

BeneVision N1

Patient Monitor

Operator's Manual

WARNING

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- the product is used in accordance with the instructions for use.

WARNING

- **Only skilled/trained clinical professionals should operate this equipment.**
 - **It is important for the hospital or organization that uses this equipment to perform a recommended service/maintenance plan. Neglect of this may result in machine breakdown or personal injury.**
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Service

Mindray maintains a network of service representatives and factory-trained distributors. Prior to requesting service, perform a complete operational check of the instrument to verify proper control settings. If operational problems continue to exist, contact Mindray service.

In North America contact the Service Department at (800) 288-2121, ext: 8116 for Technical Support or (201) 995-8000 for assistance in determining the nearest field service location.

Please include the instrument model number, the serial number, and a description of the problem with all requests for service.

Any questions regarding the warranty should be directed to the local sales or service representative.

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Preface

Manual Purpose

This manual contains the instructions necessary to operate the product safely and in accordance with its function and intended use. Observance of this manual is a prerequisite for proper product performance and correct operation and ensures patient and operator safety.

This manual is based on the maximum configuration and therefore some contents may not apply to the product. If you have any question, please contact Mindray.

This manual is an integral part of the product. It should always be kept close to the equipment so that it can be obtained conveniently when needed.

Intended Audience

This manual is geared for clinical professionals who are expected to have a working knowledge of medical procedures, practices and terminology as required for monitoring of patients.

Illustrations

All illustrations in this manual serve as examples only. They may not necessarily reflect the setup or data displayed on the patient monitor.

Conventions

- ***Italic text*** is used in this manual to quote the referenced manuals, chapters, sections and formulas.
- **Bold text** is used to indicate the screen texts and names of hard keys.
- → is used to indicate operational procedures.

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1 Safety

1.1 Safety Information

WARNING

- Indicates a potential hazard or unsafe practice that, if not avoided, could result in death or serious injury.
-

CAUTION

- Indicates a potential hazard or unsafe practice that, if not avoided, could result in minor personal injury or product/property damage.
-

NOTE

- Provides application tips or other useful information that does not involve patient or user risk.
-

1.1.1 Warnings

WARNING

- Patient with a pacemaker – on ventricular paced patients, episodes of Ventricular Tachycardia may not always be detected. Do not rely entirely upon the system's automated arrhythmia detection algorithm. Keep pacemaker patients under close surveillance.
- This equipment is used for a single patient at a time.
- This equipment is not an apnea monitor.
- To avoid explosion hazards, do not use the equipment in the presence of oxygen-rich atmospheres, flammable anesthetics, or other flammable agents.
- Do not touch the equipment's metal parts or connectors when in contact with the patient; otherwise patient injury may result.
- Never mix patient electrode types or brands. Dissimilar metals or other incompatibilities may cause considerable baseline drift and may increase trace recovery time after defibrillation.
- To reduce the hazard of burns during high-frequency surgical procedure, ensure that the monitor's cables and transducers never come into contact with the electro-surgery unit (ESU).
- The neutral electrode of the electro-surgery unit (ESU) shall properly contact the patient. Otherwise, burns may result.
- MR unsafe: the monitor is not intended to be used within the Magnetic Resonance (MR) environment.
- Before connecting the equipment to the mains power, ensure that the voltage and frequency ratings of the power line are the same as those indicated on the equipment's label or in this manual.
- Before putting the system into operation, the operator must verify that the equipment, connecting cables, and accessories are in correct working order and operating condition.
- To avoid risk of electric shock, the equipment must only be connected to mains power with protective earth, or operated on battery power.
- Do not touch the patient and live parts simultaneously. Otherwise patient injury may result.
- Do not touch the patient or metal parts in contact with the patient during defibrillation. Otherwise serious injury or death could result.
- Do not open the equipment housings. All servicing and future upgrades must be carried out by trained and authorized personnel.

- Do not rely exclusively on the audible alarm system for patient monitoring. Turning the alarm volume to a low level or off may result in a hazard to the patient. Always keep the patient under close surveillance.
 - Alarm settings should be customized according to patient situations.
 - Do not place the equipment or accessories in any position that might cause it to fall on the patient.
 - Do not start or operate the equipment unless the setup was verified to be correct.
 - To avoid inadvertent disconnection, route all cables in a way to prevent a stumbling hazard. Wrap and secure excess cabling to reduce risk of entanglement by patients or personnel.
 - The physiological data and alarm messages displayed on the equipment are for reference only and cannot be directly used for diagnostic interpretation. The equipment should not be used as the sole basis for medical decisions. It must be used in conjunction with clinical signs and symptom. If any measurement seems questionable, first check the patient's vital signs by alternate means and then check the equipment for proper functioning.
-

1.1.2 Cautions

CAUTION

- Use only parts and accessories specified in this manual.
 - Disposable accessories are not designed to be reused. Reuse may cause a risk of contamination and affect the measurement accuracy.
 - Ensure that the equipment is supplied with continuous electric power during operation from the mains power or batteries. Sudden power failure may cause data loss.
 - When no battery is installed, ensure that the monitor is supplied with continuous electric power during operation. Sudden power failure may lead to data loss.
 - Store and use the equipment in specified environmental condition. The monitor and accessories may not meet the performance specification due to aging, stored or used outside the specified temperature and humidity range.
 - Magnetic and electrical fields are capable of interfering with the proper performance of the equipment. For this reason make sure that all external devices operated in the vicinity of the equipment comply with the relevant EMC requirements. Mobile phones, X-ray equipment, and MRI devices are possible sources of interference as they may emit higher levels of electromagnetic radiation.
 - Always install or carry the equipment properly to avoid damage caused by drops, impacts, strong vibrations or other mechanical forces.
 - Dry the equipment immediately in case of rain or water spray.
 - Some settings are password protected and can only be changed by authorized personnel. Contact your department manager or biomedical engineering department for the passwords used at your facility.
 - Do not loop the patient cabling into a tight coil or wrap around the device, as this can damage the patient cabling.
 - Dispose of the package material as per the applicable waste control regulations. Keep it out of children's reach.
 - At the end of its service life, the equipment, as well as its accessories, must be disposed of in compliance with the guidelines regulating the disposal of such products. If you have any questions concerning disposal of the equipment, please contact Mindray.
-















1.1.3 Notes






















NOTE

- The equipment software copyright is solely owned by Mindray. No organization or individual shall resort to modifying, copying, or exchanging it or to any other infringement on it in any form or by any means without due permission.
- Put the equipment in a location where it can be easily viewed and operated.

- The equipment uses a mains plug as isolation means to the mains power. Do not locate the equipment in a place difficult to access the mains plug.
- During normal use, the operator is expected to face the front of the equipment.
- Remove the battery before shipping the monitor or if it will not be used for an extended period of time.
- Remove the battery before transporting the equipment or if the equipment will not be used for a long time.
- The software was developed in compliance with IEC62304, to minimize the possibility of hazards arising from software errors.
- This manual is based on the maximum configuration and therefore some contents may not apply to the product. If you have any question, please contact Mindray.
- Observance of this manual is a prerequisite for proper product performance and correct operation and ensures patient and operator safety.
- Keep this manual in the vicinity of the equipment so that it can be referenced when needed.

1.2 Equipment Symbols

Symbol	Description	Symbol	Description
	General warning sign		Refer to instruction manual/booklet
	Serial number	REF	Catalogue number
	Date of manufacture		Manufacturer
	USB connector	IPX1	Protected against vertically falling water drops per IEC 60529
IP44	IP44: protected against ingress of foreign objects no less than 1.0 mm, and against access to hazardous parts with wire; protect against harmful effects of splashing water	IP22	IP22: protected against ingress of foreign objects no less than 12.5 mm and against access to hazardous parts with finger; protected against harmful effects of vertically falling water drops with the device tilted at any angle up to 15°
	Battery indicator		Computer network
	Direct current		Lock; tighten
	Equipotentiality		Alternating current
	Defibrillation-proof type CF applied part		Defibrillation-proof type BF applied part

Symbol	Description	Symbol	Description
	Direction and angle off rotation		Polarity of d.c. power connector
	Input/output		IBP zero key
	Locking		Unlocking
	NIBP start/stop		Calibration
	Start		Stop
	Stand-by		Menu
	Gas outlet		Gas inlet
	Video output		Non-ionizing electromagnetic radiation
	Dispose of in accordance to local requirements		Plastic identification symbol
	No pushing		Conforms to ANSI Std. ES60601-1, IEC Std. 60601-1-8, IEC Std. 60601-2-25, IEC Std. 60601-2-26, IEC Std. 60601-2-27, IEC Std. 80601-2-30, IEC Std. 60601-2-34, IEC Std. 60601-2-49, ISO Std. 0601-2-55, ISO Std. 80601-2-56, and ISO Std. 80601-2-61 Certified to CAN/CSA Std. C22.2 No. 60601-1, No. 60601-1-6, No. 60601-1-8, No. 60601-2-25, No. 60601-2-26, No. 60601-2-27, No. 80601-2-30, No. 60601-2-34, No. 60601-2-49, No. 80601-2-55, No. 80601-2-56, and No. 80601-2-61
	Supporting WMTS		

2 Equipment Introduction

2.1 Indications for Use

The BeneVision N1 Patient Monitor is intended for monitoring, displaying, reviewing, storing, alarming, and transferring of multiple physiological parameters including ECG (3-lead, 5-lead, 6-lead or 12-lead selectable, Arrhythmia Detection, ST Segment Analysis, QT Analysis, and Heart Rate (HR)), Respiration (Resp), Temperature (Temp), Pulse Oxygen Saturation (SpO₂), Pulse Rate (PR), Non-invasive Blood Pressure (NIBP), Invasive Blood Pressure (IBP), Pulmonary Artery Wedge Pressure (PAWP), Carbon Dioxide (CO₂) and Oxygen (O₂). The system also provides an interpretation of resting 12-lead ECG.

All the parameters can be monitored on single adult, pediatric, and neonatal patients except for the following:

- PAWP, PNP, and PNC are intended for adult and pediatric patients only
- A-Fib is intended for adult patients only

The BeneVision N1 monitor is to be used in healthcare facilities. It can also be used during patient transport inside and outside of the hospital environment, whereas N1 configured with WMTS technology can be used inside the hospital only. It should be used by clinical professionals or under their guidance. It should only be used by persons who have received adequate training in its use. It is not intended for home use.

NOTE

- **This manual is based on the maximum configuration and therefore some contents may not apply to the product. If you have any question, please contact Mindray.**
-

2.2 Equipment Features

The monitor is intended to be used in a hospital environment including, but not limited to, ICU, CCU, PICU, Neonatology, RICU, emergency room, operating room, postoperative observation ward, etc.

The monitor can be used in two ways:

- As a stand-alone patient monitor, or
- As a multi-parameter module (MPM) for the Mindray BeneVision N22, BeneVision N19, BeneVision N17, BeneVision N15, or BeneVision N12 patient monitor, hereafter referred to as “the host monitor”.

In this manual, the N1 is generally referred to as “the monitor” except in the situation describing its use with a host monitor, where it is referred to as “the N1” to distinguish it from the host monitor.

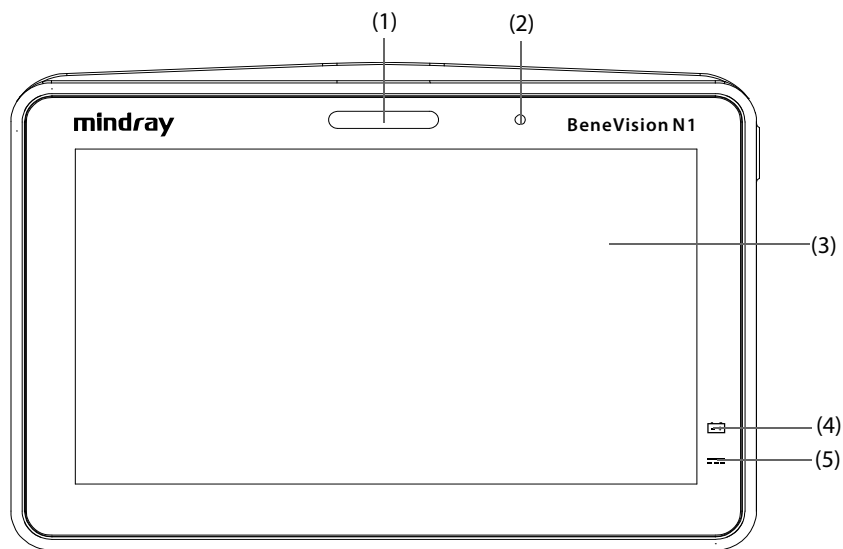
2.3 Applied Parts

The applied parts of the monitor are:

- ECG electrode and leadwire
- SpO₂ sensor
- Temp probe
- NIBP cuff
- IBP transducer
- CO₂ sampling line/nasal sampling cannula, water trap, and mask

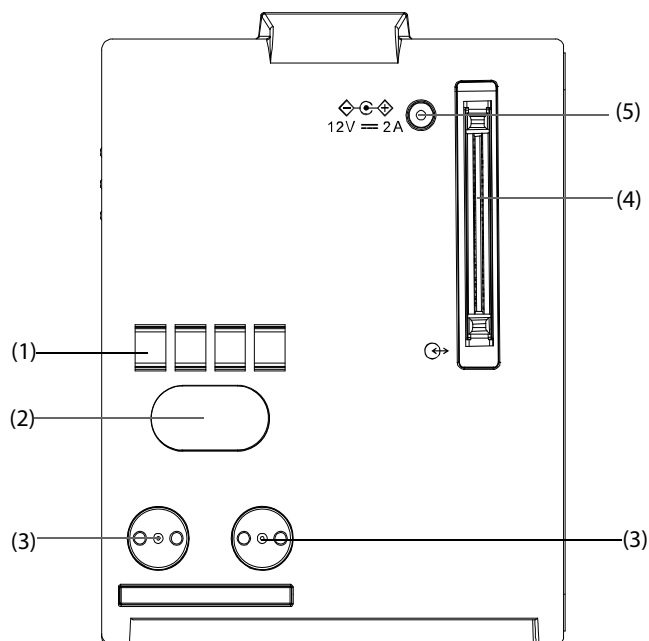
2.4 Main Unit

2.4.1 Front View



- (1) **Alarm lamp:**
When a physiological alarm or technical alarm occurs, this lamp lights and flashes corresponding with the alarm priority:
- High priority alarms: the lamp quickly flashes red.
 - Medium priority alarms: the lamp slowly flashes yellow.
 - Low priority alarms: the lamp lights in cyan without flashing.
- (2) **Ambient light sensor**
When screen brightness is set to auto, the system automatically adjusts screen brightness according to the strength of ambient light.
- (3) **Display**
- (4) **Battery LED:**
- Yellow: the battery is being charged.
 - Green: the battery is fully charged.
 - Flashing green: the monitor runs on battery power.
 - Flashing yellow: the battery is malfunctioning.
 - Off: no battery is installed, or the monitor is powered off and no external power is connected.
- (5) **External power supply indicator:**
- On: when external power supply is connected.
 - Off: when external power supply is not connected.

