales

1. Select the  .
2. Select the  on the right corner of the bottom.
3. Select the ***Scales*** tab.
4. Select the ***Time Scale*** and parameter scales for graphic trends.

Graphic trend resolution

The graphic trend resolution depends on the time scale of the trend.

Time scale	Resolution
20 min	10s
1 h and 2 h	1 min
4 h	2 min
6 h	3 min
8 h	4 min
10 h	5 min
12 h	6 min
24 h	12 min
36 h	18 min

Time scale	Resolution
48 h	24 min
72 h	36 min
96 h	48 min
120 h	60 min
144 h	72 min
168 h	84 min

Setting the graphic trend pages

1. Select the  .
2. Select the  on the right corner of the bottom.
3. Select the ***Pages*** tab.
4. Select the ***1***, ***2***, ***3*** and ***4*** vertical tab for trend pages.
5. Setup the parameters for related field.

Numeric trends

Viewing numeric trends

Numeric trends contain 3 pages with 168 hours (7 days) of trend data.

You cannot configure the layout of the ***Numerical Trends*** view.

1. Select  .
2. Select the ***Numerical Trends*** horizontal tab.
   - To see more parameters, select their vertical tabs in the trend view.
   - To see more numeric trend data, use **<< >>** at the bottom bar.

Changing the time interval of numeric trends

Numeric trends display values according to the selected time interval. Numeric trends are updated with averaged measurement data once a minute independent of the selected time scale.

1. Select the  .
2. Select the ***Numerical Trends*** tab.
3. Select the  on the bottom right corner.
4. Select a value from the ***Trends Interval*** list.

For example, a 5 minute interval will show data for every 5 minutes, and a 30 minute interval will show data for every 30 minutes. The data is displayed in columns on the screen. NIBP measurement will always add one column independent of the ***Trends Interval*** setting.

Snapshots

Description of snapshots

A snapshot is a set of measured data saved from a certain moment of time. Snapshots can contain waveform clips and trigger events. You can take up to 200 snapshots depending on the data load.

Snapshot configuration

Snapshots can be configured for waveforms and whether create on alarms. Configure snapshot through > ***Service*** > ***Snapshot*** and these settings are password protected.

For more information, see the supplemental information manual.

Manually created snapshots

You can create a snapshot manually by selecting on the keypad. The monitor saves the image of waveforms at that moment in time.

When a snapshot is taken manually, it is automatically numbered. A ***Mark xxx*** message is shown in the message field (xxx = the sequence number of the snapshot).

Automatically created snapshots

- You can create snapshots automatically on alarms if automatic snapshot creation is enabled. The alarm condition for creation are: ***Brady***, ***Tachy***, ***Art sys/dia/mean high***, and ***Art sys/dia/mean low***.
  To enable this feature:

  > ***Service*** > ***Snapshot*** > ***Create on Alarms***, this setting is password protected.

  For more information, see the supplemental information manual.
- You can define automatic snapshot creation for each arrhythmia alarm separately. To select arrhythmia alarms that will automatically create a snapshot:
  ECG digit field > ***Alarms*** tab > related arrhythmia alarms vertical tab.

  For more information, see “Setting arrhythmia alarms” in the ECG chapter.

Viewing snapshots

1. Select the .
2. Select the ***Snapshot*** horizontal tab.

Three waveforms can be displayed on the snapshot page.

The lowest field in the ***Snapshot*** view shows the snapshot time and alarm text.

You can see more snapshots by using **<< >>** at the bottom bar.

Alarm history

Viewing alarm history

Alarm history is a list that stores high and medium priority alarms.

1. Select the 
2. Select the ***Alarm History*** horizontal tab.

- The alarm history list displays the latest 100 alarms.
- The color of each alarms indicate the alarm priority.
- The  symbol means there is a snapshot attached to an event, you can click the symbol to view the related snapshot.

OxyCRG

OxyCRG description

The OxyCRG (oxycardiorespirogram) provides services to view and review specific high resolution trends, high resolution beat-to-beat HR trend, high resolution beat-to-beat SpO_2 trend and compressed respiration waveform - simultaneously in the same view.

The device displays 8 minutes OxyCRG function in the NEONATAL mode. Two types of views are provided: OxyCRG Snapshot view and OxyCRG Realtime view.

Viewing the realtime OxyCRG

1. Select 
2. Check ***Patient Type*** is ***Neonatal***.
3. Select ***OxyCRG***.

   Or:

4. In NEONATAL mode, select the  >  ***OxyCRG***.

Viewing OxyCRG snapshot

The OxyCRG snapshot is created when an OxyCRG event is triggered. The device can store up to 70 OxyCRG snapshots. OxyCRG snapshot includes the trend data 6 minutes before and 2 minutes after the OxyCRG event. If multiple OxyCRG events are triggered within 2 minutes, they will be detected as one OxyCRG event. During this time, only the first OxyCRG event will trigger OxyCRG snapshot creation.

1. In the NEONATAL mode, select the  >  ***OxyCRG***.
2. Select the ***OxyCRG Snapshot*** tab.

The lowest field shows the snapshot triggered time and condition.

You can see more OCRG snapshots by using **<< >>** at the bottom bar.

Setup OxyCRG snapshot

The OxyCRG snapshot will be triggered by any of HR, SpO2 value and Apnea time is out of OxyCRG limits range. You can setup these limits.

1. In the NEONATAL mode, select the > ***OxyCRG***.
2. Select the ***OxyCRG Setup*** tab.
3. Adjust each parameter's limits with the arrows.

Time change during a patient admit

Time adjustment is allowed during a patient admit if the monitor is configured to the CARESCAPE Network, independent on its connection status to the network. When the time is adjusted, the monitor shifts the timestamps of continuous trend data and of discrete data, except NIBP measurement.

After time adjustment continuous and discrete data cannot be compared to each other, because their timestamps no longer match.

2 minutes before device disconnected from network, the monitor may not be able to transmit the NIBP trends data to the Aware Gateway Server or CARESCAPE Gateway Server.

Erasing patient data

The patient's data is erased when

- discharge a patient
- the monitor has been off for more than 120 minutes
- the data after 168 hours (7 days)

Erased snapshots cannot be recovered.

To erase patient data, you must discharge the patient.

NOTE This will also return monitor settings to their defaults.

1. Select the .
2. Select the ***Discharge*** tab.
3. Select ***YES*** from the ***Discharge*** list.

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Printing

Printing description

Depending on the system configuration, the following printing capabilities are available:

- Printing to a recorder connected directly to the monitor.

You can print realtime waveforms (generated by a manual request or by an alarm) and numerical/graphical trends to a recorder.

NOTE Before you start printing, check that the printer is operational, make sure the recorder door is closed.

NOTE Recordings on thermal paper may be destroyed when exposed to light, heat, alcohol, etc. Take a photocopy for your archives.

Printing waveforms

Printing waveforms on alarms

An automatic strip chart printing is activated when the following alarms reach the high priority level:

Asystole, ***Tachy***, ***Brady***, ***V Fib / V Tach***, ***V Tach***, ***Art sys/dia/mean high***, ***Art sys/dia/mean low***

1. Select the > ***Recorder Setup*** > ***Waveforms*** tab.
2. Select ***YES*** or ***NO*** for the ***Start On Alarms***.

When printing is activated by alarms, the settings for waveform printouts can be set as following:

- The print delay: 12 seconds or OFF.
- The print duration: 30 seconds or continue.

Starting a waveform printout

1. Select one of the following options to start a waveform printout:
   - Select the  . Or,
   - Select the  >  ***Recorder Setup*** > ***Waveforms*** tab > ***Record Waveforms***.

   If print length has been configured for ***Cont.***, you will be required to stop the print request.