2.4.2 Left View

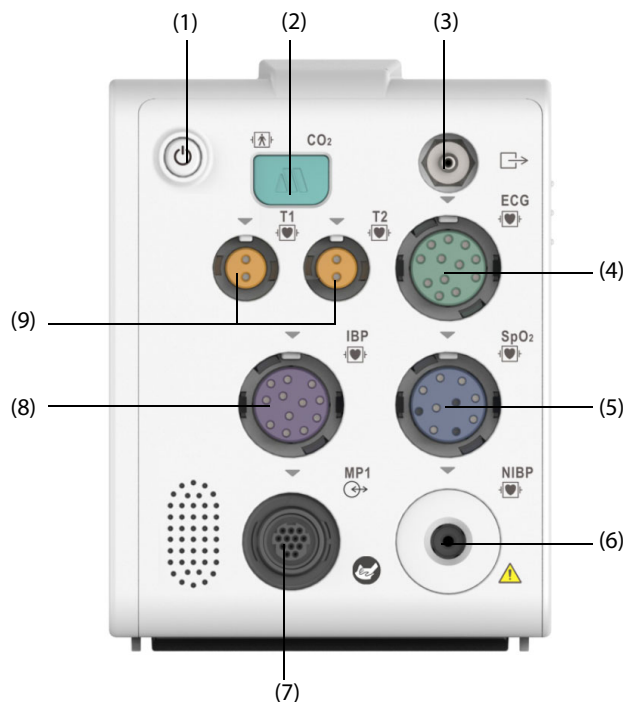


- (1) Communication interface: used for communication between the N1 and host monitor (BeneVision N series monitor).
- (2) Infrared filter: used for communication between the N1 and N series monitor if the communication interface does not work.
- (3) Contact: used for receiving power supply from the host monitor (BeneVision N series monitor).
- (4) Multi-pin connector: connects the N1 to the Modular Rack or Dock.
- (5) External DC power input connector: connects the N1 to the AC adapter

NOTE

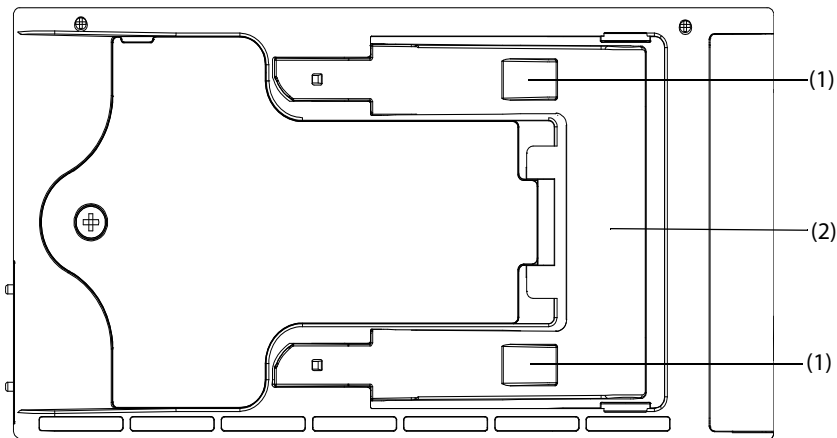
- **To ensure good contact, clean the contacts regularly, as dust and dirt may collect on them. When cleaning the contacts, wipe them with cotton, dampened with alcohol. Using forceps is recommended.**
- **In the case of water spray, dry the Multi-pin connector of the N1 before connecting the N1 to the Modular Rack or Dock.**

2.4.3 Right View



- | | | |
|---|--|-------------------------|
| (1) Power switch | (2) Sample line connector for sidestream CO ₂ | (3) Gas outlet |
| (4) ECG cable connector | (5) SpO ₂ sensor connector | (6) NIBP cuff connector |
| (7) Multifunctional connector: outputs analog ECG, IBP and defib synchronization signals. | (8) IBP cable connector | |
| (9) Temperature probe connector | | |

2.4.4 Bottom View

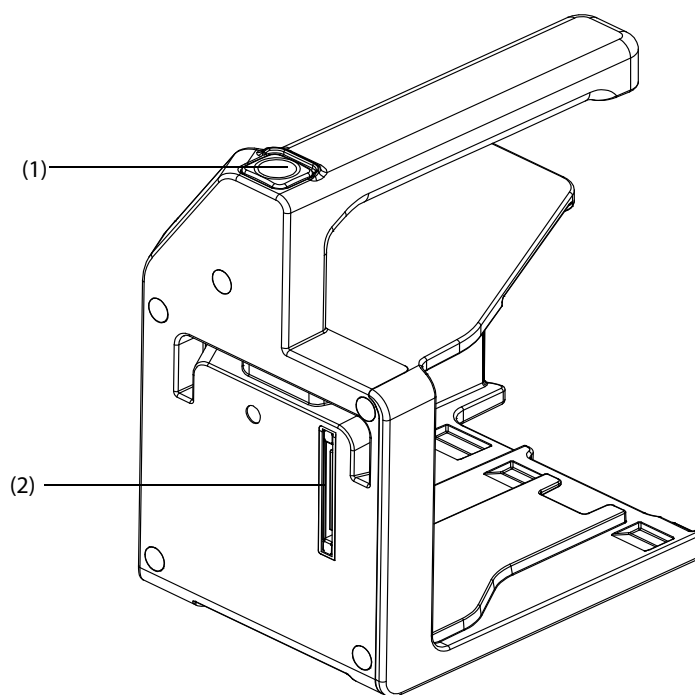


- | | |
|-----|---|
| (1) | Clip: fastens the N1 when N1 is in use with the host monitor, Dock or Modular Rack. |
| (2) | Latch: locks the N1 when the N1 is in use with the host monitor, Dock or Modular Rack. Pressing here releases the N1 so that the N1 can be removed from the host monitor, Dock or Modular Rack. |

2.5 Modular Rack

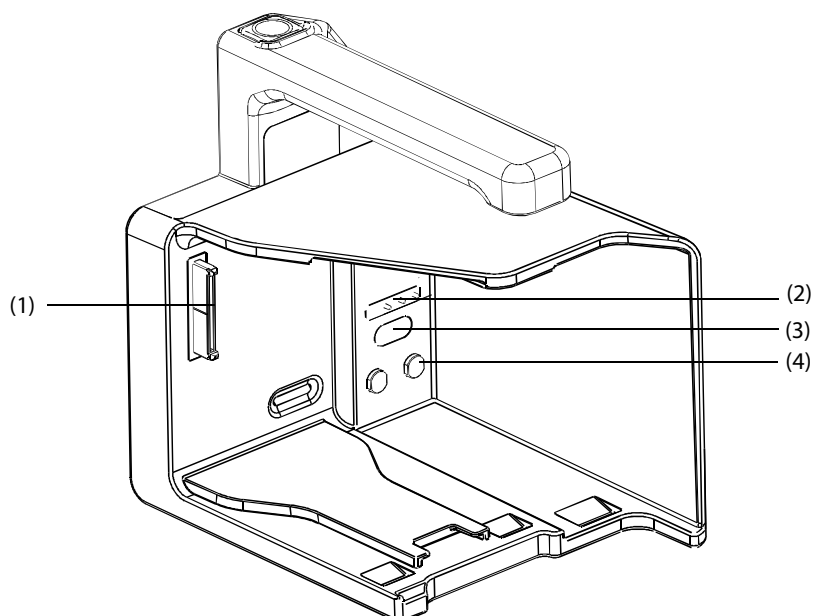
The Modular Rack is used to connect an N1 and an external parameter module as well as providing bed rail mounting capability. It can also be connected to the Dock.

2.5.1 Left View



- (1) Release button: pressing this button releases the Modular Rack from the Dock.
- (2) Multi-pin connector: connects the Modular Rack and Dock.

2.5.2 Right View

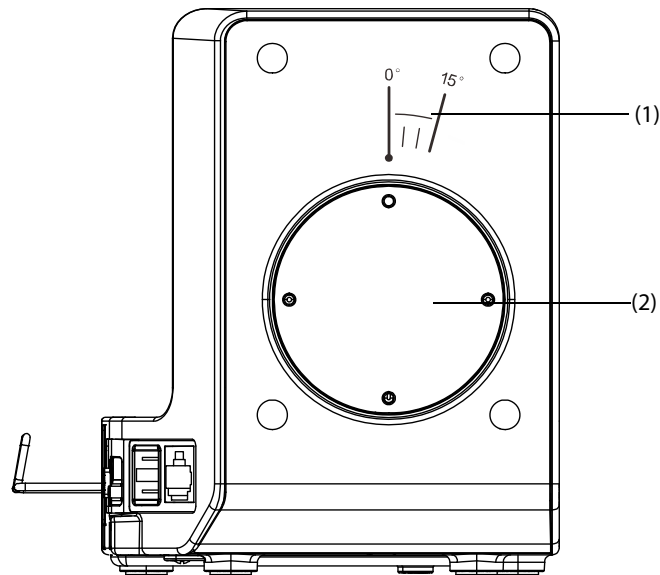


- (1) Multi-pin connector: connects the Modular Rack and N1.
- (2) Pogo pin: used for communication between the Modular Rack and external parameter module.
- (3) Infrared filter: used for communication between the Modular Rack and external parameter module.
- (4) Contact: power input connector of the external parameter module.

2.6 Dock

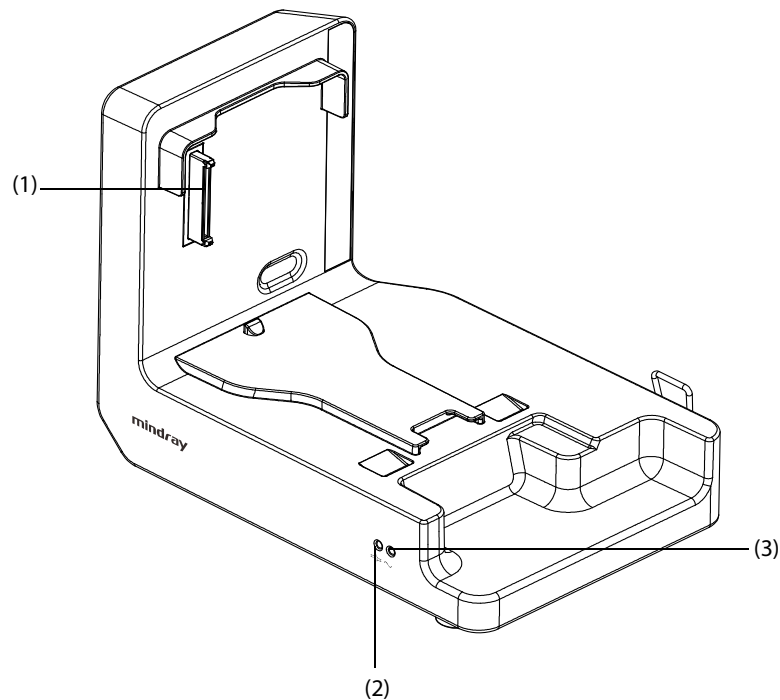
The Dock is used to connect the N1 or Modular Rack to provide power, charge the installed battery, and support connection to an external display, USB drive, network cables, and the BeneVision N series patient monitors.

2.6.1 Left View



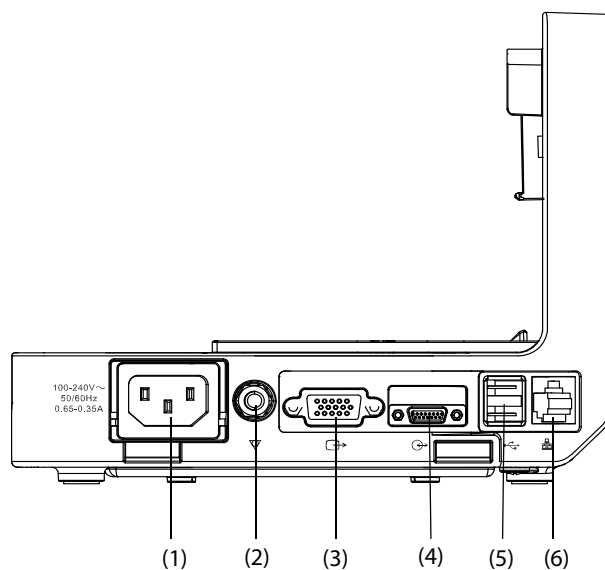
- (1) Symbol: indicates the direction and angle that Dock can rotate when Dock is fixed onto a transverse or a vertical rod.
- (2) Pole mount seat: used to fix the pole mount to the Dock and then to a transverse or a vertical rod.

2.6.2 Right View



- (1) Multi-pin connector: power input and communication connector of the N1.
- (2) Connection status indicator: it is on when the N1 is properly connected to the Dock.
- (3) External power supply indicator: it is on when the external AC power supply is connected.

2.6.3 Rear View



- (1) AC Power input connector
- (2) Equipotential grounding terminal: when using the monitor together with other devices, connect their equipotential grounding terminals together to eliminate the potential difference between them.
- (3) VGA connector: connects the external display
- (4) Host monitor connector: connects the N1 to the host monitor through a cable.
- (5) USB connector: connects USB devices.
- (6) Network connector: a standard RJ45 connector which connects the monitor to the CMS. It can also be used to transfer data..

2.7 External Parameter Modules

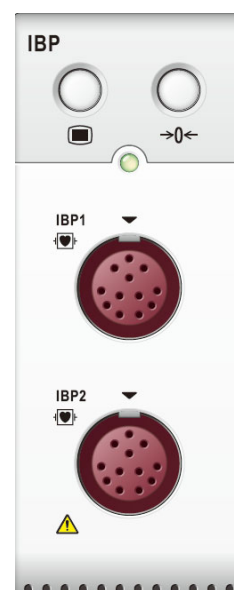
The monitor can connect the following external parameter modules through the Modular Rack.



Sidestream CO₂ module



Microstream™ CO₂ module

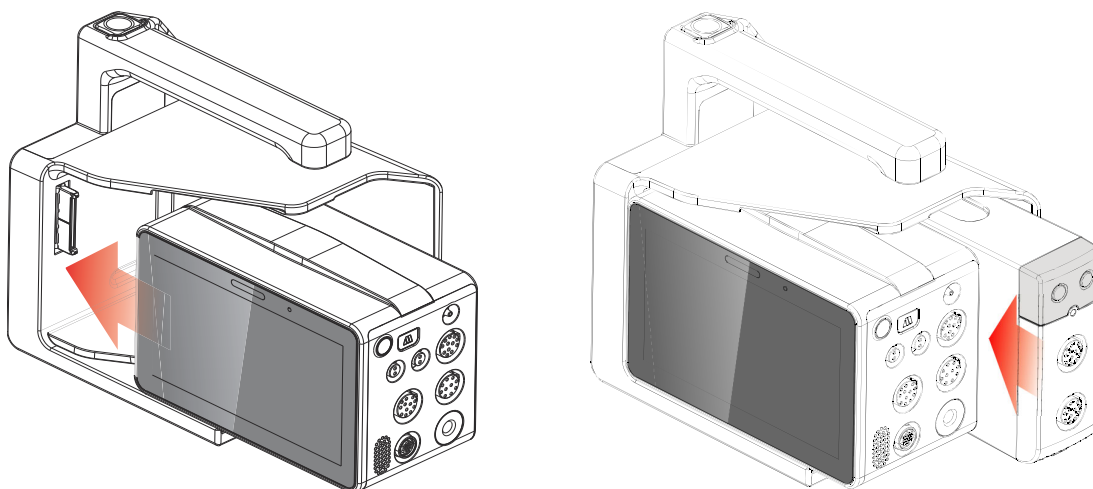


IBP module

2.8 Installation

2.8.1 Installing the N1 or External Parameter Module into the Modular Rack

Install the N1, and an external parameter module if needed, to the Modular Rack as indicated below:



Firmly push the N1 or the external module until an audible click is heard indicating that the clip (refer to 2.4.4 Bottom View) engaged the Modular Rack. To ensure that the N1 or the external module is properly connected, try to pull the N1 or the external module outward. The N1 or the external module has properly engaged the Modular Rack if it cannot be pulled out.

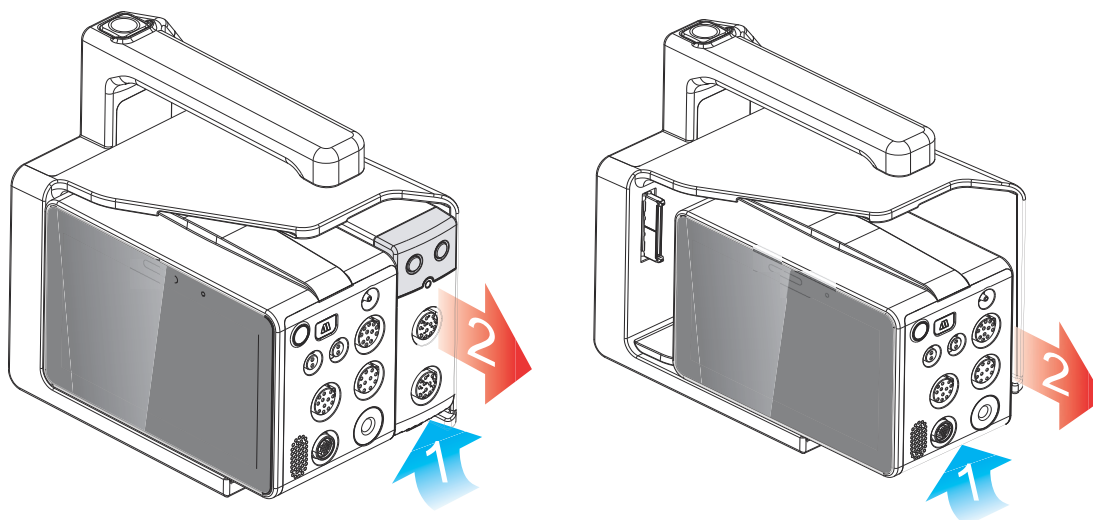
NOTE

- To prevent the N1 or the external module from falling out of the Modular Rack, after inserting the N1 or the external module into the Modular Rack, always check that the N1 or the external module properly engaged the Modular Rack.
- When the external module is properly installed, it should be further fasten to the Modular Rack with the lock at the bottom of the module to ensure the engagement.

2.8.2 Removing the N1 or External Parameter Module from the Modular Rack

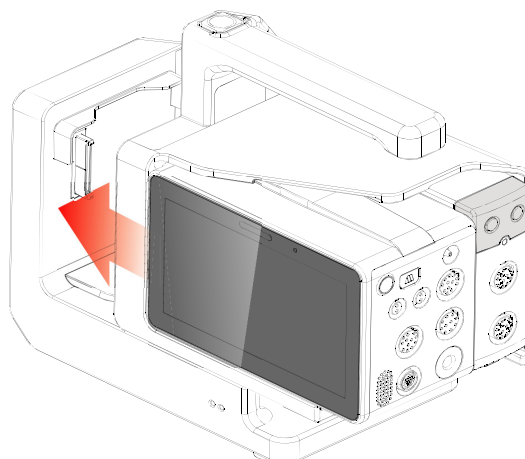
To remove the N1 or external parameter module, follow this procedure:

1. Press and hold the latch at the bottom of the N1 or parameter module. If the external module is locked to the Modular Rack, unlock it first.
2. Pull the N1 or parameter module out as indicated.



2.8.3 Installing the Modular Rack to the Dock

The Modular Rack can be installed to the Dock as indicated below:

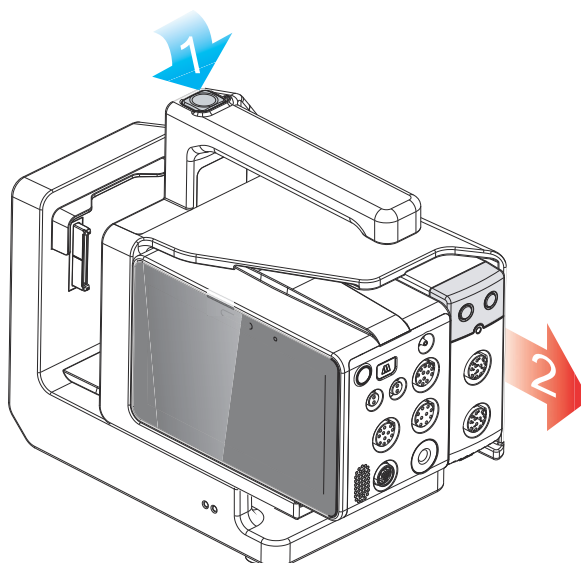


A click is heard when the Modular Rack is pushed into place.

2.8.4 Removing the Modular Rack from the Dock

To remove the Modular Rack from the Dock, follow this procedure:

1. Press and hold down the release button at the top of the Modular Rack.
2. Pull the Modular Rack out as indicated.

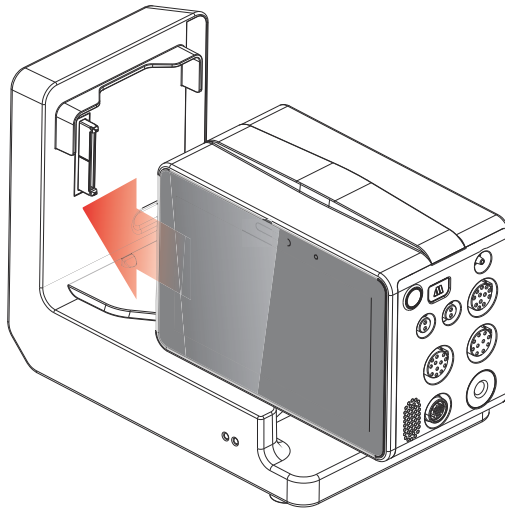


CAUTION

- To prevent the Dock from falling off, do not press the release button while transporting the N1 with the Modular Rack and Dock.
-

2.8.5 Installing the N1 to the Dock

The N1 can also be installed directly to the Dock as shown below:

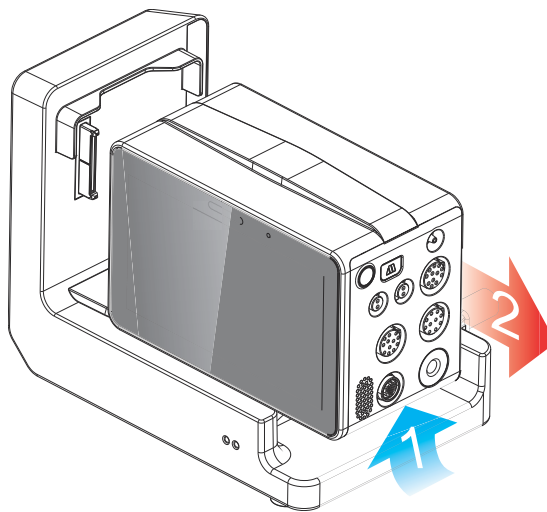


Firmly push the N1 until an audible click is heard indicating that the clip (refer to 2.4.4 *Bottom View*) engaged the Dock. To ensure that the N1 is properly connected, try to pull the N1 outward. The N1 has properly engaged the Dock if it cannot be pulled out.

2.8.6 Removing the N1 from the Dock

To remove the N1 from the Dock, follow this procedure:

1. Press and hold the latch at the bottom of the N1.
2. Pull the N1 out as indicated.



2.9 N1 in Use with a Host Monitor

When the N1 is connected to the BeneVision N series monitor, the N1 works as the parameter module while BeneVision N series monitor works as the host monitor. For more information, see section 3.7.2 *Module Mode*.

The N1 can be connected to the host monitor through the following parts:

- The module rack of the host monitor
- The Satellite Module Rack (SMR)
- The Dock

2.9.1 Connecting the N1 to the Host Monitor through the Module Rack

To connect the N1 to the module rack of the host monitor, follow this procedure:

1. Insert the N1 to the host monitor's module rack. Firmly push the N1 until an audible click is heard indicating that the clip (refer to 2.4.4 *Bottom View*) engaged the module rack.

2. To ensure that N1 is properly connected, try to pull N1 outward. The N1 has properly engaged the module rack if it cannot be pulled out.

To remove the N1 from the module rack of the host monitor, lift the latch (refer to 2.4.4 *Bottom View*) at the bottom of the N1 and pull the N1 out.

CAUTION

- To prevent the N1 from falling out, after inserting the N1 into the module rack, always check that the N1 properly engaged the module rack.
 - To prevent the N1 from falling, catch it with another hand while pulling it out from the module rack.
-

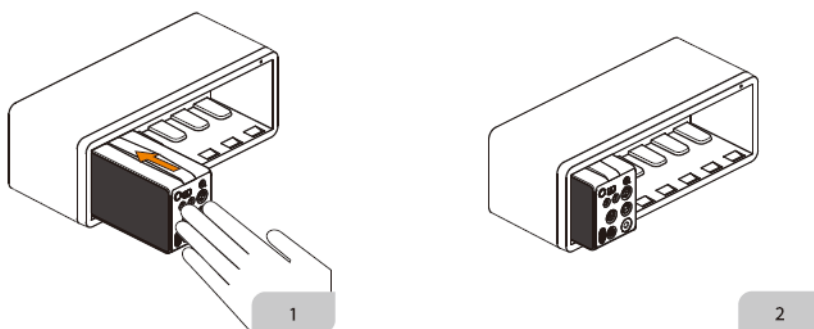
NOTE

- There is no module rack for the BeneVision N22 or BeneVision N19 monitors. The N1 can be connected to the BeneVision N22 or BeneVision N19 monitor through the SMR or Dock.
-

2.9.2 Connecting the N1 to the Host Monitor through the Satellite Module Rack (SMR)

To connect the N1 to the host monitor through the SMR, follow this procedure:

1. Connect the SMR to the host monitor.
2. Insert the N1 to the SMR. Firmly push the N1 until an audible click is heard indicating that the clip (refer to 2.4.4 *Bottom View*) engaged the SMR.
3. To ensure that the N1 is properly connected, try to pull the N1 outward. The N1 has properly engaged the module rack if it cannot be pulled out.



To remove the N1 from the SMR, lift the latch (refer to 2.4.4 *Bottom View*) at the bottom of the N1 and pull the N1 out.

CAUTION

- To prevent N1 from falling out, after inserting the N1 into the SMR, always check that the N1 properly engaged the SMR.
 - To prevent the N1 from falling, catch it with another hand while pulling it out from the SMR.
-

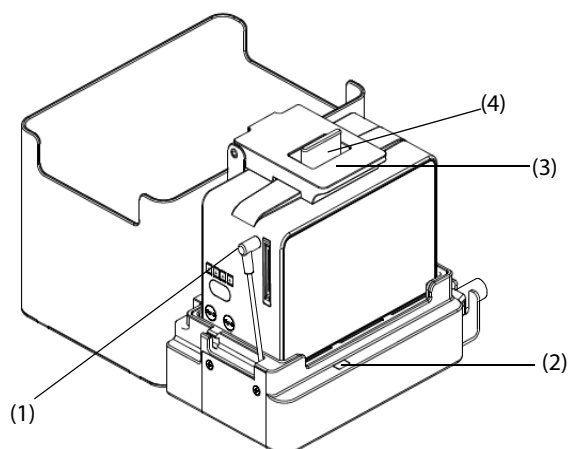
2.9.3 Connecting the N1 to the Host Monitor through the Dock

To connect the N1 to the host monitor through the Dock, follow this procedure:

1. Connect the N1 to the Dock.
2. Connect the host monitor connector of the Dock with the SMR connector of the host monitor using the dock data cable.

2.10 N1 in Use with the Transport Dock

The N1 can be used with the Transport Dock to transport a patient via ambulance, airplane fuselage or helicopter fuselage. For the installation instructions of the N1 and Transport Dock, refer to the *Transport Dock Indication for Use* (PN: H-046-011365-00).



(1) DC power input

(2) Power supply indicator

(3) Upper cover

(4) Slide block for unlocking the N1

WARNING

- **The monitor must only be connected to mains power with protective earth, and the connection should be performed by qualified service personnel.**
 - **Ensure that the external power system has secure protective earth when the monitor is used together with the Transport Dock.**
 - **Verify that the connection of protective earth and the external power system is securely connected when installing the Transport Dock.**
-

2.11 Input Devices

The monitor allows data entry through touchscreen, keyboard, mouse, and barcode reader.

2.12 Printing Devices

Use only Mindray specified printers to output patient information and data.

3

Getting Started

3.1 Equipment Preparation Safety Information

WARNING

- Use only installation accessories specified by Mindray.
 - Connect only approved devices to this equipment. Devices connected to the equipment must meet the requirements of the applicable IEC standards (e.g. IEC 60950 safety standards for information technology equipment and IEC 60601-1 safety standards for medical electrical equipment). The system configuration must meet the requirements of the IEC 60601-1 medical electrical systems standard. Any personnel who connect devices to the equipment's signal input/output port are responsible for providing evidence that the safety certification of the devices has been performed in accordance to the IEC 60601-1. If you have any questions, please contact Mindray.
 - The monitor and parameter monitoring accessories are suitable for use within the patient environment. For other equipment and accessories connected to the monitor, consult corresponding manufacturers for the suitability within the patient environment.
 - If it is not evident from the equipment specifications whether a particular combination with other devices is hazardous, for example, due to summation of leakage currents, please consult the manufacturer or an expert in the field. A determination must be made that the proposed combination will not negatively affect the devices themselves or the patient's safety.
-

CAUTION

- The equipment should be installed by Mindray authorized personnel.
 - When disposing of the packaging material, be sure to observe the applicable waste control regulations and keep it out of children's reach.
 - Before use, verify whether the packages are intact, especially the packages of single use accessories. In case of any damage, do not apply it to the patient.
 - Make sure that the equipment operating environment meets the specific requirements. Otherwise unexpected consequences, e.g. damage to the equipment, could result.
 - Avoid rough handling during transport.
-

NOTE

- This manual is based on the maximum configuration and therefore some contents may not apply to the product. If you have any question, please contact Mindray.
 - Put the equipment in a location where it can be easily viewed and operated.
 - Keep this manual in the vicinity of the equipment so that it can be referenced when needed.
 - Save the packing case and packaging material as they can be used if the equipment must be reshipped.
 - Many settings in the patient monitor are password protected. It is recommended to change the default passwords and keep the passwords safe. Passwords should only be changed by authorized personnel. Contact the department manager or biomedical engineering department for the passwords used at the facility.
-

3.2 Monitor Installation

3.2.1 Unpacking and Checking

Before unpacking, examine the packaging carefully for signs of damage. If any damage is detected, contact the carrier, distributor, or Mindray.

If the packing case is intact, open the package and remove the equipment and accessories carefully. Check all materials against the packing list and check for any mechanical damage. Contact Mindray in case of any problems.

NOTE

- **If the N1 purchased contains the internal CO₂ module, connect the CO₂ adapter to the CO₂ receptacle soon after unpacking the monitor to avoid losing the CO₂ adapter.**
-

3.2.2 Environmental Requirements

The operating environment of the equipment must meet the requirements specified in this manual.

The environment where the equipment is used shall be reasonably free from noises, vibration, dust, corrosive, flammable and explosive substances. Moreover, to maintain good ventilation, the equipment shall be at least 2 inches (5cm) away from around the cabinet.

When the equipment is moved from one place to another, condensation may occur as a result of temperature or humidity difference. In this case, never start the system before the condensation evaporates.

CAUTION

- **Make sure that the equipment operating environment meets the specific requirements. Otherwise unexpected consequences, e.g. damage to the equipment, could result.**
-

3.3 Setting Up the Equipment

Observance of this manual is a prerequisite for proper product performance and correct operation. It ensures patient and operator safety.

3.3.1 Connecting the AC Mains

The monitor can be powered by AC power supply when it is connected to the AC adapter or Dock. Before connecting the equipment to the AC mains, check that the voltage and frequency ratings of the power line are the same as those indicated on the AC adapter or Dock.

WARNING

- **Operate the equipment on battery power if the integrity of the protective earth conductor or the protective earthing system in the installation is in doubt.**
-

CAUTION

- **Always use the accompanying power cord delivered with the monitor.**
 - **Before connecting the equipment to the AC mains, check that the voltage and frequency ratings of the power line are the same as those indicated on the AC adapter and Dock.**
-

NOTE

- **Use AC power source when the N1 is in use with the Dock.**
 - **Use the cable retainer to secure the power cord to prevent it from falling off.**
-

3.3.1.1 Connecting the AC Mains through the AC Adapter

To connect the N1 to the AC power source through the AC adapter, follow this procedure:

1. Connect the N1 to the AC adapter.

2. Connect the female end of the power cord to the AC adapter, and the male end of the power cord to a wall AC outlet.
3. Check that the external power supply indicator is on.

The external power supply indicator lies in the lower right corner of the display. When the AC mains is not connected, the external power supply indicator is off. When AC mains is connected, the external power supply indicator is illuminated in green.

CAUTION

- **Always use the AC adapter specified by Mindray.**
-

3.3.1.2 Connecting the AC Mains through the Dock

To connect the N1 to the AC power source through the Dock, follow this procedure:

1. Connect the N1 to the Dock.
2. Connect the female end of the power cord to the AC power input of the Dock, and the male end of the power cord to a wall AC outlet.
3. Check that the external power supply indicator of the N1 and Dock are on.

3.3.2 Connecting the Input Devices

Connect the mouse, keyboard, and/or barcode reader to the USB ports on the rear of the Dock if necessary.

3.3.3 Installing the External Parameter Module

If an external parameter module is needed, refer to section 2.8.1 *Installing the N1 or External Parameter Module into the Modular Rack* for installation.

3.4 Turning on the Monitor

Before beginning measurements, turn on the monitor, perform the following inspections:

1. Check the monitor for any mechanical damage. Make sure that all external cables, plug-ins and accessories are properly connected.
2. Connect the monitor to the AC power source using AC adapter or Dock. Make sure the battery power is sufficient if the monitor is powered by the battery.
3. Press the power switch to turn on the monitor.

The monitor automatically performs a self test at startup. Check that the alarm tone is heard and the alarm lamp illuminates, one after the other, in red, yellow, and cyan. This indicates that the visible and audible alarm indicators functions correctly.

When the monitor is turned on, the alarms are paused for two minutes. Then the alarm system is activated.