Stopping a waveform printout

1. Select one of the following options to stop printing a waveform:
   - Select the  . Or,
   - Select the  >  ***Recorder Setup*** > ***Waveforms*** tab > ***Stop Waveforms***.

Setting the print delay

1. Select the  >  ***Recorder Setup*** > ***Waveforms*** tab.
2. Select a value from the ***Delay*** list:
   - ***12 s***: Waveform printing starts when an event occurs and the 12 seconds prior to the event are recorded from the recorder memory.
   - ***OFF***: Manual waveform printing starts with real time data.

Setting the print speed

To select the sweep speed for the actual paper speed of a recorder:

1. Select the  >  ***Recorder Setup*** > ***Waveforms*** tab.
2. Select a time value from the ***Paper Speed*** list.

Setting the print duration

The length of the event shall determine the length of the printout.

1. Select the  >  ***Recorder Setup*** > ***Waveforms*** tab.
2. Choose a time value from the ***Length*** list: ***30 s*** or ***Cont.***.

   If you select ***Cont.***, waveforms continue to print until you stop the printing.

Selecting waveforms to print

1. Select the  >  ***Recorder Setup*** > ***Waveforms*** tab.
2. Choose the desired ECG lead/parameter for waveforms 1-3.

NOTE If choose 3 waveforms to print, the waveforms may not display entirely.

Printing trends

Printing numerical trends

Manual printing is possible only when the printing device is not processing another job at the same time.

1. Select the > ***Recorder Setup***.
2. Select the ***Trends*** tab.
3. Select desired ***Time Interval*** for numerical trends.

   The record numerical values not only follow time interval but also follow NIBP value and snapshot, if have.
4. Select ***Record Numerical*** to start printing.
5. Select ***Stop Numerical*** to stop printing.

Printing graphical trends

Manual printing is possible only when the printing device is not processing another job at the same time.

1. Select the > ***Recorder Setup*** .
2. Select the ***Trends*** tab.
3. Select the parameter for ***Graphic. Trend 1*** and ***Graphic. Trend 2***.
4. Select ***Record Graphical*** to start printing.
5. Select ***Stop Graphical*** to stop printing.

Printing format

Waveform printout format

The waveform printout header includes the following:

- Date and time
- Waveform labels and scale, if available
- Paper speed

The waveform printout footer (at the end of the recording) includes the following:

- Patient ID
- Last Name of patient
- First Name of patient

When printing 1 or 2 waveforms, the waveform printout include the annotations as follow:

- Top line: HR, SpO2, NIBP, IBP1'Art', IBP2'CVP'
- Bottom line: EtCO2, T1'T1', T2'T2', Resp

Numerical trends printout format

The contents for numerical trends are preconfigured, you can't choose the parameters or change their order.

The format of numerical trends printout is as follows:

Header	Sample of one column
Date	:Time
HR/min / SpO2 %	:xxx/xxx
NIBP SYS/DIA mmHg	:xxx/xxx
IBP1 'Art' Sys/Dia mmHg	:xxx/xxx
IBP2 'CVP' Mean mmHg	:(xxx)
T1'T1'/T2'T2' CEL	:xxxx/xxxx
CO2 ET/FI %	:xxxx/xxxx
Resp Rate /min	:xxx

Inserting recorder paper

1. Press the door latch to open the recorder door.
2. Remove the paper core.
3. Place a new paper roll between the tabs of the paper holder. Make sure the paper unroll from underneath the paper roll.

4. Pull out 3 to 4 cm of paper, then close the door.
5. Select the  to print out a strip.

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Cleaning and care

Cleaning and care safety precautions

Cleaning and care warnings

WARNING Before cleaning or disinfecting, disconnect the device from the power supply.

WARNING Regular preventive maintenance should be carried out annually. Failure to implement the recommended maintenance schedule may cause equipment failure and possible health hazards.

WARNING SAFETY HAZARD. To avoid risks to personnel and patient, or damage to the equipment, only perform maintenance procedures described in this manual. Unauthorized modifications can lead to safety hazards.

WARNING Avoid using other chemicals than the ones described in this manual as they may damage device surfaces, labels, or cause equipment failures.

WARNING To prevent liquids from entering the monitor, do not tilt the monitor.

WARNING If liquid has accidentally entered the system or its parts, disconnect the power cord from the power supply and have the equipment serviced by authorized service personnel.

WARNING Cleanup and disposal of broken displays must be in compliance with the safety and waste control guidelines regulating this product.

WARNING Never immerse any part of the device, cables, or leadwires in liquids or allow liquid to enter the interior of the device.

WARNING Do not autoclave any part of the system with steam (including cables or leadwires) or sterilize with ethylene oxide.

WARNING Do not pour or spray any liquid so that it may seep into connections or openings.

WARNING Never use conductive solutions, oxidizing compounds, wax, or wax compounds to clean devices, cables or leadwires.

WARNING EXPLOSION OR FIRE. Using non-recommended battery could result in injury/burns to the patients or users. Only use battery recommended or manufactured by GE. The warranty can be voided if non-recommended battery is used.

WARNING PHYSICAL INJURY. Make sure the battery is completely inserted and the battery door is completely closed. Falling batteries could seriously or fatally injure neonatal or other vulnerable patients.

WARNING EXPLOSION HAZARD. Do not incinerate a battery or store at high temperatures. Serious injury or death could result.

WARNING Non-medical equipment does not provide the same level of protection against electrical shock. Do not touch the patient and any part of non-medical equipment at the same time. An example of non-medical equipment is external display.

Cleaning and care cautions

CAUTION Do not apply pressurized air or gas to any outlet or tubing connected to the monitor. Pressure may destroy sensitive elements.

CAUTION Do not use or store equipment outside the specified temperature, humidity, or altitude ranges

Disposal safety precautions

Disposal warnings

WARNING Do not incinerate a battery or store at high temperatures. Serious injury or death could result.

Disposal cautions

CAUTION DISPOSAL. At the end of its service life, the product described in this manual, as well as its accessories, must be disposed of in compliance with the guidelines regulating the disposal of each product. If you have any questions concerning disposal of a product, please contact GE or its representatives.

CAUTION PACKAGING DISPOSAL. Dispose of the packaging material, observing the applicable waste control regulations.

Cleaning and care schedules

See the technical manuals for more comprehensive checks.

For details about cleaning, disinfecting and sterilizing the accessories, see the instructions for use in the accessory package.

Do not reuse single-use disposable accessories.

Always consider your hospital guidelines as well.

Daily checks

- Check that the accessories, cables, cable connectors, monitor, module and display parts are clean and intact.
- Check the charge of the monitor battery.

Check every two months

- Change the water trap.
- Check the airway gases calibration if the measurement is in continuous use.

Check every six months

- Check the airway gases calibration if the measurement is in normal (not continuous) use.

Once a year checks

- Check the calibration of temperature, NIBP and invasive blood pressure.
- Planned maintenance check

NOTE The invasive blood pressure transducers should be calibrated whenever a transducer error occurs.

NOTE Discharge patient before do calibration and maintenance.

Regular calibration checks

The following parameters require calibration checks at regular intervals, in addition to the calibration performed while monitoring patients.

- Airway gases
  The recommended calibration interval for airway gas measurements is every six months in normal use and every two months in continuous use, to ensure that the measurement accuracy remains within specifications. Familiarize yourself with instructions regarding the airway gases measurement, including the calibration instructions.
- Temperature, NIBP, and invasive pressures
  A calibration check of temperature, NIBP and invasive blood pressures should be performed at least once a year to ensure that the measurement accuracy remains within specifications. For calibration instructions, see the Technical Manual.