CAUTION

- **Check that visual and auditory alarm signals are presented correctly when the equipment is powered on.**
 - **Do not use the monitor for any monitoring procedure on a patient if you suspect it is not working properly, or if it is mechanically damaged. Contact the service personnel or Mindray.**
-

NOTE

- **For first use, connect the monitor to the AC power source and then turn on the monitor to activate the battery.**
 - **The time for the monitor to warm up from the minimum storage temperature between uses until the monitor is ready for its intended use is 10 minutes when the ambient temperature is 20 °C.**
 - **The time for the monitor to cool down from the maximum storage temperature between uses until the monitor is ready for its intended use is 10 minutes when the ambient temperature is 20 °C.**
-

3.5 Operation and Navigation

Everything needed to operate the monitor is on its screen. Almost every element on the screen is interactive. Screen elements include parameter values, waveforms, quick keys, information fields, alarms fields, dialogs, and menus. Often you can access the same element in different ways. For example, you can access a parameter dialog by selecting the corresponding numeric area or waveform area, or by selecting the **Main Menu** quick key → from the **Parameters** column select **Setup**.

3.5.1 Using the Touchscreen


You can use the touchscreen to select a screen element by pressing directly on the monitor's screen.


3.5.1.1 Tapping or Swiping across the Screen

- Tapping the screen
 - ◆ To select an item from menus or lists or select a quick key, tap on it with your finger.
 - ◆ To enter a parameter menu, tap the corresponding numeric area or waveform area. For example, select the ECG numeric area or waveform area to enter the **ECG** dialog.
 - ◆ If an external display is connected and actively displaying information, tapping the screen of the N1 switches the active display to the N1. If the N1's display is active, tapping on the screen of the external display switches the active display to the external display.
- Swiping the screen with a single finger
 - ◆ To scroll through a list or a menu, swipe up or down.
 - ◆ If an external display is connected, to show or expand the Minitrends screen or the EWS screen on the external display, swipe right across the corresponding screen.
 - ◆ If an external display is connected, to contract or hide the Minitrends screen or the EWS screen on the external display, swipe left across the corresponding screen.
- Swiping across the screen with two fingers
 - ◆ If an external display is connected, to switch to another screen, swipe left or right across the screen. For example, on the Normal screen, swipe with two fingers from left to right to switch to the Minitrends screen.
 - ◆ To discharge a patient, swipe from top to bottom.

3.5.1.2 Locking the Touchscreen

To avoid accidental use, the touchscreen is locked in the following situations:

- The touchscreen is not used in 60 seconds when the N1 runs on battery and is not connected to an external display.
- Select the **Unlock** quick key , and swipe the slider up as instructed.





When the touchscreen is locked, the quick key changes to . To unlock the touchscreen, touch anywhere on the touchscreen and swipe the slider up as instructed.

NOTE

- **Wipe off any water on the touchscreen in case of rain or water spray.**

3.5.2 Using the On-Screen Keyboard

The on-screen keyboard enables information entry:

- Enter the information by selecting one character after another.
- Select the Backspace key  to delete single characters or select  to delete the entire entry.
- Select the Caps Lock key  to access uppercase letters.
- Select the Enter key  to confirm the entry and close the on-screen keyboard.

If a conventional keyboard is connected to the monitor, you can use it instead of, or in combination with, the on-screen keyboard.

3.5.3 Using the Barcode Reader

The monitor supports both a linear (1D) barcode reader and two-dimensional (2D) barcode reader. The barcode reader is connected to the monitor through the USB connector on the rear of the Dock.

NOTE

- Use the Mindray custom barcode reader to obtain all the available patient information from both the 2D and 1D barcodes. Using other barcode readers can only output the patient's medical record number (MRN) and visit number.

3.5.3.1 Clearing Old Data Formats (for the Mindray Custom 2D Barcode Reader)

If you are using the Mindray custom 2D barcode reader (Model HS-1R or HS-1M), before using the it for the first time, clear old data formats and configure the barcode reader. To do so, follow this procedure:

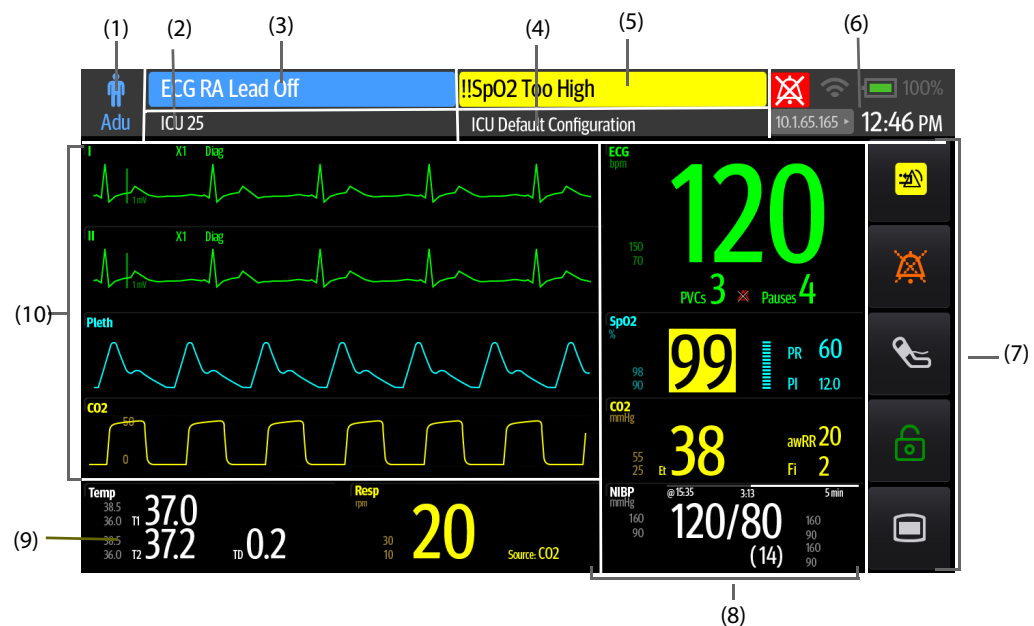
1. Scan the engineering barcode to clear the previous data format.
2. Scan the 2D engineering barcode which contains the hospital's data format.

NOTE

- Contact the scanner manufacturer or Mindray to obtain the barcodes for clearing data formats and programming the hospital's data format.

3.6 Screen Display

The following figure shows the normal screen:


























- (1) Patient information area: displays patient category and gender. The displayed patient information is configurable. Selecting this area enters the **Patient Management** dialog. For more information, see 5.2.2 *Editing Patient Information*.
- (2) Patient information area: displays patient information, including department, room number, bed number, and so on. The displayed patient information is configurable. Selecting this area enters the **Patient Management** dialog. For more information, see 5.2.2 *Editing Patient Information*.
- (3) Technical alarm information area: displays technical alarm message or prompt message.
- (4) The current configuration: displays the name of the configuration that can be loaded from the main menu.
- (5) Physiological alarm information area: displays physiological alarm message.
- (6) System status information area: displays alarm symbol, battery status, network status, currently connected CMS, and system time. For more information, see 3.6.1 *On-screen Symbols*.

- (7) Quick key area: displays quick keys.
- (8) Parameter numerics area: displays parameter values, alarm limits, and alarm status. This area can also display the parameter list. For more information, see *3.9.3 Displaying the Parameter List*. Selecting a parameter numeric block enters the corresponding parameter dialog. Selecting the parameter list enters Tabular Trends review.
- (9) Parameter waveform/numerics area: unique area of the screen that can be configured to display either parameter numerics or parameter waveforms. Depending on the configuration, the tiles take on the characteristics of either area (8) or area (10).
- (10) Parameter waveform area: displays parameter waveforms, measurement ranges, and magnification. Selecting a waveform enters the corresponding parameter dialog.

3.6.1 On-screen Symbols

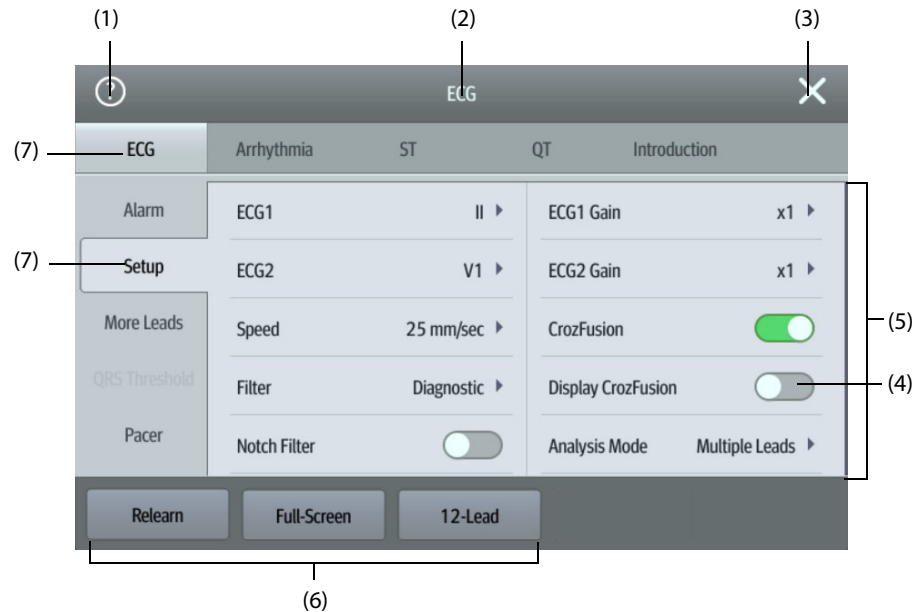
The following table lists the on-screen symbols displayed on the system status information area:

Symbol	Description	Symbol	Description
	Adult, male		Adult, female
	Pediatric, male		Pediatric, female
	Neonate, male		Neonate, female
	Wireless network is connected. The solid part indicates network signal strength.		Wireless network is not connected.
	WMTS is connected. The solid part indicates network signal strength.		WMTS is not connected
	Wired network is connected.		Wired network is not connected.
	All the alarms are paused.		Individual physiological alarms are turned off or the monitor is in the alarm off status.
	Audible alarm tones are paused.		Audible alarm tones are turned off.
	The alarm system is reset.		The battery is working correctly. The green portion represents the remaining charge.
	The battery has low power and needs to be charged.		The battery has critically low charge and needs to be charged immediately. Otherwise, the monitor will automatically shut down soon.

Symbol	Description	Symbol	Description
	The battery is being charged.		No battery is installed.
	Battery fault, battery communication fault, or battery charging fault. Contact service personnel for help.		

3.6.2 Dialogs

All dialogs have similar style and structure, see the figure below:















- (1) Selecting the question mark can show help for a menu option. Some menu items come with help information. When the question mark is selected, it turns into cyan and corresponding menu options are followed by question marks. Then you can see help when these menu options are selected.
- (2) Dialog heading
- (3) Exit button: closes the current dialog.
- (4) Switch:
 - Green: the switch is on.
 - Gray: the switch is off.
- (5) Main body area: includes dialog items and options.
- (6) Operation buttons
- (7) subdialog tabs

3.6.3 Quick Keys of N1

The monitor provides quick keys for you to quickly access some functions. The quick key area is located at the right of the screen. The quick key area displays 5 quick keys. You can also swipe down on the quick key area for more quick keys. The following table shows available quick keys.

The following table shows available quick keys.

Symbol	Label	Function	Symbol	Label	Function
	Main Menu	Enters the main menu.		Alarm Reset	Resets the alarm system.
	Alarm Pause	Pauses the physiological alarm system (Availability depends on configuration of Pause in Maintenance → Alarm → Pause/Reset dialog).		Audio Pause	Pauses alarm tone (Availability depends on configuration of Pause in Maintenance → Alarm → Pause/Reset dialog).
	Screen Setup	Enters the Screen Setup dialog.		Standby	Enters the standby mode.
	Manual Event	Manually saves an event into the Events list.		Print	Starts printing a real-time report.
	NIBP Start/Stop	Starts an NIBP measurement or stops the current NIBP measurement.		NIBP Measure	Opens the NIBP Measure interval options.
	Lock	Selects and operates as instructed to unlock the touchscreen		Unlock	Selects and operates as instructed to lock the touchscreen

3.7 Operating Modes

The monitor provides different operating modes. This section describes the different monitoring modes and standby modes.

3.7.1 Monitoring Mode

The monitoring mode is the most frequently used clinical mode for patient monitoring. When the monitor is turned on, it automatically enters the monitoring mode.

3.7.2 Module Mode

When the N1 is connected to the host monitor, the N1 enters the module mode. For connection of the N1 and the host monitor, see section 2.9 *N1 in Use with a Host Monitor*. The N1 monitor has the following features when it enters the module mode:

- The patient information, parameter setup, and alarm setup of the N1 and the host monitor will be synchronized. For data transfer strategy, see the operator's manual of the host monitor.
- The N1 can still store the parameter data and the alarm events.
- The N1 receives and stores the parameter trends data from the host monitor.
- All audible sounds of the N1 are off.
- Wired and wireless network of the N1 are not available.
- The alarm indications of the battery related alarms of the N1 are given by the host monitor.
- Turning on or off the host monitor simultaneously powers on or off the N1.
- The main screen of the N1 is off when it is connected to the host monitor through the SMR or the module rack of the host monitor.

The N1 resumes to monitor mode when it is disconnected from the host monitor.

3.7.3 Privacy Mode

The privacy mode is a special clinical monitoring mode. In the privacy mode, the monitor does not display patient information and monitoring data. This provides controlled access to patient data and ensures confidentiality.

The privacy mode is only available when the patient admitted by the monitor is also monitored by the CMS. The monitor continues monitoring the patient, but patient data is only visible at the CMS.

3.7.3.1 Entering the Privacy Mode

To enter the privacy mode, select the **Main Menu** quick key → from the **Display** column select **Privacy Mode** → select **Ok**.

The monitor has the following features after entering the privacy mode:

- The screen turns blank.
- Except for the low battery alarm, the monitor inactivates alarm tones and alarm lights for all other alarms.
- The monitor suppresses all system sounds, including heart beat tone, pulse tone, and prompt tone.

WARNING

- **In the privacy mode, all audible alarms are suppressed and the alarm light is deactivated at the monitor. Alarms are presented only at the CMS. Pay attention to potential risk.**
-

NOTE

- **The privacy mode is not available if the Department is set to OR.**
 - **You cannot enter the privacy mode if a low battery alarm is active.**
-

3.7.3.2 Exiting the Privacy Mode

The monitor automatically exit the privacy mode in any of the following situations:

- The monitor disconnects from the CMS.
- The low battery alarm occurs.

You can also operate the touchscreen, mouse, or keyboard to manually exit the privacy mode.

3.7.4 Night Mode

The night mode is a special clinical monitoring mode. To avoid disturbing the patient, you can use the night mode.

You can disable the night mode feature. This is password protected. For more information, see **Disable Night Mode** in 21.3.10.3 *Setting the Night Mode Switch*.

3.7.4.1 Entering the Night Mode

To enter the night mode, follow this procedure:

1. Select the **Main Menu** quick key → from the **Display** column select **Night Mode**.
2. Change the night mode settings if necessary.
3. Select **Enter Night Mode**.

CAUTION

- **Verify the night mode settings before entering the night mode. Pay attention to potential risk in case of improper settings.**
-

NOTE

- If the night mode feature is disabled, the Night Mode option is not available.
-

3.7.4.2 Setting the Auto Night Mode Switch

You can configure the monitor to automatically enter and exit the night mode. To do so, follow this procedure:

1. Select the **Main Menu** quick key → from the **Display** column select **Night Mode**.
2. Switch on or off **Auto Night Mode**.
 - ◆ **On:** the monitor automatically enters the night mode when the night mode period starts and exits the night mode when the night mode period ends. For more information on setting the night time period, see 21.8.4 *Defining the Night Time Period*.
 - ◆ **Off:** the monitor will not automatically enter the night mode. To manually enter the night mode, see **Nighttime** from 3.7.4.1 *Entering the Night Mode*.

The Auto Night Mode switch is Off by default.

3.7.4.3 Changing Night Mode Settings

To change night mode settings, follow this procedure:

1. Select the **Main Menu** quick key → from the **Display** column select **Night Mode**.
2. Change the following settings as necessary.
 - ◆ Screen brightness
 - ◆ Alarm volume, QRS volume, key-striking volume, and reminder volume
 - ◆ NIBP End Tone switch and Stop NIBP switch

3.7.4.4 Muting All Monitor Sounds

If the monitor is connected with the CMS, you can silence the monitor in the Night mode. To do so, switch on **All Mute** from the **Night Mode Setup** dialog. Local password for accessing the Maintenance dialog is required for switching on **All Mute**.

After the monitor is silenced, the monitor will not generate the alarm tone, QRS tone, key tone, reminder tone, or NIBP end tone.

NOTE

- Alarms at the bedside monitor will be restored if connection to the CMS is interrupted.
-

3.7.4.5 Exiting the Night Mode

To exit the night mode, select the **Main Menu** quick key → from the **Display** column select **Exit Night Mode** → select **OK**.

NOTE

- If your monitor is connected to the CMS, it automatically exits the night mode if the connection to the CMS is interrupted.
 - The monitor reverts to the previous settings after exiting the night mode.
-

3.7.5 Standby Mode

You can temporarily stop patient monitoring without switching off the monitor by entering the standby mode.

3.7.5.1 Entering the Standby Mode

1. Select the **Standby** quick key, or select the **Main Menu** quick key → from the **Patient Management** column select **Standby**.
2. Define where the patient is by selecting a location in the drop down list when the monitor enters the standby mode.
3. Select **Ok**.

The monitor behaves as follows after entering the standby mode:

- Stops all parameter measurements.
- Disables all the alarms and prompt messages, except for the battery low alarm.
- Turns screen brightness to the dimmest after entering the standby mode for 30 seconds.

WARNING

- **Pay attention to the potential risk of placing the monitor to standby. In the standby mode, the monitor stops all parameter measurements and disable all the alarm indications, except for the battery low alarm.**
-

3.7.5.2 Changing the Patient Location at Standby

To change the patient's location, select patient location from the Standby screen.

3.7.5.3 Exiting the Standby Mode

To exit the standby mode, choose any of the following ways:

- Select **Resume Monitor** to exit the standby mode and resume monitoring the current patient.
- Select **Discharge Patient** to discharge the current patient.

If the monitor automatically enters the standby mode after a patient is discharged, choose any of the following ways to exit the standby mode:

- Select **Monitor** to exit the standby mode and admit a new patient.
- Select **Patient Management** to enter the patient information for preparing to admit a new patient.

When the monitor exits Standby mode and resumes monitoring, the alarms are paused for two minutes, after which the alarm system is activated.

3.7.6 Outdoor Mode

The outdoor mode is intended for transferring patients outdoors. The monitor behaves as follows after entering the outdoor mode:

- The parameter color is white and unchangeable.
- The screen brightness is automatically changed to 10.

3.7.6.1 Entering the Outdoor Mode

To enter the outdoor mode, select the **Main** quick key → from the **Display** column select **Enter Outdoor Mode**.

NOTE

- **The monitor enters the outdoor mode automatically if the strength of ambient light is greater than the threshold.**
-

3.7.6.2 Exiting the Outdoor Mode

When **Enter Outdoor Mode** is set to **Manual**, select the **Main Menu** quick key → from the **Display** column select **Exit Outdoor Mode**.

The monitor automatically exits the outdoor mode in the following situation:

- The monitor is connected to a host monitor.
- The strength of ambient light is lower than the threshold when **Enter Outdoor Mode** is set to **Auto**.

3.7.7 Discharge Mode

The discharge mode is a special standby mode after a patient is discharged.

3.8 Configuring the Monitor

Configure the monitor before putting it in use.

3.8.1 Setting the Date and Time

To set the system time, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Time**.
2. Set **Date** and **Time**.
3. Set **Date Format**.
4. If you want to use the 12-hour mode, switch off **24 Hour Time**.
5. If you want to use daylight saving time, switch on **Daylight Saving Time**. You can manually switch on or off the daylight saving time only when the auto daylight saving time function is disabled. For more information, see *21.8.5 Enabling Auto Daylight Savings Time* for details.

If the monitor is connected to a central monitoring system (CMS) or hospital clinical system (HIS), the date and time are automatically taken from the CMS. In this case, you cannot change the date and time on the monitor.

CAUTION

- **Changing the date and time affects the storage of trends and events and may result in loss of data.**
-

3.8.2 Adjusting the Screen Brightness

To adjust the screen brightness, follow this procedure:

1. Access **Display** in either of the following ways:
 - ◆ Select the **Screen Setup** quick key → select the **Display** tab.
 - ◆ Select the **Main Menu** quick key → from the **Display** column select **Display**.
2. Set **Brightness**. If **Brightness** is set to **Auto**, the monitor automatically adjust the screen brightness according to the ambient light.

3.8.3 Adjusting the Key Volume

To adjust the key volume, follow this procedure:

1. Select the **Main Menu** quick key → from the **Display** column select **Display**.
2. Set the **Key Volume**.

3.9 General Operation

This section describes the operations that are generally used when monitoring a patient.

3.9.1 Switching On or Off a Parameter

You can manually switch on or off a parameter when its module is connected. If setting parameter switches is not password protected, follow this procedure to set parameter switches:

1. Access **Parameters On/Off** in either of the following ways:
 - ◆ Select the **Screen Setup** quick key → select the **Parameters On/Off** tab.
 - ◆ Select the **Main Menu** quick key → from the **Parameters** column select **Parameters On/Off**.

2. Switch on or off desired parameters.

When a parameter is switched off, the monitor stops data acquisition and alarming for this measurement.

NOTE

- **When a parameter is manually switched off even, you cannot monitor this parameter if related accessories of this parameter are connected.**

3.9.2 Displaying Parameter Numerics and Waveforms

You can configure the parameter numerics, waveforms, and their sequence displayed on the normal screen. To do so, follow this procedure:

1. Access **Tile Layout** in either of the following ways:
 - ◆ Select the **Screen Setup** quick key → select the **Tile Layout** tab.
 - ◆ Select the **Main Menu** quick key → from the **Display** column select **Tile Layout**.
2. Select a parameter numeric area or waveform area, and then from the popup list select an element you want to display in this area. The parameters and waveforms you did not select will not be displayed.


3.9.3 Displaying the Parameter List

You can display the trends of HR, SpO₂, RR, and NIBP/IBP in the parameter numerics area. To do so, follow this procedure:

1. Access **Tile Layout** in either of the following ways:
 - ◆ Select the **Screen Setup** quick key → select the **Tile Layout** tab.
 - ◆ Select the **Main Menu** quick key → from the **Display** column select **Tile Layout**.
2. Select the parameter numerics area where you want to display the parameter list, and then from the popup list select **Parameter List**.

3.9.4 Accessing Parameter Setup Dialogs

Each parameter has a setup dialog in which you can adjust the alarm and parameter settings. You can enter a parameter setup dialog by using any of the following methods:

- Select the parameter numeric area or waveform area.
- Press the setup hard key  on the module front of the CO₂ module.
- Select the **Parameters Setup** quick key, and then select the desired parameter.
- Select the **Main Menu** quick key → from the **Parameters** column select **Setup** → select the desired parameter.

NOTE

- **In this manual, we always use the first method to enter the setup dialog. But you can use any method you prefer.**

3.9.5 Accessing the On-screen Guide

The monitor provides the on-screen guide to help you understand parameter monitoring functions. On-screen guide provides measurement principle, points to note, accessory connection, operating procedure, and so on.

To access the on-screen guide, follow this procedure:

1. Select the desired numerics area or waveform area to enter the parameter menu.
2. Select the **Introduction** tab.
3. Select a tab as required.

NOTE

- The on-screen guide is not available for Respiration and temperature monitoring.

3.9.6 Changing Measurement Colors

You can set the color of measurement values and waveforms for each parameter. To do so, follow this procedure:

1. Select **Main Menu** quick key → from the **Parameters** column select **Parameter Color**.
2. Select the **Current** tab and set the colors of the currently monitoring measurement values and waveforms.
3. Select the **All** tab and set the colors of measurement values and waveforms for all parameters.

3.9.7 Choosing a Screen

The monitor enters the normal screen after it is powered on. The normal screen is most frequently used for patient monitoring. You can also select other screens. To do so, follow this procedure:

1. Access **Choose Screen** in either of the following ways:
 - ◆ Select the **Screen Setup** quick key.
 - ◆ Select the **Main Menu** quick key → from the **Display** column select **Choose Screen**.
2. Select the desired screen.

3.9.8 Selecting the Big Numerics Screen

The big numerics screen displays parameter numerics in big font size. You can configure the parameters and their layout on the big numeric screen. Quickly switch between the normal screen and the big numeric screen by swiping left or right on the touchscreen with two fingers. You can also select the big numeric screen by proceeding as follows:

1. Access **Choose Screen** in either of the following ways:
 - ◆ Select the **Screen Setup** quick key.
 - ◆ Select the **Main Menu** quick key → from the **Display** column select **Choose Screen**.
2. Select **Big Numerics**.
3. Select **Big Numerics** tab.
4. Select a parameter numeric area or waveform area, and then from the popup list select an element to display in this area.

3.10 Initiating a Manual Event

To save a manual event, follow this procedure:

1. Select the **Manual Event** quick key to enter the **Manual Event** menu.
2. Select a name for this event, for example **Intubated**, or input a name.
3. Select **OK**.

To edit the name of preset event names, select  to enter the **Manual Event Setup** menu.

Selecting or editing manual event name functionality is available only if the **Manual Event Edit** switch is turned on. For more information, see *21.15.3 Setting the Manual Event Edit Switch*.

You can review the manual events. For more information, see *15.2.7 Events Review Page*.

3.11 Capturing the Screen (only available when the N1 is used with the independent external display)

The monitor provides the function of screen capture. To capture the current screen display, follow this procedure:

1. Connect the N1 to the Dock.

2. Connect the USB drive to the Dock's USB connector.
3. Press and hold the **More** quick key. Wait until it turns from blue to grey.

The captured pictures are automatically saved in the USB drive.

The screen capture function is disabled by default. To enable the screenshot function, see *21.15.4 Setting the Screenshot Switch (only available when the N1 is used with the independent external display)*.

3.12 Connecting the CMS

You can connect the monitor to the BeneVision CMS through wired LAN or wireless LAN. When connected to the CMS, the system provides the following function.

- The monitor can transmit parameter values, waveforms, alarms, and events to the CMS. From the CMS, you can check the patient's monitoring data and alarms.
- The monitor can transmit parameter values and alarms from the connected external devices to the CMS. From the CMS you can check the patient's monitoring data and alarms obtained from the connected external devices.
- Patient information, alarm settings, and alarm status can be synchronized between the monitor and the CMS.
- You can start or stop NIBP measurements from the CMS.
- In case of network disconnection, the monitor can transmit the offline data to the CMS when the network is reconnected.

For more information on the CMS, see the operator's manual of corresponding central monitoring system.

To select a CMS, select the system status information area at the top right corner of the main screen. Select the desired CMS from the popup CMS list.

NOTE

- **For the N1 connecting the CMS via WMTS, patient data monitored when the CMS is disconnected cannot be sent to the CMS even if the CMS is re-connected.**
- **The N1 can be connected to the CMS with system software V05.00.00.01 and above via WMTS.**
- **You can select CMS only when the Select CMS switch is on. For more information, see *21.12.5 Enabling Selecting a CMS*.**

3.13 Connecting the eGateway


You can connect the monitor to the eGateway through wired LAN or wireless LAN to implement interaction between the monitor and external devices. When connected to the eGateway, the system provides the following functions:

- The monitor can transmit parameter values, waveforms, alarm settings, and events to the eGateway.
- The monitor can transmit parameter values and alarm settings received from the Benelink-connected external devices to the eGateway.
- Clock can be synchronized between the monitor and the eGateway.

3.14 Connecting the Wireless Network (for N1 Supporting Wi-Fi)


You can add up to five wireless networks for the monitor. For more information, see *21.12.2 Setting the Wireless Network (for N1 Supporting Wi-Fi)*.

If connecting the current wireless network fails, the monitor automatically connects other wireless networks in the order when they were added.


To manually switch the wireless network, from the system status information area on the top right corner of the screen select , and select the desired wireless network.

3.15 Disconnecting the Wireless Network (for N1 Supporting Wi-Fi)

To disconnect the wireless network manually, follow this procedure:

1. Swipe the screen from top down with a single finger.
2. Select .

To reconnect the wireless network after it is disconnected manually, follow this procedure:

1. Swipe the screen from top down with a single finger.
2. Select .

3.16 Turning Off the Monitor

Before turning off the monitor, perform the following check:

1. Ensure that monitoring of the patient has been completed.
2. Disconnect the cables and sensors from the patient.
3. Save or clear the patient data as required.

To turn off the monitor, press and hold the power switch for 3 seconds.

CAUTION

- **Press and hold the power switch for no less than 10 seconds to forcibly shut down the monitor if it could not be shut down normally. This may cause loss of patient data.**

NOTE

- **Turning off the monitor does not disconnect the monitor from the AC mains. To completely disconnect the power supply, unplug the power cord.**
 - **In case of a temporary power failure, if the power is restored within 30 minutes, monitoring will resume with all active settings unchanged. If the monitor is without power for more than 30 minutes, it behaves the same as if it were normally turned off.**
-

4 Using the External Display

4.1 Using the External Display

The N1 can be connected to an external display through the VGA connector of the Dock. When the external display is connected, you can monitor a patient's condition either through the N1 or through the external display.

The external display can be configured as an independent display which can be configured to show information different with that on the N1. For the configuration of the independent external display, see section *21.14.6 Setting the External Display*.

The following screens or functions can be viewed and operated only on the independent external display:

- Minitrends Screen
- OxyCRG Screen
- Remote View Screen
- ECG Half-Screen
- PAWP Screen
- Calculations
- ST Graphic
- Targeted Goal
- EWS
- GCS
- SepsisSight
- AF Summary
- ECG 24h Summary

NOTE

- **The external display can share the mouse or keyboard with the monitor. If the mouse or keyboard are needed, connect them to the USB connector of the Dock.**

4.1.1 Connecting the N1 to the External Display

To connect the external display, follow this procedure:

1. Connect the Dock and the external display using the VGA cable.
2. Connect the Dock and the external display using the USB cable accompanying the external display.
3. Connect the external display to the AC mains and turn on the display.
4. Connect the N1 to the Dock.

4.1.2 External Display Troubleshooting

Problem	Corrective Actions
Image offset	Adjust the external display by using the auto adjust function or adjust the external display manually.
No image or the image displays abnormally	<ul style="list-style-type: none">• Check that the external display is properly connected to the AC mains and is powered on.• Check that the VGA cable is properly connected.• Remove the N1 from the Dock and reconnect it.

















Problem	Corrective Actions
Touchscreen failure	Check that both ends of the USB cable accompanying the external display are connected properly to the Dock and the external display.






CAUTION

- Use only the specified display. Using unspecified displays may result in unexpected problems.

4.1.3 Quick keys of the independent external display

The following table displays the quick keys that are available for the independent external display.

Symbol	Label	Function	Symbol	Label	Function
	Main Menu	Enters the main menu.		Alarm Reset	Resets the alarm system.
	Alarm Pause	Pauses the physiological alarm system (Availability depends on configuration of Pause in Maintenance → Alarm → Pause/Reset dialog).		Audio Pause	Pauses alarm tone (Availability depends on configuration of Pause in Maintenance → Alarm → Pause/Reset dialog).
	Screen Setup	Enters the Screen Setup dialog.		Standby	Enters the standby mode.
	Manual Event	Manually saves an event into the Events list.		Print	Starts printing a real-time report.
	NIBP Start/Stop	Starts an NIBP measurement or stops the current NIBP measurement.		NIBP Measure	Opens the NIBP Measure interval options.
	NIBP STAT	Starts a five-minute continuous NIBP measurement.		NIBP Stop All	Stops all NIBP measurements.
	Alarm Setup	Enters the Alarm dialog.		More	Shows more quick keys.
	Zero IBP	Enters the Zero IBP dialog.		PAWP	Opens the PAWP screen.
	Parameters Setup	Enters the Parameters Setup dialog.		Remote View	Opens the Remote View screen to view other patients.
	Review	Enters the Review dialog to review historical data.		Minitrends	Opens the Minitrends screen.

Symbol	Label	Function	Symbol	Label	Function
	OxyCRG	Opens the OxyCRG screen.		ECG Full-Screen	Opens the ECG full screen.
	Privacy Mode	Enters the privacy mode.		Night Mode	Enters the night mode.
	CPB Mode	Enters the CPB mode.		Intubation Mode	Enters the intubation mode.
	Volume	Enters the Volume dialog.		Freeze	Freezes waveforms.
	Calculations	Enters the Calculations dialog.		Load Config	Enters the Load Config dialog.
	Patient Management	Enters the Patient Management dialog.		ECG Lead/Gain	Enters the ECG Lead/Gain dialog.
	Venipuncture	Inflates the NIBP cuff to help venous puncture.		EWS	Opens the EWS screen.
	GCS	Enters the GCS dialog.		SepsisSight	Enters the SepsisSight dialog.
	Discharge Patient	Enters the Discharge Patient dialog to discharge the patient and restore pre-configured default settings.		Discharged Patients	Enters the Discharged Patients dialog and displays previously discharged patients.
	Targeted Goal	Opens the Targeted Goal screen.		End Case Report	Prints the selected end case reports
	ECG 24h Sum	Views the 24-hour ECG summary.		AF Summary	Opens the AF Summary window
	OxyCRG Expand	Enters the OxyCRG Expand screen.			