Cleaning and care points to note

- Warranty does not cover any damages caused by using other than GE approved substances and methods.
- Do not let liquid pool around connection pins. If this should happen, blot dry with a soft, lint-free cloth.
- Do not use excessive drying techniques, such as oven, forced heat, or sun drying.
- Do not spray cleaner directly on the display screen.

- Never connect any device or applied part to a patient until it is thoroughly dry.
- If you discover any signs of deterioration or damage in the device, discontinue its use.

Permitted detergents

Product	Manufacture
CAVIWIPES	Metrex Research, LLC
Clorox Healthcare Hydrogen Peroxide Cleaner Disinfectant Wipes	Clorox Professional
Clinell Universal Sanitizing Wipes	GAMA Healthcare
Water	NA
Mild soap	NA

Cleaning and care instructions

Setting the touchscreen off

You can set the touchscreen feature off when you need to clean the screen.

1. Select > ***Lock*** .
2. To enable the touchscreen, press any keypad key, or use the Trim Knob.

NOTE Press the **On/Off** key will turn off the monitor.

Cleaning non-applied parts, general instructions

Follow these instructions to clean the monitor, module and other non-applied parts unless there are separate part-specific instructions. Non-applied parts refer to those parts of the system that are not in direct contact with the patient.

Visual inspect the non-applied parts first, if there are any unacceptable deterioration such as corrosion, discoloration, pitting, cracked seals, please contact authorized service personnel, or properly dispose the parts according to the regulation guidelines.

1. Turn off the power to the equipment.
2. Disconnect the equipment from the power supply.
3. Remove the recorder and E-module from monitor.
4. Remove all cables and battery, close battery door.
5. Use wipes with one of the permitted detergents (wring excess liquid as needed).
6. Wipe the exterior surface.

   Avoid any contact of cleaning solutions with metal parts as this may cause corrosion.

   Do not damage or bend connector pins when cleaning or drying.

7. Allow solution to remain on device for a minimum of one minute or per hospital guidelines.

   Do not let fluid pool around connection pins. If this happens, blot dry with a cotton swab or soft cloth.

8. Wipe off the cleaning solutions with a clean, lightly moistened cloth.
9. Dry thoroughly with a dry, lint-free cloth and let air dry (recommend for at least 30 minutes), or follow hospital guidelines.

   Drying times may vary based on the environmental conditions.

10. Insert battery and close battery door.
11. Reconnect the equipment to the power supply.
12. Turn on the power to the equipment.

Visual inspect the non-applied parts are clean. If needed, repeat the cleaning process.

Other parts cleaning instructions

For details about cleaning and disinfecting the accessories, see the instructions for use in the accessory package.

Do not reuse single-use disposable accessories.

Always consider your hospital guidelines as well.

Water trap care instructions

- Empty the water trap container when it is more than half full. With a sample gas temperature of 37°C, a room temperature of 23°C, and sample gas relative humidity of 100 %RH, the water trap should be emptied every 24 hours (applies when the sample gas flow is within 150 ± 25 ml/min for E-miniC).
- In anesthesia: Replace the D-fend or Mini D-fend water trap when the message ***Replace D-Fend*** appears. The recommended change interval is every two weeks, the maximum lifetime of the water trap is two months.
- In critical care: Replace the D-fend or Mini D-fend water trap every 24 hours, for each new patient, or when the message ***Replace D-Fend*** appears.
- When using a new water trap, mark the date on the appropriate label on the water trap cartridge: 
- The water trap cartridge is disposable. Do not wash, or reuse the cartridge.

Monitor battery care

Replacing the monitor battery

1. Open the battery cover by pressing the battery cover and slide.
2. Pull the battery out using the battery strap.
3. Insert a new battery all the way with the test button facing up.
4. Close the battery door carefully.

Battery recycling

When a battery no longer holds a charge, it should be replaced. Contact authorized service personnel to remove the old battery or follow your local recycling guidelines.

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Messages

Messages related to ECG measurement

For information regarding alarm priorities and escalation times, see the supplemental information manual.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- MF = message field
- WF = waveform field
- DF = digit field

Message	Location	Explanation	What to do
• ***Alarm setup changed from Central***	• MF	Any of the ECG alarms (HR, ST alarms) are turned ON/OFF or its limits are adjusted from the Central.	• Check the alarm settings at the Central.
• ***Arrhythmia Paused***	• WF	ECG channels have not been available for analysis for the last 20 seconds or the internal HR calculation has not been updated for the last 30 seconds due to excessive artifact.	• Check the patient status. • Check electrode placement. • Prepare the patient's skin at electrode sites. • Change or move electrodes.
• ***Arrh Paused***	• MF		
• ***Asystole***	• MF, WF	Physiological alarm.	• Check the patient status.
• ***ASY***	• DF		
• ***Artifact***	• WF	Muscle artifact or high/low frequency noise.	• Check electrode contact. • Check lead placement. • Perform skin preparation. • Reposition/replace electrodes. • Request the patient to remain still.
• ***Brady***	• MF, WF	Physiological alarm.	• Check the patient status.
• ***ECG measurements removed***	• MF	The ECG module inside host has lost ECG communication.	• If the problem persists, contact authorized service personnel.

Message	Location	Explanation	What to do
• ***ECG module error***	• MF	The ECG module communication problem.	• If the problem persists, contact authorized service personnel.
• ***LA/L lead off*** • ***LL/F lead off*** • ***RA/R lead off*** • ***RL/N lead off*** • ***V/C lead off***	• WF	An electrode is disconnected.	• Check the electrodes.
• ***Lead changed***	• WF	The monitor automatically switches the ECG1 waveform selection to a measurable ECG Lead (I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5 or V6) if the current ECG1 waveform is not measurable.	• Note that the ECG waveform changes according to the lead it is measured from. Check the lead.
• ***Leads off***	• MF, WF	One or more of the connected electrodes is disconnected and arrhythmia detection is not possible.	• Check the connections.
• ***Learning***	• WF	ST algorithm is in learning phase, message shown e.g. when ECG measurement is started.	• No action required.
• ***ST Ant high*** / ***ST Ant low*** • ***ST Inf high*** / ***ST Inf low*** • ***ST Lat high*** / ***ST Lat low***	• MF	Physiological alarm.	• Check the patient status. • Adjust alarm limits if necessary.
• ***Tachy***	• MF, WF	Physiological alarm.	• Check the patient status.
• ***V Fib / V Tach***	• MF, WF	Physiological alarm.	• Check the patient status.
• ***V Tach***	• MF, WF	Physiological alarm.	• Check the patient status.
• ***VT > 2***	• MF, WF	Physiological alarm.	• Check the patient status.
• ***R on T***	• MF, WF	Physiological alarm.	• Check the patient status.
• ***V Brady***	• MF, WF	Physiological alarm.	• Check the patient status.
• ***Couplet***	• MF, WF	Physiological alarm.	• Check the patient status.
• ***Bigeminy***	• MF, WF	Physiological alarm.	• Check the patient status.
• ***Accel. Ventric.***	• MF, WF	Physiological alarm.	• Check the patient status.
• ***Trigeminy***	• MF, WF	Physiological alarm.	• Check the patient status.
• ***Multifocal PVCs***	• MF, WF	Physiological alarm.	• Check the patient status.
• ***A Fib***	• MF, WF	Physiological alarm.	• Check the patient status.
• ***Missing Beat***	• MF, WF	Physiological alarm.	• Check the patient status.
• ***Pause***	• MF, WF	Physiological alarm.	• Check the patient status.