4.1.4 Configuring the Displayed Quick Keys (only available when the N1 is used with the independent external display)

To select the quick keys you want to display, follow this procedure:

- Access **Quick Keys** in either of the following ways:
 - Select the **Screen Setup** quick key → Select the **Quick Keys** tab.
 - Select the **Main Menu** quick key → from the **Display** column select **Quick Keys**.

2. Select the **Current** tab to configure the quick keys you want to display on the screen: From the top of this page, select a block where you want to show a certain quick key, and then select the quick key from the quick key list. For example, if you want to show the **Screen Setup** quick key at the first block, select the first block, and then select **Screen Setup** from the list.
3. Select the **More** tab to configure the quick keys you want to display when the **More** quick key is selected.


4.2 Minitrends Screen


The Minitrends screen shows the recent graphic trends of parameters.

4.2.1 Entering the Minitrends Screen

Choose one of the following methods to enter the Minitrends screen:

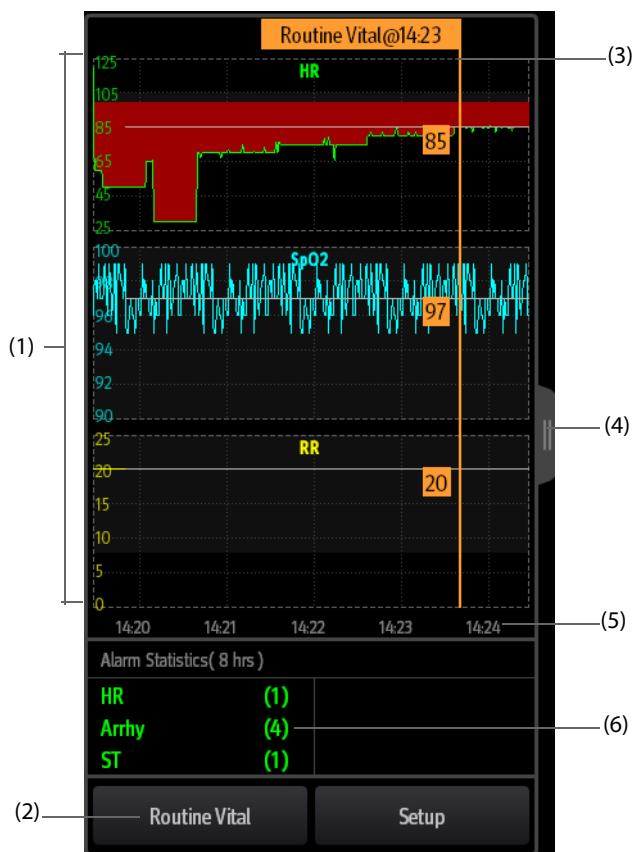
- Swipe left or right on the touchscreen with two fingers to switch among the Minitrends screen, normal screen, and the big numerics screen.
- Select the **Minitrends** quick key.
- Select the **Screen Setup** quick key → Select the **Choose Screen** tab → select **Minitrends**.
- Select the **Main Menu** quick key → from the **Display** column select **Choose Screen** → select **Minitrends**.

For adult and pediatric patients, when the Minitrends screen is hidden as , you can also choose one of the following methods to quickly enter the Minitrends screen.

- Swipe left or right across the touchscreen with two fingers until you switch to the Minitrends screen.
- Swipe right across the touchscreen with a single finger.
- Select the  button.

4.2.2 The Display of Minitrends Screen

The following figure shows the minitrends screen. Your display may be configured to look slightly different.



(1) Scale

- (2) **Routine Vital** button. If the department is set to **OR**, then the **Baseline** button is displayed.
- (3) Routine Vital/Baseline
- (4) Select this button to view the long trends, or contract the long trends screen to the Minitrends screen.
- (5) Time line
- (6) Alarm statistic area

4.2.3 Viewing the Long Trends

To expand the Minitrends screen to view the long trends, choose either of the following ways:

- Select the  button.
- Swipe right across the Minitrends screen with a finger.

4.2.4 Setting Minitrends Parameters

To set parameters, follow this procedure:

1. Enter the Minitrends screen.
2. Select the **Setup** button.
3. Set parameters. If you want to use the default parameters, select **Default Parameter**.

4.2.5 Setting the Minitrend Length

To set the Minitrend length, follow this procedure:

1. Enter the Minitrends screen.
2. Select the **Setup** button.
3. Set the **Minitrend Length**.

4.2.6 Setting the Alarm Statistics Switch

The Minitrends screen can be configured to display the statistic number of physiological alarms in its lower half screen. To set the alarm statistics switch, follow this procedure:

1. Enter the Minitrends screen.
2. Select the **Setup** button.
3. Switch on or off the **Alarm Statistics** switch.

4.2.7 Setting the Alarm Statistics Duration

The time length within which the alarms statistics are made is configurable. To set the alarm statistics length, follow this procedure:

1. Enter the Minitrends screen.
2. Select the **Setup** button.
3. Set **Alarm Statistics Duration**.

4.2.8 Routine Vital/Baseline

The Routine vital/Baseline function is used for marking the parameter measurements of certain moment for later reference. If the department is set to **OR**, then the **Baseline** button is available. For other departments, the **Routine Vital** button is available.

4.2.8.1 Manually Marking the Routine Vital/Baseline

To manually mark the Routine Vital/Baseline, follow this procedure:

1. Enter the Minitrends screen.

2. Select the **Routine Vital** button or **Baseline** button.

NOTE

- If you do not see the **Baseline** button or **Routine Vital** button in the **Minitrends** screen, you can select the **Setup** button and switch on the **Baseline** switch, or set the **Routine Vital** to **Manual** or **Auto**.

4.2.8.2 Configuring Automatic Routine Vital Settings

The monitor can automatically mark the routine vital sign values. To enable this function, follow this procedure:

1. Enter the **Minitrends** screen.
2. Select the **Setup** button.
3. Select the **Routine Vital** tab.
4. Select **Auto** from the dropdown list of **Routine Vital**.
5. Select **Time** to set the time for marking the first routine vital sign values.
6. Select **Interval** to set the interval for marking the routine vital sign values.

4.3 The OxyCRG Screen

The monitor displays the OxyCRG screen by default when the neonatology department is selected. The OxyCRG screen is available in any department setting, but only when the patient size is set to **Neo**. This screen displays 6-minute HR, SpO₂ trends, CO₂/Resp compressed waveform, ABD parameters, and the latest ABD events.

The OxyCRG function is intended for neonatal patents only.

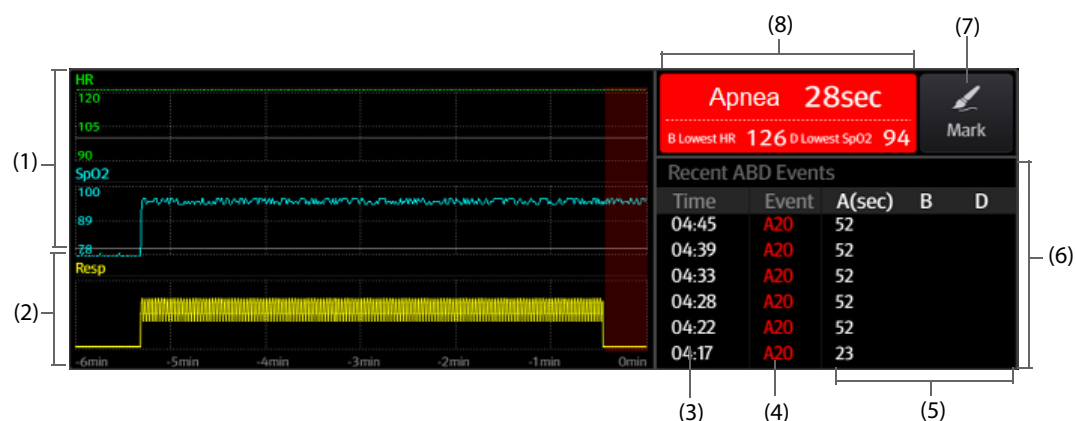
4.3.1 Entering the OxyCRG Screen

To enter the OxyCRG screen, choose any of the following ways:

- Swipe left or right on the touchscreen with two fingers to switch to the OxyCRG screen.
- Select the **OxyCRG** quick key.
- Select the **Screen Setup** quick key → select the **Choose Screen** tab → select **OxyCRG**.
- Select the **Main Menu** quick key → from the **Display** column select **Choose Screen** → select **OxyCRG**.

4.3.2 The Display of the OxyCRG Screen

The following figure shows the OxyCRG screen. Your display may be configured to look slightly different.



- (1) HR, SpO₂ trend
- (2) Resp/CO₂ compressed waveform
- (3) Event time
- (4) Event type
- (5) Parameter values of ABD events

- (6) ABD event list: displays the latest red ABD events. Selecting the ABD event list area enters the OxyCRG review page.
- (7) Mark button: opens the **Mark** dialog to edit the events.
- (8) ABD event prompt area: displays parameter values of currently active OxyCRG events.

4.3.3 OxyCRG Events

The following table lists the ABD events and their criteria:

Event type	Description	Remarks
A	Apnea event: the apnea duration exceeds the threshold. <ul style="list-style-type: none"> A20: the apnea duration is greater or equal to 20 seconds. A15: the apnea duration is between 15 to 20 seconds (excluding 20 seconds). A10: the apnea duration is between 10 to 15 seconds (excluding 15 seconds). 	A20 is a red event
B	Low Heart Rate event: the duration of low heart rate exceeds the threshold.	/
D	Low SpO ₂ event: the duration of SpO ₂ Desat exceeds the threshold.	/
BD	Low Heart Rate and low SpO ₂ happen at the same time.	/
AB	Apnea and Low Heart Rate happens at the same time.	Red event
AD	Apnea and low SpO ₂ happen at the same time.	Red event
ABD	Apnea, Low Heart Rate, and low SpO ₂ happen at the same time.	Red event

NOTE

- The monitor records all ABD events for OxyCRG review, but only red events displays in the ABD list of the OxyCRG screen.

4.3.4 The Display of the ABD Event Area

The ABD event area displays parameter values of currently active OxyCRG events and lists the latest red ABD events.

4.3.5 Setting OxyCRG Parameters

Select parameter trends or compressed waveform to set parameters and the compressed waveform you want to display. The selected parameters will be used for ABD event calculation.

4.3.6 Setting the Threshold of ABD Events

Select any parameter trend or the compressed waveform to perform the following setup:

- Set the threshold of ABD events.
- Set **Event Storage Format**:
 - ◆ **1 min+3 min**: stores data one minute before and three minutes after the event.
 - ◆ **3 min+1 min**: stores data three minutes before and one minute after the event.
 - ◆ **2 min+2 min**: stores data two minutes before and two minutes after the event.

The stored data includes the trends of the OxyCRG parameters, compressed waveform, alarm thresholds, NIBP, and Temp measurements.

4.3.7 Editing ABD Events

To edit ABD events, follow this procedure:

- Select the **Mark** button to enter the **Mark** dialog box.
- Drag the event list upwards and downwards to select the desired event.

3. Select the patient's status when the event happened.
4. Select **Save**.

4.4 The Targeted Goal Screen

If you are concerned with specific parameters and their trends, you can use the Targeted Goal screen. The Targeted Goal screen focuses on the target parameter and displays parameter measurements in big numerics. You can easily identify whether parameter target is reached via a dashboard and review the statistics of the target parameter by sections.

The Targeted Goal screen displays parameter measurements and waveforms of ECG, SpO₂, IBP, PI, PR, CO₂, Resp, NIBP, and Temp. You can define the target parameter and secondary parameters. The measurements of these parameters displays in big numerics.

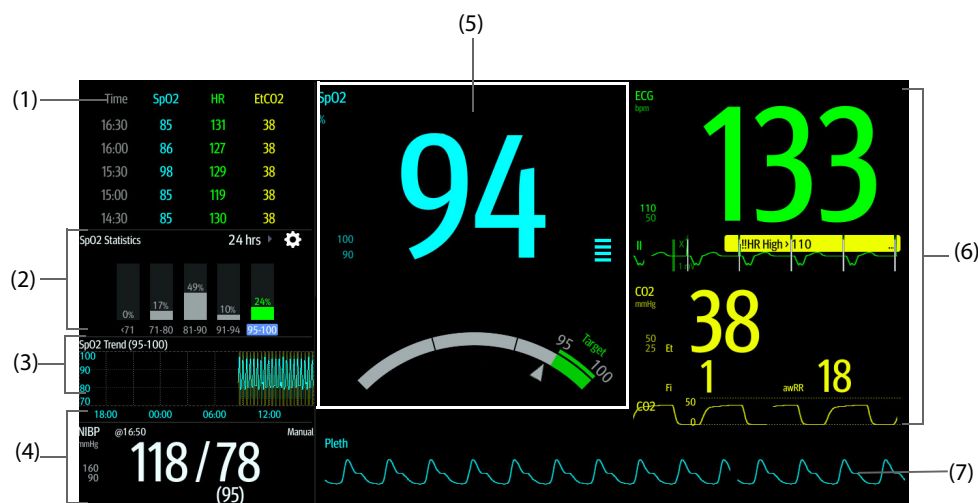
4.4.1 Entering the Targeted Goal Screen

To enter the Targeted Goal screen, choose any of the following ways:

- Select the **Screen Setup** quick key → select the **Choose Screen** tab → select Targeted Goal screen.
- Select the **Main Menu** quick key → from the **Display** column select **Choose Screen** → select Targeted Goal Screen.
- If the **Patient Category** is set to **Neo**, swipe left or right on the touchscreen with two fingers to switch to the Targeted Goal screen.

4.4.2 The Display of the Targeted Goal Screen

The following figure shows the Targeted Goal screen. Your display may be configured to look slightly different.



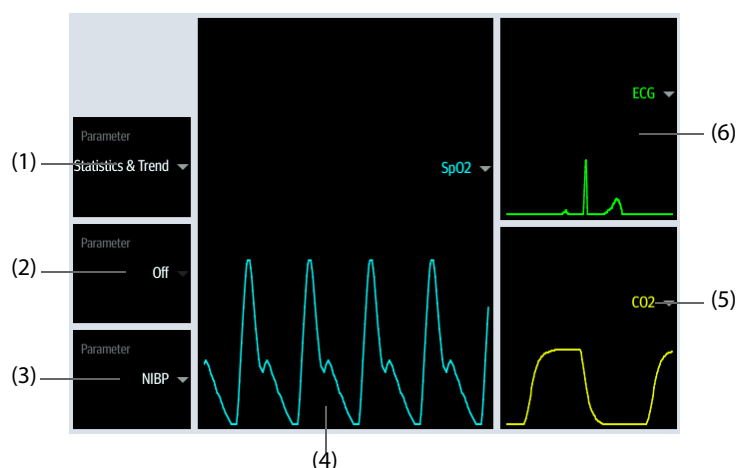
- (1) Parameter trends area: displays trends of the target parameter and secondary parameters. If the target parameter is Art, this area only lists the trend of arterial pressure. Selecting this area enters the **Tabular Trends** review page.
- (2) Target parameter statistics area: displays the statistics of the target parameter by sections.
- (3) Target parameter trends area: displays the graphic trends of the target parameter. If this area is not configured to display the trends of the target area, other selected parameter is displayed.
- (4) Other parameter area: displays parameter measurements and alarm limits of parameters other than the target parameter and secondary parameters.
- (5) Target parameter area: displays the measurement of the target parameter in big numerics, as well as its target range, and alarm limits.
 - If the target parameter is Resp or PR, parameter source is also displayed.
 - The dashboard shows the target range in green.
 - The \triangle pointer below the dashboard indicates the current measurement value.
 - Selecting this area enters the corresponding parameter setup dialog.

- (6) Secondary parameters area: displays parameter measurement of secondary parameters in big numerics, as well as waveforms and alarm limits. If secondary parameters are Resp and PR, parameter sources are also displayed.
- (7) Target parameter waveform area: displays the waveform of the target parameter.
 - If the target parameter is Resp or PR, the waveform of the source parameter is displayed.
 - If the target parameter is ECG, the first ECG waveform is displayed by default.

4.4.3 Configuring the Targeted Goal Screen Layout

To configure the parameter numerics, waveforms, and their sequence displayed on the Targeted Goal screen, follow this procedure:


1. Access the Targeted Goal screen in either of the following ways:
 - ◆ Select the **Screen Setup** quick key → select the **Choose Screen** tab → select Targeted Goal screen.
 - ◆ Select the **Main Menu** quick key → from the **Display** column select **Choose Screen** → select Targeted Goal Screen.
2. Select a parameter numeric area or waveform area, and then from the popup list select an element to display in this area. The parameters and waveforms not selected will not displayed.