Messages related to impedance respiration measurement

For information regarding alarm priorities and escalation times, see the supplemental information manual.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- MF = message field
- WF = waveform field
- DF = digit field

Message	Location	Explanation	What to do
• ***Apnea*** • ***APN***	• WF, MF • DF	No breathing detected.	• Check the patient status. • Check the ventilator and the patient's breathing status.
• ***Apnea deactivated*** • ***No breath deactivated*** (Not available for FDA countries.)	• DF	The case has recently been patient admitted on the monitor, or the measurement has just been started.	• Wait. The message disappears after the monitor detects breaths.
• ***LA/L-lead off*** • ***LL/F-lead off*** • ***RA/R-lead off***	• WF, DF	One of the electrodes is off.	• Check the electrodes and their connections.
• ***Measurement off***	• WF, DF	ECG leads are not connected to the patient.	• Connect the ECG leads to the patient to start the impedance respiration measurement.
• ***No Breath*** (Not available for FDA countries.)	• WF, MF, DF	No breath detected in neonatal mode with NEO RESP license.	• Check the patient status. • Check the ventilator and patient's breathing status.
• ***Resp high*** / ***Resp low***	• MF	Measurement values are equal to or outside the set alarm limits.	• Check the patient status. • Adjust alarm limits if necessary.
• ***Small resp curve***	• DF	Signal amplitude < 0.4 Ohm	• Check the patient status. • Check the electrodes placement.

Messages related to SpO_2 measurement

For information regarding alarm priorities and escalation times, see the supplemental information manual.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- MF = message field
- WF = waveform field
- DF = digit field

Message	Location	Explanation	What to do
• ***Check Device***	• DF	Only for Masimo type. Module malfunction.	• If the problem persists, contact authorized service personnel.
• ***Check Probe***	• DF	There is no detectable SpO_2 signal, the sensor is faulty or is detached from the patient.	• Check the sensor and connections.
• ***Check SpO2 probe***	• MF	There is no detectable SpO_2 signal, the sensor is faulty or is detached from the patient.	• Check the sensor and connections.
• ***Faulty Probe***	• DF	The sensor has failed, or not compatible.	• Replace the sensor. See the Suppliers and accessories.
• ***Incompatible Probe***	• DF	The sensor is not compatible.	• Replace the sensor. See the Suppliers and accessories.
• ***Incompatible SpO2 Probe***	• MF		
• ***Interference***	• DF	The measurement is disturbed.	• Check the sensor.
• ***Low Perfusion***	• DF	Low perfusion at the measurement point.	• Check the sensor and sensor positioning. • Relocate the sensor to a better measurement site, if possible. • Make sure the patient is not shivering.
• ***Low signal quality***	• DF	The quality of the signal is questionable.	• Check the sensor and sensor positioning. • Relocate the sensor to a better measurement site, if possible. • Make sure the patient is not shivering.
• ***No SpO2 probe***	• MF	Sensor is not connected to the monitor. Sensor is not compatible.	• Check connection between the sensor and the monitor. • Replace the sensor. See the Suppliers and accessories.

Message	Location	Explanation	What to do
• ***No SpO2 pulse*** • ***No Pulse***	• MF • DF	No pulses detected.	• Try another measuring site.
• ***Poor Signal***	• DF	Only for Masimo type. When the low perfusion is detected.	• Check the sensor and sensor positioning. • Relocate the sensor to a better measurement site, if possible. • Make sure the patient is not shivering.
• ***Probe Off***	• DF	The sensor may be defective.	• Check the patient status. • Reposition the SpO_2 sensor. • Replace the SpO_2 sensor.
• ***Pulse Search***	• DF	Defective or damaged sensor or cable. Sensor is off of the patient. Detection of a repeatable pulse has stopped.	• Check the sensor and cable. • Reposition or replace sensor.
• ***SpO2 faulty probe***	• MF	The sensor has failed, or not compatible.	• Replace the sensor. See the Suppliers and accessories.
• ***SpO2 high*** / ***SpO2 low***	• MF	Measurement values are equal to or outside the set alarm limits.	• Check the patient status. • Adjust alarm limits if necessary.
• ***SpO2 measurement removed***	• MF	Only for Nellcor or Masimo type. Hemo module of measuring SpO2 removed.	• If the problem persists, contact authorized service personnel.
• ***SpO2 module error***	• MF	Only for Nellcor or Masimo type. SpO2 module recognize a communication problem.	• If the problem persists, contact authorized service personnel.
• ***SpO2 probe off***	• MF	The finger or earlobe may be too thin or the sensor is off the patient.	• Check the patient status. • Reposition the SpO_2 sensor. • Replace the SpO_2 sensor.

Messages related to NIBP measurement

For information regarding alarm priorities and escalation times, see the supplemental information manual.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- MF = message field
- WF = waveform field
- DF = digit field

Message	Location	Explanation	What to do
• ***Call service: Error x*** where x = 0 - 99	• DF	0 = RAM test failure 1 = ROM checksum failure 2 = Pump on during idle or over current detected 3 = Startup communication failure with safety CPU 4 = EEPROM protection is off 5 = EEPROM read/write error 6 = Valve stuck closed during cuff typing 7 = Could not save calibration data 8 = PT2 higher than 150 for greater than 15 seconds while idle 9 = Determination time too long 10 = RTK 400Hz timer re-entry 11 = RTK 50Hz timer re-entry 12 = Not in use 13 = RTK overrun 14 = Too early AUTO START according to module check 15 = Calibration data invalid on initialization or unit never calibrated 16 = Communication timeout between main and safety CPU 17 = Safety CPU report communication timeout 18 = Wrong message rate in communication between main and safety CPU >< +/– 2% (480 msg/s)	• Contact authorized service personnel.
• ***NIBP call service error***	• MF		
• ***Check NIBP***	• MF	Systolic and/or diastolic results missing.	• Check the patient status. • Check NIBP cuff and hoses. • Repeat the measurement.
• ***Control measurement***	• DF	Pressure alarm limit exceeded.	• Allow measurement to complete. • Check the patient status.
• ***Cuff loose***	• DF	Loose cuff or cuff hose.	• Check the cuff and cuff hose.
• ***Cuff occlusion***	• DF	Occlusion during measurement or overpressured cuff.	• Check the cuff.
• ***Cuff overpressure*** • ***NIBP cuff overpressure***	• DF • MF	NIBP cuff has exceeded the maximum cuff pressure during an NIBP measurement.	• Check NIBP cuff and hoses. • Repeat the measurement.

Message	Location	Explanation	What to do
• ***Incompatible NIBP***	• MF	NIBP module with firmware version lower than 1.06 inserted	• Contact authorized service personnel.
• ***Long measurement time***	• MF, DF	The measurement time is long. The triggering values vary according to the module and inflation limits in use: • >2 min for adult/ child, 75 s to 80 s for infant	• Check the patient status. • Check the cuff and hose connections. • Restart the measurement.
• ***NIBP manual***	• MF	During auto cycling • Loose cuff or cuff hose. • Long measurement time	• Check the cuff and cuff hose whether loose.
• ***NIBP cuff loose***	• MF	Loose cuff or cuff hose.	• Check the cuff and cuff hose whether loose.
• ***NIBP cuff occlusion***	• MF	Occlusion during measurement or overpressured cuff.	• Check the cuff.
• ***NIBP DIA high*** / ***NIBP DIA low*** • ***NIBP MAP high*** / ***NIBP MAP low*** • ***NIBP SYS high*** / ***NIBP SYS low***	• MF	Measurement values are equal to or outside the set alarm limits.	• Check the patient status. • Adjust alarm limits if necessary.
• ***NIBP measurement removed***	• MF	Hemo module has lost NIBP communication.	• If the problem persists, contact authorized service personnel.
• ***Unstable zero pressure***	• DF	Pressure is unstable at start of the NIBP measurement.	• Check the patient status. • Check hose and cuff position. • Repeat the measurement. • If the problem persists, contact authorized service personnel.
• ***Weak pulsation***	• MF, DF	Weak or unstable oscillation signal.	• Check the patient status. • Reposition the cuff. • Repeat the measurement.

Messages related to invasive pressures measurement

For information regarding alarm priorities and escalation times, see the supplemental information manual.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- MF = message field

- WF = waveform field
- DF = digit field

Message	Location	Possible causes	Suggested actions
• ***P1 over range*** • ***Over range > 320 mmHg*** or ***Over range > 43 kPa***	• MF • DF	Measurement is over range, or the sensor is faulty. Transducer has not been zeroed correctly.	• Check the patient's pressure by alternative means. • Check the cable and connections. • Rezero the transducer. • Replace the sensor. • Replace the transducer. • If the problem persists, contact authorized service personnel.
• ***Px under range*** • ***Under range < -40 mmHg*** or ***Under range < -5 kPa***	• MF • DF	Measurement is under range, or the sensor is faulty. Transducer has not been zeroed correctly.	• Check the patient's pressure by alternative means. • Check the cable and connections. • Rezero the transducer. • Replace the sensor. • Replace the transducer. • If the problem persists, contact authorized service personnel.
• ***ABP disconnect*** • ***Art disconnect*** • ***UAC disconnect***	• MF	Invasive pressure line is disconnected.	• Check the patient status. • Check connections. • If pressure drops because of zeroing, perform the zeroing process.
• ***ABP Sys high*** / ***ABP Sys low*** • ***ABP Mean high*** / ***ABP Mean low*** • ***ABP Dia high*** / ***ABP Dia low***	• MF	Measurement values are equal to or outside the set alarm limits.	• Check the patient status. • Adjust alarm limits if necessary.
• ***Art Sys high*** / ***Art Sys low*** • ***Art Mean high*** / ***Art Mean low*** • ***Art Dia high*** / ***Art Dia low***	• MF	Measurement values are equal to or outside the set alarm limits.	• Check the patient status. • Adjust alarm limits if necessary.
• ***Calibrated***	• Menu	Channel calibrated successfully.	• Wait until the message disappears before starting a measurement.

Message	Location	Possible causes	Suggested actions
• ***Calibrating***	• Menu	Calibration of a channel is in progress.	• No action required.
• ***Failed***	• Menu	Unsuccessful calibration.	• If the problem persists, contact authorized service personnel.
• ***Failed: P<100***	• Menu	Unsuccessful calibration.	• If the problem persists, contact authorized service personnel.
• ***CPP high*** / ***CPP low***	• MF	Measurement values are equal to or outside the set alarm limits.	• Check the patient status. • Adjust alarm limits if necessary.
• ***CVP Sys high*** / ***CVP Sys low*** • ***CVP Mean high*** / ***CVP Mean low*** • ***CVP Dia high*** / ***CVP Dia low***	• MF	Measurement values are equal to or outside the set alarm limits.	• Check the patient status. • Adjust alarm limits if necessary.
• ***IBP1 Sys high*** / ***IBP1 Sys low*** / ***IBP2 Sys high*** / ***IBP2 Sys low*** • ***IBP1 Mean high*** / ***IBP1 Mean low*** / ***IBP2 Mean high*** / ***IBP2 Mean low*** • ***IBP1 Dia high*** / ***IBP1 Dia low*** / ***IBP2 Dia high*** / ***IBP2 Dia low***	• MF	Measurement values are equal to or outside the set alarm limits.	• Check the patient status. • Adjust alarm limits if necessary.
• ***ICP Sys high*** / ***ICP Sys low*** • ***ICP Mean high*** / ***ICP Mean low*** • ***ICP Dia high*** / ***ICP Dia low***	• MF	Measurement values are equal to or outside the set alarm limits.	• Check the patient status. • Adjust alarm limits if necessary.
• ***InvBP's not zeroed*** • ***Not Zeroed***	• MF • DF	There is at least one invasive pressure channel that has not been zeroed.	• Perform zeroing for all channels.
• ***LAP Sys high*** / ***LAP Sys low*** • ***LAP Mean high*** / ***LAP Mean low*** • ***LAP Dia high*** / ***LAP Dia low***	• MF	Measurement values are equal to or outside the set alarm limits.	• Check the patient status. • Adjust alarm limits if necessary.

Message	Location	Possible causes	Suggested actions
• ***No x transducer***	• MF	No transducer connected to the channel indicated in the message, or the sensor is faulty.	• Connect a transducer. • Check the cable and connections. • Replace the sensor. • Replace the transducer.
• ***PA Sys high*** / ***PA Sys low*** • ***PA Mean high*** / ***PA Mean low*** • ***PA Dia high*** / ***PA Dia low***	• MF	Measurement values are equal to or outside the set alarm limits.	• Check the patient status. • Adjust alarm limits if necessary.
• ***STP measurements removed***	• MF	The Hemo parameters have been removed.	• If the problem persists, contact authorized service personnel.
• ***RAP Sys high*** / ***RAP Sys low*** • ***RAP Mean high*** / ***RAP Mean low*** • ***RAP Dia high*** / ***RAP Dia low***	• MF	Measurement values are equal to or outside the set alarm limits.	• Check the patient status. • Adjust alarm limits if necessary.
• ***RVP Sys high*** / ***RVP Sys low*** • ***RVP Mean high*** / ***RVP Mean low*** • ***RVP Dia high*** / ***RVP Dia low***	• MF	Measurement values are equal to or outside the set alarm limits.	• Check the patient status. • Adjust alarm limits if necessary.
• ***UAC Sys high*** / ***UAC Sys low*** • ***UAC Mean high*** / ***UAC Mean low*** • ***UAC Dia high*** / ***UAC Dia low***	• MF	Measurement values are equal to or outside the set alarm limits.	• Check the patient status. • Adjust alarm limits if necessary.
• ***UVC Sys high*** / ***UVC Sys low*** • ***UVC Mean high*** / ***UVC Mean low*** • ***UVC Dia high*** / ***UVC Dia low***	• MF	Measurement values are equal to or outside the set alarm limits.	• Check the patient status. • Adjust alarm limits if necessary.
• ***Zero adj > 100 mmHg***	• DF	IBP channel zeroed to over 100 mmHg pressure.	• Repeat the transducer zeroing. • Replace the sensor. • Replace the transducer. • Re-zero the pressure channel.

Message	Location	Possible causes	Suggested actions
• ***Zeroed***	• DF	Zeroing was successful.	• No action required. Message is automatically removed after 10 seconds.
• ***Zeroing***	• DF	IBP channel is currently being zeroed.	• No action required. Message is automatically removed and replaced with the zeroing results after completion.
• ***Zeroing failed***	• DF	Pulsating waveform detected. Defective transducer Offset is >150 mmHg.	• Open the transducer to room air and zero the channel. • Replace the transducer, open it to room air, and zero the channel.
• ***Zero ICP separately***	• MF	The ICP channel must be zeroed separately from all other invasive pressures.	• Zero the channel using the ***Zero*** option found under the ICP channel setup menu.

Messages related to temperature measurement

For information regarding alarm priorities and escalation times, see the supplemental information manual.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- MF = message field
- WF = waveform field
- DF = digit field

Message	Location	Explanation	What to do
• ***Performing temp test***	• DF	Temperature is calibrating.	• No action required.
• ***STP measurements removed***	• MF	The Hemo parameters have been removed.	• If the problem persists, contact authorized service personnel.
• ***T1 high*** / ***T1 low*** • ***T2 high*** / ***T2 low***	• MF	Measurement values are equal to or outside the set alarm limits.	• Check the patient status. • Adjust alarm limits if necessary.
• ***Temperature error*** • ***T1 temperature error*** / ***T2 temperature error***	• DF • MF	Hardware or calibration test failure in the measurement device.	• Change the cable. • If the problem persists, contact authorized service personnel.