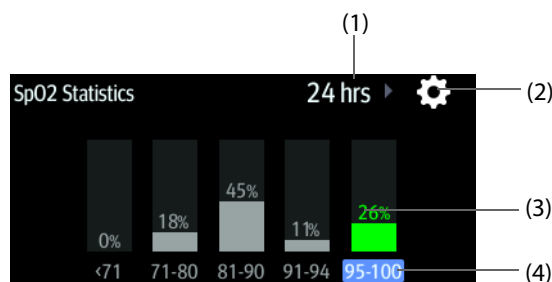
- (1) Select this area to define items to be displayed for the target area:
 Statistics: this area displays the statistics of the target parameter by sections.
 Statistics & Trend: this area displays the statistics of the target parameter by sections and the area below displays the graphic trends of the target parameter.
- (2) If the graphic trends of the target parameter is not displayed, select this area to define other parameter to be displayed.
- (3) Select this area to define other parameter (other than the target parameter and the secondary parameter) to be displayed.
- (4) Select this area to define the target parameter.
- (5) Select this area to define the secondary parameter.
- (6) Select this area to define the secondary parameter.

4.4.4 Setting Parameter Statistics

You can show the statistics of the target parameter for a defined period of time. To do so, follow this procedure:

1. Select  from the target parameter statistics area to enter the parameter statistics dialog.
2. Select the range of each section: from the **To** column select the parameter value at which corresponding section ends.
3. From the **Target** column select the target section. The target section is highlighted in green in the statistics area.
4. From the target parameter statistics area, select the duration to redefine the statistics duration.

The following figure shows the target parameter statistics area when SpO₂ is set as the target parameter:



- (1) Statistics duration
- (2) Statistics setup icon
- (3) Statistics results
- (4) Sections for statistics: the section in green indicates the target range.

4.5 Remote View (for N1 Supporting Wi-Fi)

The patient alarm and real time physiological data of the N1 can be viewed by other networked monitors. When the external display is connected, you can also observe alarm conditions and view real time physiological data from patients on other networked monitoring devices.

A device from a remote site is called a remote device or bed. You can simultaneously watch up to 12 remote devices. You can also view waveforms of one remote device on the external display.

You can watch the remote devices in the **Remote View** screen, or the alarm watch tiles on the main screen.

In the **Remote View** screen, you can view real time parameters and waveforms from one specific device, and watch the alarms of other monitored devices at the same time.

NOTE

- A particular monitor (for example Monitor #1) can be viewed by at most 32 remote devices at the same time, of which eight of those remote devices can watch Monitor #1's waveforms.

4.5.1 Entering the Remote View Screen

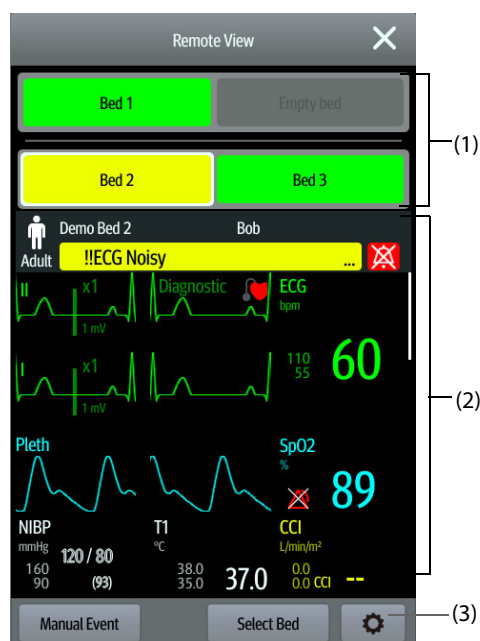
To enter the **Remote View** screen, choose one of the following ways:

- Select the **Remote View** quick key.
- Select the bed at the alarm watch tile on the main screen. For more information, see 4.5.10.2 *Displaying the Alarm Watch Tile on the Main Screen*.
- Select the **Screen Setup** quick key → select the **Choose Screen** tab → select **Remote View**.

4.5.2 About the Remote View


The **Remote View** screen displays parameter measurements and waveforms of the remote device.

The following figure shows the **Remote View** screen.



(1) Alarm watch area

Displays all the monitored remote beds. Each bed displays the room number, bed number, connection status and alarm status. The background color indicates the alarm status on the corresponding bed.

Background Color	Description
Green	No alarm is occurring at the bed.
Red	The remote device is disconnected or a high priority alarm is currently the highest alarm level on the bed. If the remote device is disconnected, the  icon is displayed.
Yellow	The medium priority alarm is currently the highest alarm level on the bed.
Cyan	The low priority alarm is currently the highest alarm level on the bed.
Grey	The bed is in the standby mode.

(2) Main area

Displays the patient's information, alarm status and messages, waveforms, measurements, etc. of the selected bed. This bed is called main bed.


(3) Remote View setup button: select it to enter the Remote View setup dialog.

WARNING

- **The data presented in the Remote View screen has a delay. Do not rely on this screen for real time data.**

4.5.3 Adding a Bed

After adding the desired remote devices, then the alarms from these devices can be viewed on the monitor. To add a remote device, follow this procedure:


1. Enter the **Select Bed** dialog. To do so, choose either of the following ways:
 - ◆ In the **Remote View** screen, select **Select Bed**. For more information, see 4.5.1 *Entering the Remote View Screen*.
 - ◆ Select the  icon at the alarm watch tile if the tile is configured to display on the main screen.
2. In the **Select Bed** dialog, select a desired department. All the beds under this department will be listed.
3. Select a desired tile at the A-W1 or A-W2 areas and then select a bed from the bed list. The selected bed will appear in the tile.

NOTE

- The added bed is indicated by a check mark (✓) at the left of the bed list.

4.5.4 Removing a Bed

To remove a remote device from remote monitoring, follow this procedure:

1. Enter the **Select Bed** dialog. Choose either of the following ways:
 - ◆ In the **Remote View** screen, select **Select Bed**. For more information, see 4.5.1 *Entering the Remote View Screen*.
 - ◆ Select the  icon in the alarm watch tile if the tile is configured to display on the main screen.
2. In the **Select Bed** dialog, select a bed at the A-W1, A-W2 or A-W3 areas, and then select **Clear Bed**. If you want remove all beds, select **Clear All Beds**.

4.5.5 Displaying the Main Bed

In the **Remote View** screen, you can select a bed in the alarm watch area, then the main body of the **Remote View** screen will display the real time monitoring screen of the device.

4.5.6 Saving a Manual Event

You can initiate a manual event on the remote monitor by selecting **Manual Event** in the **Remote View** screen.

4.5.7 Managing Alarms from Remote Devices

You can view and manage the alarms coming from remote devices.

If the monitor and remote devices have alarms at the same time, the monitor presents alarms according to the following rules:

- If the alarm tone pattern for the monitor is same as that for the remote devices, the monitor prioritizes all the alarms and sounds the highest alarm tone.
- If the alarm tone pattern for the monitor is different from that for the remote devices, the monitor sounds the alarms in their corresponding tone.


The monitor provides the same alarm tone pattern for the remote device alarms as those for the monitor alarms by default. You can change the alarm tone pattern of the remote monitor; see 21.3.6.5 *Setting the Tone Pattern for Alarms from Remote Devices*.

4.5.8 Resetting Alarms for Remote Devices

You can reset the alarms on the remote devices by selecting **Alarm Reset** in the **Remote View** screen. This function needs to be enabled. For more information, see 21.3.6.1 *Resetting Alarms for Remote Devices*.

4.5.9 Selecting Beds By Care Group

If configured, the monitor automatically selects beds in the same care group during the shift of care groups in the CMS. To enable this function, follow this procedure:

1. Enter the **Select Bed** window. Choose either of the following ways:
 - ◆ In the **Remote View** window, select **Select Bed**. For more information, see 4.5.1 *Entering the Remote View Screen* for entering the **Remote View** window.
 - ◆ Select the  icon in the alarm watch tile if the tile is configured to display on the main screen.
2. In lower left corner of the **Select Bed** window, select **Select Beds By Care Group**.

4.5.10 Alarm Watch

The alarm watch function provides the alarm notification by color and sound.

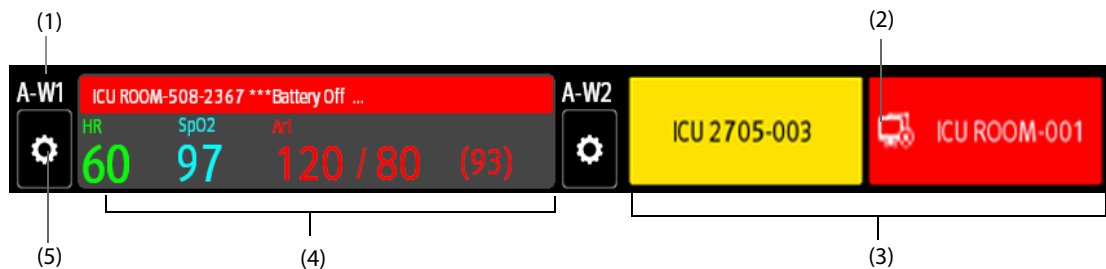
- The monitor sounds the highest priority alarm tone from all the monitored remote devices.

- The monitor displays the highest priority alarm in corresponding background color for each bed at the following areas:
 - ◆ At the top of the **Remote View**. For more information, see 4.5.2 *About the Remote View* for details.
 - ◆ On the main screen. For more information, see 4.5.10.1 *About Alarm Watch Tile* for details.

4.5.10.1 About Alarm Watch Tile

The main screen can display two alarm watch tiles, namely A-W1 and A-W2. Each tile can accommodate up to six beds.

The following figure shows the alarm watch tiles.



- (1) Alarm watch tile label
- (2) Disconnection icon: when the remote device is disconnected, this icon displays at the tile, and the tile background color is red.
- (3) Bed area (multiple beds): if more than one bed is assigned to an alarm watch tile, each bed cyclically displays the bed number, room number, and the alarm of the highest priority. The background color of each bed indicated the status of this bed.
- (4) Bed area (one bed): if only one bed is assigned to an alarm watch area, this area displays the bed number, room number, parameter value, and alarm message from this bed, etc.
- (5) Select bed icon: select it to enter the **Select Bed** dialog.

The alarm watch tile in the main screen is similar to the alarm watch area in the **Remote View**. For more information, see 4.5.2 *About the Remote View*.

4.5.10.2 Displaying the Alarm Watch Tile on the Main Screen

To configure the alarm watch tile to be displayed on the monitor's main screen, follow this procedure:


1. Select the **Main Menu** quick key → from the **Display** column select **Choose Screen** to enter the **Screen Setup** dialog.
2. Select the **Tile Layout** tab.
3. Select the numeric area where you want to display the alarm watch tile, and then in the drop-down list, select **Alarm Watch** → **A-W1** or **A-W2**.

4.5.11 Auto Displaying the Alarm Bed

The monitor provides the function of automatically displaying the remote alarm bed. If this function is enabled, when a remote bed issues an alarm, the monitor automatically displays this bed as the main bed on the **Remote View** screen.

If multiple remote beds issue alarms, the monitor cyclically displays the alarm beds as per the preset interval and in the order of alarm time.

The auto displaying alarm bed function is disabled by default. To enable this function, follow this procedure:

1. From the **Remote View** screen, select  to enter the **Remote View** setup dialog.
2. Switch on **Rollup Alarm Beds**.
3. Set **Rollup Interval**:
 - ◆ **Off**: do not cyclically display the remote alarm beds. Once a new alarm is issued, the monitor automatically switches to the new alarm bed.

- ◆ **10 sec, 20 sec, or 30 sec:** If multiple remote beds issue alarms, the monitor cyclically displays the alarm beds as per the preset interval and alarm priority in the order of alarm time.
4. Set Alarm Priority:
 - ◆ **High Only:** Only when a high priority alarm is issued, the monitor automatically switches to the alarm bed.
 - ◆ **High & Med:** If **Rollup Interval** is set to **Off** and when a high priority alarm or medium priority alarm is issued, the monitor automatically switches to the alarm bed. If **Rollup Interval** is set to **10 sec, 20 sec, or 30 sec** and multiple remote beds issue alarms, the monitor cyclically displays the alarm beds with higher priority in the order of alarm time. For example, if both high priority alarms or medium priority alarm are issued, only beds with high priority alarms are cyclically displayed.
 5. Set **Switch Bed Prompt Voice**. If this function is enabled, the monitor issues a reminder sound each time the main bed switches.

4.6 Freezing Waveforms

During patient monitoring, the freeze feature allows you to freeze the currently displayed waveforms on the screen so that you can have a close examination of the patient's status. Additionally, you can select any frozen waveform for recording.

4.6.1 Freezing Waveforms

To freeze waveforms, select the **Freeze** quick key. Except waveforms of the following screens, all displayed waveforms stop refreshing and scrolling after you select the **Freeze** quick key:

- **Minitrends** screen
- **oxyCRG** screen
- **Remote View** screen
- **EWS** screen

4.6.2 Viewing Frozen Waveforms

To view the frozen waveforms, follow this procedure:

- Select the  or  button in the **Freeze** dialog.
- Slide the frozen waveform leftward or rightward.

At the lower right corner of the bottom most waveform displays the freeze time. The initial frozen time is **0 s**. With the waveforms scrolling, the freeze time changes at an interval of 1 second. For example, **-2 s** means the two seconds before the frozen time. This change will be applied for all waveforms on the screen.

NOTE

- You can view the frozen waveforms of up to 120 seconds.

4.6.3 Unfreezing Waveforms

To unfreeze the frozen waveforms, select the  button upper right corner of the **Freeze** dialog.

4.6.4 Printing Frozen Waveforms

To print the frozen waveforms, select the  button at the upper left corner of the **Freeze** dialog.

5 Managing Patients

5.1 Starting Monitoring a Patient

After turning on the monitor, follow this procedure to monitor a patient:

1. Admit the patient.
2. Check patient settings. Make sure that alarm limits, patient category and paced status, and so on, are appropriate for the patient. Change them if necessary.
3. Perform desired measurements. For more information, see corresponding measurement chapters.

5.2 Admitting a Patient

The monitor admits a new patient in the following situations:

- After a patient is manually discharged, the monitor automatically admits a new patient.
- After being switched off for the selected time period, the monitor automatically discharges the previous patient and admits a new patient at startup.
- If the monitor has not detected certain patient vital signs (ECG, SpO₂, PR, RR, NIBP) for 30 minutes, it will prompt whether to start monitoring a new patient if any of the above vital signs are detected again.

Always input patient information as soon as the patient is admitted. For more information, see *5.2.2 Editing Patient Information* for details.

WARNING

- **The default Patient Category setting is Adult, and Paced setting is Unspecified. Set Paced and check if the Patient Category setting is correct for the patient.**
 - **For paced patients, set Paced to Yes. If it is incorrectly set to No, the monitor could mistake a pace pulse for a QRS and fail to alarm when the ECG signal is too weak.**
 - **For non-paced patients, set Paced to No.**
-

5.2.1 Entering the Patient Management Dialog

Use any of the following methods to enter the **Patient Management** dialog:

- Select the patient information area at the top left corner of the screen.
- Select the **Patient Management** quick key (only available when the N1 is used with the independent external display).
- Select the **Main Menu** quick key → from the **Patient Management** column select **Patient Management**.

5.2.2 Editing Patient Information

Edit patient information after a patient has been admitted, or when patient information is incomplete, or when it is necessary to change patient information:

To edit patient information, follow this procedure:

1. Enter the **Patient Management** dialog. For more information, see *5.2.1 Entering the Patient Management Dialog*.
2. Edit patient information as required.

If a barcode reader is connected to the monitor, scanning the patient's barcode will enter the patient's information.

NOTE

- **The monitor will reload the configuration if you change the patient category.**
-

5.2.3 Loading Patient Information from the CMS (for N1 Supporting Wi-Fi)

If the monitor is connected to the central monitoring system (CMS). You can load patient information from the CMS to the monitor. To do so, follow this procedure:

1. Enter the **Find Patient** dialog in either of the following ways:
 - ◆ Select the **Main Menu** quick key → from the **Patient Management** column select **Find Patient**.
 - ◆ From the **Patient Management** dialog select **Find Patient**.
2. Input query criteria.
3. Select **Search**. Then a list pops up, including all the patients that meet the query criteria.
4. Select a patient from the patient list, and then select **Admit**. Corresponding patient information in the monitor will be updated.

Patients that can be searched for are configurable based on location. For more information, see *21.2.2 Setting the Range of Finding Patient*.