Messages related to gases measurement

For information regarding alarm priorities and escalation times, see the supplemental information manual.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- MF = message field
- WF = waveform field
- DF = digit field

Message	Location	Possible causes	Suggested actions
• ***Apnea***	• MF, WF	No breathing detected.	• Check the patient status. • Check the ventilator and breathing status.
• ***APN***	• DF		
• ***Apnea deactivated***	• DF	A new patient has been admitted, or the measurement has been started and the apnea alarm is not active yet.	• Wait. The message disappears after the monitor detects 3 breaths during the last minute.
• ***Calibrating gas sensor***	• WF	Due to the module warm-up, CO_2 measurement is not available during the first minute after the module has been connected.	• Wait until the warm-up has been completed.
• ***Check sample gas out***	• MF, WF, DF	The water trap is not connected, the sample gas outflow is blocked, or there is a leak inside the module.	• Check water trap connection. • Remove the blockage from the sample gas outlet. • Change module, if needed.
• ***Check D-Fend and sample gas out. Wait 30 sec and press Home to continue.***	• WF	The water trap is not connected, the sample gas outflow is blocked, or there is a leak inside the module.	• Check the patient status. Check water trap connection. • Remove the blockage from the sample gas outlet. • Change module, if needed.
• ***Check D-Fend***	• MF, WF, DF		
• ***Continuous blockage. Check sample line and D-Fend.***	• WF	The gas sampling line is blocked or the water trap is occluded.	• Change sampling line and water trap.
• ***Sample line blocked***	• MF, WF, DF		
• ***CO2 over scale***	• WF	Gas signal exceeds the maximum waveform field.	• Check the patient status. • Select a larger scale for waveform.
• ***EtCO2 high*** • ***EtCO2 low***	• MF	Measurement values are equal to or outside the set alarm limits.	• Check the patient status. • Adjust alarm limits if necessary.

Message	Location	Possible causes	Suggested actions
• ***FiCO2 high*** • ***FiCO2 low***	• MF	Measurement values are equal to or outside the set alarm limits.	• Check the patient status. • Adjust alarm limits if necessary.
• ***Gas measurements removed***	• MF	Acquisition module has been removed.	• Connect the module if you want to restart the measurement.
• ***Low gas sample flow***	• MF	Sample flow is less than 80% of the module's nominal flow value. This can happen if nebulized medications are given without disconnecting the sample line.	• Check the sample line. • If the problem persists, contact authorized service personnel.
• ***Replace D-Fend***	• MF	Water trap is partially blocked.	• Replace the water trap.
• ***Resp high*** / ***Resp low***	• MF	Measurement values are equal to or outside the set alarm limits.	• Check the patient status. • Adjust alarm limits if necessary.
• ***Sensor INOP***	• WF	Ambient pressure is too high or too low. No response from the gas module, high temperature inside the module, or EEPROM checksum failure.	• If the problem persists, contact authorized service personnel.

Messages related to trends, and snapshots

For information regarding alarm priorities and escalation times, see the supplemental information manual.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- MF = message field
- WF = waveform field
- DF = digit field

Message	Location	Explanation	What to do
• ***Check OxyCRG***	• MF	The new a OxyCRG snapshot is created successfully There is new OxyCRG snapshot when warm start.	• Check OxyCRG snapshot, if needed.
• ***Creating OxyCRG snapshot***	• MF	HR is out of limit SpO_2 is out of limit Apnea time is out of limit	• No action required.

Message	Location	Explanation	What to do
• ***End of 20 min trend data***	• MF	There is more trend data available but not with current resolution.	• Change the time resolution in graphic trends to be more than 20 minutes (e.g., 1 hour, 2 hours). • Scroll the trends to see past data.
• ***Mark xxx*** (where xxx = snapshot sequence number)	• MF	A snapshot has been taken manually.	• No action required.
• ***Snapshot created***	• MF	A snapshot has been created.	• No action required.
• ***Snapshot memory full. Oldest snapshot erased.***	• MF	You are trying to save a snapshot but the memory capacity is full.	• No action required.

Messages related to various situations

For information regarding alarm priorities and escalation times, see the supplemental information manual.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- MF = message field
- WF = waveform field
- DF = digit field

Message	Location	Explanation	What to do
• ***Alarm setup changed from Central***	• MF	The alarm setup is retrieved from the central station.	• Check the alarm settings and adjust if necessary.
• ***Alarms reset from Central***	• MF	The alarms were remotely paused from the central station.	• You can activate the alarms by pressing the audio pause key.
• ***Battery empty***	• MF	The monitor is battery powered and less than 5 min of monitoring time is available with battery.	• Charge the battery by using the monitor on main power.
• ***Battery low***	• MF	The monitor is battery powered and less than 20 min of monitoring time is available with battery.	• Charge the battery by using the monitor on main power.
• ***Battery temperature high***	• MF	The battery's temperature is too high.	• Replace the battery. • If the problem persists, contact authorized service personnel.
• ***Call service UMBC error***	• MF	UMBC communication error, and UMBC communication is disabled.	• Contact authorized service personnel.

Message	Location	Explanation	What to do
• ***Condition battery***	• MF	Battery is not working properly.	• Replace or remove the battery for conditioning.
• ***DEMO MODE***	• MF	DEMO mode has been enabled.	• To exit the DEMO mode: Contact authorized service personnel.
• ***Default settings returned***	• MF	The monitor settings is returned.	• Check the settings adjust if necessary.
• ***Frame temperature high***	• MF	The temperature inside the frame is over 60°C/140 °F.	• Turn off the monitor, wait for it cool down. • Make sure there is sufficient ventilation. • If the problem persists, contact authorized service personnel.
• ***Identical IP address noticed***	• MF	Two or more monitors on the network have the same IP address.	• Contact authorized service personnel.
• ***Identical unit&bed name noticed***	• MF	Two or more monitors in the network have the same unit and bed name.	• Contact authorized service personnel.
• ***License invalid***	• MF	License is invalid doing start up.	• Contact authorized service personnel.
• ***Loading failed***	• MF	Loading mode from network has been interrupted.	• Check device or network cable connections.
• ***Loading from network***	• MF	Patient data is being loaded from the network.	• No action required.
• ***Memory ERROR***	• MF	Displays after software download.	• Restart the monitor.
• ***Mode data reset***	• MF	There is error when loading settings from the flash file. This failure may occur during cold start, warm start, upgrade start, revert mode, etc,.	• Contact authorized service personnel.
• ***Network: HL***	• MF	When network connection between HL7 TCP Client application and monitor is made.	• No action required.
• ***Network: X***	• MF	Network is connected.	• No action required.
• ***Network down: X***	• MF	CARESCAPE Network connection has failed.	• Try to re-establish the connection. • If the problem persists, contact authorized service personnel.

Message	Location	Explanation	What to do
• ***Network down: HL7***	• MF	No HL7 TCP Client is configured to connect to monitor on the network.	• Try to re-establish the connection. • If the problem persists, contact authorized service personnel.
• ***Network made***	• MF	When CARESCAPE network is connected.	• No action required.
• ***Network recording...***	• MF	Network recording selected.	• Network recorder has been started. Please wait until the recording is finished.
• ***No battery backup***	• MF	There is no battery inserted. The battery is not compatible.	• Insert a battery. • Check battery model whether is FLEX-3S3P.
• ***Patient admitted***	• MF	The current patient has been admitted.	• No action required.
• ***Patient discharged***	• MF	The patient has been discharged.	• No action required.
• ***Recorder: cover open***	• MF	The recorder cover is open.	• Close the recorder cover.
• ***Recorder: input voltage high*** / ***Recorder: input voltage low***	• MF	There are problems with the recorder input voltage.	• Contact authorized service personnel.
• ***Recorder: out of paper***	• MF	The recorder is out of paper or the recorder cover is open.	• Replace recorder paper. • Close the recorder cover.
• ***Recorder system error***	• MF	The local recorder is not working.	• Disconnect and reconnect the recorder cable. • If the problem persists, contact authorized service personnel.
• ***Recorder thermal array overheat***	• MF	There are problems with the recorder temperature.	• Try stopping the recording as it may help. • If the problem persists, contact authorized service personnel.
• ***Recorder module removed***	• MF	Recorder module has been removed.	• Reconnect the recorder module if you need.
• ***Replace battery***	• MF	Battery is not working properly.	• Replace the battery.
• ***Restart needed***	• MF	The monitor should be restarted.	• Restart the monitor.
• ***Saving to network***	• MF	Saving trend and information to Network.	• No action required.

A

Abbreviations

List of abbreviations

The abbreviations that appear in the monitor software are indicated with bold and italic typeface. Other abbreviations listed in this table appear in the monitor manuals. Some abbreviations listed have multiple meanings but are differentiated by the context in which they appear.

/min	beats per minute, breaths per minute
°C	Celsius degree
°F	Fahrenheit degree
µ	micro
12RL	twelve reduced leads
12SL	twelve simultaneous leads
a	arterial
A	auricular alveolar
A Fib	atrial fibrillation
AA	anesthetic agent
AaDO2	alveoli-arterial oxygen difference
AAMI	Association for the Advancement of Medical Instrumentation
AC	alternating current
Accel. Ventric.	accelerated ventricular rhythm
AGSS	anesthetic gas scavenging system
AHA	American Heart Association
AirW	airway temperature
Alpha	alpha frequency band
Alpha%	alpha frequency band percentage
Amp	amplitude
ANATEL	Agência Nacional de Telecomunicações
ANSI	American National Standards Institute
Ant.	anterior

AoA	adequacy of anesthesia
APN	apnea
Arrh	arrhythmia
Art; ABP	arterial pressure
ASA	American Society of Anesthesiologists
ASB	assisted spontaneous breathing
ASY	asystole
ATMP	atmospheric pressure
ATPD	atmospheric/ambient temperature and pressure, dry gas
Auto	continuous NIBP measurement mode
aVF	left foot augmented lead
aVL	left arm augmented lead
AVOA	automatic view on alarm
aVR	right arm augmented lead
Axil	axillary temperature
BAEP	brainstem auditory evoked potential
BE	base excess
Beta	beta frequency band
Beta%	beta frequency band percentage
BIPAP	biphasic positive airway pressure
BIS	bispectral index
BISx	digital signal processing unit
Blad	bladder temperature
BNP	B-type natriuretic peptide
bpm	beats per minute
Brady	bradycardia
BSA	body surface area
BSR	burst suppression ratio
B-to-B	beat-to-beat
BTPS	body temperature and pressure, saturated gas
BUN	blood urea nitrogen
C	central
C (C1 - C6)	chest
$C(a\text{-}v)O_2$	arteriovenous oxygen content difference
C.I.	cardiac index
C.O.	cardiac output
C1 to C6	ECG lead C1 to ECG lead C6

CaO2	arterial oxygen content
cc	cubic centimeter
CCI	continuous cardiac index
CCO	continuous cardiac output
CcO2	capillary oxygen content
CCU	cardiac (coronary) care unit
CFI	Cardiac function index
CIC	Clinical Information Center
CIcalc	cardiac index calculated by Fick equation
CISPR	International Special Committee on Radio Interference
CK-MB	cardiac muscle type creatine kinase
Cl	chlorine
cmH2O	centimeter of water
CMRR	common mode rejection ratio
CNS	central nervous system
CO2	carbon dioxide
COcalc	cardiac output calculated by Fick equation
Compl	compliance
Core	core temperature
Count	count of responses
CPP	cerebral perfusion pressure
CPU	central processing unit
CSA	Canadian Standards Association compressed spectral array
CT	computed tomography
CvO2	venous oxygen content
CVP	central venous pressure
d	day
dB	decibel
DBS	double burst stimulation
DC	direct current
Delta	delta frequency band
Delta%	delta frequency band percentage
DEMO	demonstration (mode)
Des	desflurane
Dia; DIA	diastolic pressure
DO2	oxygen delivery

DO2I	oxygen delivery index
dPmax	Index of left ventricular contractility
DS	dead space ventilation
DSC	digital signal converter
e	estimated
ECG	electrocardiogram
ECT	electroconvulsive therapy
ED	emergency department
EDV	end-diastolic volume
EEG	electroencephalogram
EMC	electromagnetic compatibility
EMG	electromyogram
EMI	electromagnetic interference
EMMV	extended mandatory minute ventilation
Enf	enflurane
EP	evoked potential
ESD	electrostatic discharge electrostatic sensitive devices
Eso	esophageal temperature
ESU	electrosurgical unit
ESV	end-systolic volume
ESVI	end-systolic volume index
ET	endotracheal
ET; Et	end-tidal concentration
EtAA	end-tidal anesthetic agent
EtBal	end-tidal balance gas
EtCO2	end-tidal carbon dioxide
EtN_2O	end-tidal nitrous oxide
EtO_2	end-tidal oxygen
EVLW	Extravascular lung water
Exp; exp	expiratory
F	foot (describing location) frontal
$feCO_2$	mixed expired carbon dioxide concentration
Fem	femoral
FEMG	frontal electromyogram
FemV	femoral venous

feO_2	mixed expired oxygen concentration
FFT	fast Fourier transform
FI; Fi	fraction of inspired gas
FiAA	fraction of inspired anesthetic agent
Fib	fibrillation
FiCO2	fraction of inspired carbon dioxide
FiN_2	fraction of inspired nitrogen
FiN2O	fraction of inspired nitrous oxide
FiO2	fraction of inspired oxygen
Flow; F	flow
Flow-Vol Loop	flow volume loop
Fp	fronto-polar
Fr	French (unit of measure for a Catheter diameter scale)
ft	feet foot
g	gram
g/dl	grams per deciliter
g/l	grams per liter
GND	ground
h	hour
Hal	halothane
Hb	hemoglobin
HbO_2	oxyhemoglobin
HCO3-	bicarbonate
Hct	hematocrit
Hemo	hemodynamic
HFV	high frequency ventilation
HME	heat and moisture exchanger
HMEF	heat and moisture exchanger with filter
hPa	hectopascal
HR	heart rate
HRdif	heart rate difference
Hz	hertz
I	lead I
I.U.	international unit
I:E	inspiratory-expiratory ratio
IABP	intra-aortic balloon pump

iCa	ionized Calcium
ICASA	Independent Communications Authority of South Africa
ICP	intracranial pressure
ICU	intensive care unit
ID	identification
IEC	International Electrotechnical Commission
II	lead II
III	lead III
IM	intramuscular
Imped	impedance
in	inch
Insp; insp	inspiratory
Intellirate	automatic heart rate source selection of PDM
IP	internet protocol invasive blood pressure
IPPV	intermittent positive pressure ventilation
IPPV/ASSIST	intermittent positive pressure ventilation & assisted
IrMod%	infrared modulation percentage
Iso	isoflurane
ISO	International Standards Organization
ITBI	Intrathoracic blood volume index
ITBV	Intrathoracic blood volume
ITTV	Intrathoracic thermal volume
IV	intravenous
J	joule
K	potassium
kcal	kilocalorie
KCC	Korea Communications Commission
kg	kilogram
kJ	kilojoule
kPa	kilopascal
l	liter
l/min	liters/minute
LA	left arm (describing location)
Lab	laboratory
LAN	local area network
LAP	left atrial pressure

lb	pound
LCD	liquid crystal display
LCW	left cardiac work
LCWI	left cardiac work index
LED	light emitting diode
LL	left leg (describing location)
MAC	minimum alveolar concentration
MACage	MAC compensated with patient age, patient temperature, and atmospheric pressure
Man	manual
Man/Spont	manual/spontaneous
MAP	mean arterial pressure
Max.	maximum
mbar	millibar
mcg/l	microgram per liter
mcmol/l	micromole per liter
Mean; M	mean blood pressure
mEq	milliequivalent
mEq/l	milliequivalent per liter
MetHb	methemoglobin
mg	milligram
mg/dl	milligram per deciliter
ml.U.	milli International Unit
min	minute
ml	milliliter
MLAEP	middle-latency auditory evoked potential
mm	millimeter
mmHg	millimeters of mercury
mmol	millimol
mmol/l	millimole per liter
MMV	mandatory minute ventilation
MMV/ASB	mandatory minute ventilation & assisted spontaneous breathing
mol	mole
MRI	magnetic resonance imaging
MRN	medical record number
ms	millisecond
MV	minute volume

MVexp	expired minute volume (l/min)
MVinsp	inspired minute volume (l/min)
MVspont	spontaneous minute volume
Myo	myocardiac temperature
N	neutral
N/A	not applicable
N_2	nitrogen
N2O	nitrous oxide
Na	sodium
Naso	nasopharyngeal temperature
Neo	neonate
Neuro	neurological
ng/l	nanogram per liter
ng/ml	nanogram per milliliter
NIBP	non-invasive blood pressure
NICU	neonatal intensive care unit
NMBA	neuromuscular blocking agent
NMT	neuromuscular transmission
NTPD	normal temperature and pressure, dry gas
O	occipital
O2	oxygen
O2ER	oxygen extraction ratio
OR	operating room
Oxy	oxygenation
P	pressure
Pa	Pascal
PA	pulmonary arterial pressure
Paced	paced beats
PaCO2	partial pressure of carbon dioxide in the arteries
PACU	post anesthesia care unit
PaO_2	partial pressure of oxygen in the arteries
PAO2	partial pressure of oxygen in the alveoli
Paw	airway pressure
Paw-Vol Loop	pressure volume loop
PBSA	Predicted body surface area
PBW	Predicted body weight
pCO2; PCO2	carbon dioxide partial pressure

pcs	pieces
PCV	pressure controlled ventilation
PCV-A/C	pressure controlled ventilation & assisted control
PCV-CMV	pressure controlled ventilation – controlled mandatory ventilation
PCV-CPAP	pressure controlled ventilation & continuous positive airway pressure
PCWP	pulmonary capillary wedge pressure
PCV-SIMV	pressure controlled ventilation & synchronized intermittent mandatory ventilation
PDF	portable document format
PE	polyethylene
Peds	pediatrics
PEEP	positive end-expiratory pressure
PEEPe	extrinsic positive end expiratory pressure (ICU, NICU, ED software packages)
PEEPe+PEEPi	total positive end expiratory pressure (ICU, NICU, ED software packages)
PEEPi	intrinsic positive end expiratory pressure (ICU, NICU, ED software packages)
PEEPtot	total positive end expiratory pressure (OR, PACU software packages)
pg/ml	picogram per milliliter
pH	potential of hydrogen
pHa	arterial pH
pHv	mixed venous pH venous pH
PIC	patient interface cable
Pinsp	inspiratory (target) pressure
Pleth	plethysmographic pulse waveform
Pmean	mean pressure
PN	part number
pO2; PO2	oxygen partial pressure
Ppeak	peak pressure
Pplat	plateau (pause) pressure
PPV	pulse pressure variation
PR	pulse rate
PT	prothrombin time
PTC	post tetanic count
PVC	polyvinyl chloride premature ventricular contraction
PvCO2	carbon dioxide partial pressure in mixed venous blood
PvO2	partial pressure of oxygen in (mixed) venous blood

PVPI	Pulmonary vascular permeability index
PVR	pulmonary vascular resistance
PVRI	pulmonary vascular resistance index
QRS	QRS complex
Qs/Qt	venous admixture
QT	Q-T interval
QTc	corrected value of the QT interval
R	right (describing location)
R on T	early PVC, close to the T wave of the preceding normal beat
RA	right arm (describing location)
RAP	right atrial pressure
Raw	airway resistance
RCW	right cardiac work
RCWI	right cardiac work index
RE	response Entropy
Rect	rectal temperature
REF	right ventricular ejection fraction
Resp Rate	respiration rate (total) (measured)
RF	radio frequency
RL	reduced leadset
RMS	average (root mean square) power
Room	room temperature
RQ	respiratory quotient
RR	respiration rate
RVP	right ventricular pressure
RVSW	right ventricular stroke work
RVSWI	right ventricular stroke work index
s	second
SaO2	arterial oxygen saturation
SB	spontaneous breathing
ScvO2	central venous oxygen saturation
SE	state Entropy
SEF	spectral edge frequency
Sev	sevoflurane
Skin	skin temperature
SL	simultaneous leads
SN	serial number

SO2	saturated oxygen
SPI	surgical pleth index
Spiro	Patient Spirometry
SpO2	oxygen saturation
Spont	spontaneous
SPV	systolic pressure variation
SQ	subcutaneous
SQI	signal quality index
SR	suppression ratio
ST	single twitch ST segment
Stat	five minute continuous NIBP measurement mode
STPD	standard temperature and pressure, dry gas
Supra	supramaximal
Surf	surface temperature
SV	stroke volume supraventricular
SW; sw	software
SVC	supra ventricular contraction
SVI	stroke volume index
SvO2	mixed venous oxygen saturation
SVR	systemic vascular resistance
SVRI	systemic vascular resistance index
SV Tachy	supra ventricular tachycardia
SVV	stroke volume variation
Sync MAS	Synchrom Master
Sync SLV	Synchrom Slave
Sys; SYS	systolic pressure
T	temperature temporal
T(BTPS)	temperature in BTPS conditions
T1	first twitch
T1%	first stimulus as percent of the reference value NMT
Tab	tabular
Tachy	tachycardia
Tblood	blood temperature
TC	transcutaneous

TcCO2	transcutaneous carbon dioxide
TcO2	transcutaneous oxygen
TCO2	total carbon dioxide
Tcorr	patient temperature used to correct pH, PCO_2, PO_2
Temp	temperature
Texp	expiratory time
Theta	theta frequency band
Theta%	theta frequency band percentage
Tinj	injectate temperature
Tinsp	inspiratory time
TOF	train of four
TOF%	train of four percentage
Tpause	pause time
TTX	telemetry transmitter
TV	tidal volume
TVexp	expired tidal volume (ml)
TVinsp	inspired tidal volume (ml)
Tx-Ty	temperature difference
Tymp	tympanic temperature
UAC	umbilical arterial catheter
UI	user interface
UVC	umbilical venous catheter
V	ventricular
V; Vent	ventilation
V (V1-V6)	chest
V Brady	ventricular bradycardia
V Fib	ventricular fibrillation
V Tach	ventricular tachycardia
v	venous
VA	alveolar ventilation
VCO2	carbon dioxide production
Vd	dead space
Vd/Vt	dead space ventilation
Vent	ventilator
WLAN	wireless local area network
VO2	oxygen consumption
VO2calc	calculated oxygen consumption

VO2Icalc	calculated oxygen consumption index
VO2	oxygen consumption index
Vol; V	volume
Vol Assist	volume assisted
VT > 2	ventricular tachycardia with more than two beats
yrs	years

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