NOTE

- **If a monitor with system software version before V01.28.00.01 is connected to the CMS with system software version V05.00.00.01 and above, you cannot search patients from the CMS.**
 - **If ADT Query is switched on, input query criteria from the Discharged Patients page.**
-

5.2.4 Loading Patient Information from the ADT Server (for N1 Supporting Wi-Fi)

If the monitor is connected with the Admit-Discharge-Transfer (ADT) server through the eGateway. You can load patient information from ADT server to the monitor.

To do so, follow this procedure:

1. Enter the **Find Patient** dialog in either of the following ways:
 - ◆ Select the **Main Menu** quick key → from the **Patient Management** column select **Find Patient**.
 - ◆ Select **Find Patient** from the **Patient Management** dialog.
2. Input query criteria.
3. Select **Search**. Then a list pops up, including all the patients that meet the query criteria.
4. Select a patient from the patient list, and then select **Admit**. Corresponding patient information in the monitor will be updated.

The patient where you can search is configurable. For more information, see *21.2.2 Setting the Range of Finding Patient*.

NOTE

- **You can load patient information from the ADT server only when ADT Query is enabled. For more information, see 21.12.10 Using the ADT Gateway.**
 - **The monitor can automatically upload the patient information from the ADT server when:**
 - ◆ The configured keywords of the monitor and the eGateway are the same.
 - ◆ The IP address of the monitor is added to the eGateway configuration dialog.
 - **Loading patient information from the ADT server updates only patient information in the monitor. The patient's monitoring data is not changed and the patient is not discharged.**
-

5.3 Transferring Patient

Patient settings and data can be transferred from an N1 into a host monitor. The patient settings and data includes patient information, trend data, alarm events, and parameter alarm limits. The N1 also allows transfer of full disclosure data.

For detailed information about patient data transfer, refer to the user manual of the host monitor. For the connection of N1 and the host monitor, refer to section 2.9 *N1 in Use with a Host Monitor*.

WARNING

- **Do not discharge a patient on the bedside monitor before patient information is completely transferred. Discharging the patient during transfer will result in incomplete patient information.**
-

NOTE

- **The system automatically switches on the HR/PR (high, low) alarms and lethal arrhythmia alarms after transferring the patient data.**
-

5.4 Exporting Patient Data

You can export the demographic information and monitoring data of the current and discharged patients via a USB drive. For more information, see 21.6.3 *Exporting Patient Data*.

5.5 Deleting Patient Data

To delete the data of discharged patients, follow this procedure:

1. Access the **Discharged Patients** dialog box by selecting the **Main Menu** quick key → from the **Patient Management** column select **Discharged Patients**.
2. From the patient list select desired patients.
3. Select **Delete**.

5.6 Stopping a Parameter Measurement

To stop monitoring a parameter, follow this procedure:

1. Remove corresponding sensor from the patient.
2. Disconnect the sensor from the patient cable.
3. Disconnect the patient cable from the parameter module.

5.7 Discharging a Patient

Before monitoring a new patient, discharge the previous patient. The technical alarms are reset, and monitor settings return to their defaults. For more information, see 20.3 *Setting Default Patient Category*.

After a patient is discharged, the monitor automatically admits a new patient.

WARNING

- **Always discharge the previous patient before starting to monitor a new patient. Failure to do so can lead to data being associated with the wrong patient.**
-

To manually discharge a patient, use any of the following methods to access the **Discharge Patient** dialog:

- Swipe down the touchscreen with two fingers.
- Select the **Discharge Patient** quick key (only available when the N1 is used with the independent external display).
- Select the patient information area at the top left corner of the screen → **Discharge Patient**.

- Select the **Patient Management** quick key → **Discharge Patient** (only available when the N1 is used with the independent external display).
- Select the **Main Menu** quick key → from the **Patient Management** column select **Discharge**.

Select a button in the **Discharge Patient** dialog:

- **Print End Case Report:** prints the end case report when the patient is discharged.
- **Discharge:** clears the waveform data of the current patient. The monitor loads the default configuration and goes to the standby mode. The current patient becomes a discharged patient.
- **Clear Patient Data:** discharges the current patient and clears the waveform data. The monitor loads the default configuration and does not go to the standby mode. The current patient becomes a discharged patient.

6 Alarms

6.1 Alarm Introduction

This chapter describes alarm functions and alarm settings.

6.2 Alarm Safety Information

WARNING

- A potential hazard can exist if different alarm presets and default configuration settings are used for the same or similar equipment in the same care area, for example an intensive care unit or cardiac operating room.
 - If the monitor is connected to the central monitoring system (CMS) or other monitors, alarms can be presented and controlled remotely. Remote suspension, inhibition, or reset of monitor alarms via the CMS or other monitors may cause a potential hazard. For more information, see the operator's manuals for the CMS and the other monitors.
 - The monitors in the care area may each have different alarm settings to suit different patients. Always check that the alarm settings are appropriate for the patient before starting the monitoring. Always make sure that necessary alarm limits are active and set according to the patient's clinical condition.
 - Setting alarm limits to extreme values may cause the alarm system to become ineffective. For example, setting the SpO₂ high alarm limit to 100%, is equivalent to switching the alarm off.
 - When the alarm sound is switched off, the monitor gives no alarm tones even if a new alarm occurs. Be careful when considering to switch off the alarm sound. When the alarms are off or while alarm audio is paused either temporarily or indefinitely, observe the patient frequently.
 - When monitoring patients that are not continuously attended by a clinical operator, properly configure the alarm system and adjust alarm settings as per the patient's condition.
 - Do not rely exclusively on the audible alarm system for monitoring. Adjustment of alarm volume to a low level may result in a hazard to the patient.
-

6.3 Alarm Categories

The monitor has two different types of alarms: physiological alarms and technical alarms.

- Physiological alarms are triggered by patient measurement exceeding the parameter limits, or by an abnormal patient conditions.
- Technical alarms are triggered by an electrical, mechanical, connectivity, or other monitor abnormal operation, 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.

Apart from the physiological and technical alarms, the monitor can also prompt with some messages describing the system status or patient status.

6.4 Alarm Priorities

By severity, the alarms are classified into the following priority levels:

- High priority alarms: indicate a life threatening situation or a severe device malfunction. High priority alarms require an immediate response.
- Medium priority alarms: indicate abnormal vital signs or a device malfunction. Medium priority alarms require a timely response.
- Low priority alarms: indicate a discomfort condition, a device malfunction, or an improper operation. Low priority alarms require you to be aware of this condition.

- Messages: provides additional information on the patient or the equipment.

6.5 Alarm Indicators

When an alarm occurs, the monitor indicates it through visual or audible alarm indications. For more information, see the following table.

Alarm Indicator		High Priority Alarm	Medium Priority Alarm	Low Priority Alarm	Message
Alarm lamp		Red Flashing frequency: 1.4 - 2.8 Hz Duty cycle: 20 - 60% on	Yellow Flashing frequency: 0.4 - 0.8 Hz Duty cycle: 20 - 60% on	Cyan No flashing Duty cycle: 100% on	None
Audible tone pattern	Special alarm sound	Repeat pattern of high-pitched single beep	None	None	None
	ISO	Repeat pattern of triple + double + triple + double beeps	Repeat pattern of triple beeps	Repeat pattern of single beep	None
	ISO2	Repeat pattern of triple + double + triple + double beeps	Repeat pattern of triple beeps	Repeat pattern of single beep	None
	ISO3	Repeat pattern of triple + double + triple + double beeps	Repeat pattern of triple beeps	Repeat pattern of double beeps	None
Alarm message		White text inside a red box	Black text inside a yellow box	Black text inside a cyan box	White text
Alarm priority indicator		!!!	!!	!	None
Parameter value		White text inside a flashing red box	Black text inside a flashing yellow box	Black text inside a flashing cyan box	None

NOTE

- When multiple alarms of different priority levels occur simultaneously, the monitor selects the highest priority alarm to light the alarm lamp and issue the alarm tone.
- When multiple alarms of the same priority levels occur simultaneously alarm messages are displayed cyclically.
-
- The frequency of the alarm tone is different with those of the heart beat tone, pulse tone, and keystroke tone so that the alarm tone can be distinguished with other tones.

6.5.1 Alarm Status Symbols

Apart from the alarm indicators as described in **6.5 Alarm Indicators**, the monitor uses the following symbols to indicate the alarm status:



Alarm pause: indicates that all the alarms are paused.



Alarm off: indicates that individual measurement alarms are turned off or the system is in the alarm off status.



Audio pause: indicates that audible alarm tones are paused.



Audio off: indicates that audible alarm tones are turned off.



Alarm reset: indicates that the alarm system is reset.

6.5.2 Special Alarm Sound

You can configure the monitor to give a special alarm sound to indicate that the patient may be in a critical condition when any of the following alarms is triggered:

- Arrhythmias, including Asystole, V-Fib/V-Tach, V-Tach, Vent Brady, Extreme Tachy, and Extreme Brady
- SpO2 Desat
- Apnea

This function is password protected. For more information, see *21.3.1.5 Enabling Special Alarm Sound*

NOTE

- The special alarm sound is available only when Alarm Sound is set to ISO2.

6.5.3 Highlighted Display of Alarm Messages

When any of the following alarms is triggered, alarm messages are highlighted to indicate that the patient may be in a critical condition.

- Arrhythmia alarms, including Asystole, V-Fib/V-Tach, V-Tach, Vent Brady, Extreme Tachy, and Extreme Brady.
- SpO2 Desat
- Apnea

When an alarm is highlighted, the alarm message covers both the physiological alarm area and the technical alarm area with enlarged word size. Messages of technical alarms and other physiological alarms are displayed at the left of the highlighted alarm.

6.6 Alarm Limits

When a parameter measurement exceeds the alarm limit, the monitor generates an alarm according to the alarm priority setting.

6.6.1 Guard Limit

The monitor provide guard limits for HR, Sp₂, RR, NIBP, IBP, Temp, CO₂, and some arrhythmia thresholds to prevent alarm limits from being set too high or too low. Setting guard limits is password protected.

For more information on setting guard limits, see *21.3.4 Setting Guard Limits*.

6.6.2 Auto Alarm Limits

The monitor can automatically calculate alarm limits based on the latest measured values. Before applying automatically created alarm limits, confirm if they are appropriate for the patient. If not, you can adjust them manually. These alarm limits remain unchanged until you select auto limits again or adjust them manually.

The monitor calculates auto limits based on the following rules:

Module	Parameter	Patient Category	Lower Limit	Upper Limit	Auto Limit Range
ECG	HR/PR (bpm)	Adult	HR × 0.8, or 40, or guard limit (whichever is greater, no greater than 70)	HR × 1.25 or 240, or guard limit (whichever is smaller, no less than 100)	35 to 240
		Pediatric	HR × 0.8 or 40, or guard limit (whichever is greater, no greater than 80)	HR × 1.25 or 240, or guard limit (whichever is smaller, no less than 120)	35 to 240
		Neonate	(HR - 30) or 90 (whichever is greater, no greater than 100)	(HR + 40) or 200 (whichever is smaller, no less than 160)	55 to 225

Module	Parameter	Patient Category	Lower Limit	Upper Limit	Auto Limit Range
Resp	RR (rpm)	Adult/ Pediatric	$RR \times 0.5$ or 6 (whichever is greater, no greater than 12)	$(RR \times 1.5)$ or 30, or guard limit (whichever is smaller, no less than 20)	6 to 55
		Neonate	$(RR - 10)$ or 30 (whichever is greater, no greater than 40)	$(RR + 25)$ or 85 or guard limit (whichever is smaller, no less than 70)	10 to 90
SpO ₂	SpO ₂ (%)	All	Same as default alarm limit	Same as default alarm limit	Same as measurement range
NIBP	NIBP-S (mmHg)	Adult	$(SYS \times 0.68 + 10)$ or guard limit (whichever is greater, no greater than 110)	$(SYS \times 0.86 + 38)$, or guard limit (whichever is smaller, no less than 140)	45 to 270
		Pediatric	$(SYS \times 0.68 + 10)$ or guard limit (whichever is greater, no greater than 90)	$(SYS \times 0.86 + 38)$, or guard limit (whichever is smaller, no less than 100)	45 to 185
		Neonate	$(SYS - 15)$ or 45 (whichever is greater, no greater than 60)	$(SYS + 15)$ or 105 (whichever is smaller, no less than 80)	35 to 115
	NIBP-M (mmHg)	Adult	$(Mean \times 0.68 + 8)$ or guard limit (whichever is greater, no greater than 80)	$(Mean \times 0.86 + 35)$, or guard limit (whichever is smaller, no less than 100)	Adult: 30 to 245
		Pediatric	$(Mean \times 0.68 + 8)$ or guard limit (whichever is greater, no greater than 60)	$(Mean \times 0.86 + 35)$, or guard limit (whichever is smaller, no less than 80)	30 to 180
		Neonate	$(Mean - 15)$ or 35 (whichever is greater, no greater than 40)	$(Mean + 15)$ or 95 (whichever is smaller, no less than 60)	25 to 105
	NIBP-D (mmHg)	Adult	$(Dia \times 0.68 + 6)$ or guard limit (whichever is greater, no greater than 60)	$(Dia \times 0.86 + 32)$, or guard limit (whichever is smaller, no less than 80)	Adult: 25 to 225
		Pediatric	$(Dia \times 0.68 + 6)$ or guard limit (whichever is greater, no greater than 50)	$(Dia \times 0.86 + 32)$, or guard limit (whichever is smaller, no less than 60)	25 to 150
		Neonate	$(Dia - 15)$ or 20 (whichever is greater, no greater than 30)	$(Dia + 15)$ or 80 (whichever is smaller, no less than 50)	20 to 90
Temp	Txx (°C)	All	Txx - 0.5	Txx + 0.5	1 to 49
	xx refers to temperature site				
	ΔT (°C)	All	Same as the default alarm limit	Same as the default alarm limit	Same as measurement range

Module	Parameter	Patient Category	Lower Limit	Upper Limit	Auto Limit Range
IBP	IBP-S (mmHg)	Adult	$SYS \times 0.68 + 10$ or guard limit (whichever is greater, no greater than 110)	$SYS \times 0.86 + 38$ or guard limit (whichever is smaller, no less than 140)	45 to 270
		Pediatric	$SYS \times 0.68 + 10$ or guard limit (whichever is greater, no greater than 90)	$SYS \times 0.86 + 38$ or guard limit (whichever is smaller, no less than 100)	45 to 185
		Neonate	$(SYS - 15)$ or 45 (whichever is greater, no greater than 60)	$(SYS + 15)$ or 105 (whichever is smaller, no less than 80)	35 to 115
	IBP-M (mmHg)	Adult	$Mean \times 0.68 + 8$ or guard limit (whichever is greater, no greater than 80)	$Mean \times 0.86 + 35$ or guard limit (whichever is smaller, no less than 100)	30 to 245
		Pediatric	$Mean \times 0.68 + 8$ or guard limit (whichever is greater, no greater than 60)	$Mean \times 0.86 + 35$ or guard limit (whichever is smaller, no less than 80)	30 to 180
		Neonate	$(Mean - 15)$ or 35 (whichever is greater, no greater than 40)	$(Mean + 15)$ or 95 (whichever is smaller, no less than 60)	25 to 105
	IBP-D (mmHg)	Adult	$(Dia \times 0.68 + 6)$ or guard limit (whichever is greater, no greater than 60)	$(Dia \times 0.86 + 32)$ or guard limit (whichever is smaller, no less than 80)	25 to 225
		Pediatric	$(Dia \times 0.68 + 6)$ or guard limit (whichever is greater, no greater than 50)	$(Dia \times 0.86 + 32)$ or guard limit (whichever is smaller, no less than 60)	25 to 150
		Neonate	$(Dia - 15)$ or 20 (whichever is greater, no greater than 30)	$(Dia + 15)$ or 80 (whichever is smaller, no less than 50)	20 to 90
	IBP refers to arterial pressure only, including Art, Ao, UAP, BAP, FAP, LV, P1, P2, P3, P4.				
IBP	PA-S (mmHg)	All	$SYS \times 0.75$, no less than guard limit and no greater than 15	$SYS \times 1.25$, no greater than guard limit and no less than 25	3 to 120
	PA-M (mmHg)	All	$Mean \times 0.75$, no less than guard limit and no greater than 5	$Mean \times 1.25$, no greater than guard limit and no less than 10	3 to 120
	PA-D (mmHg)	All	$Dia \times 0.75$, no less than guard limit and no greater than 5	$Dia \times 1.25$, no greater than guard limit and no less than 6	3 to 120
	IBP-M	All	$Mean \times 0.75$, no less than guard limit and no greater than 5	$Mean \times 1.25$, no greater than guard limit and no less than 10	3 to 40
	IBP refers to venous pressure only, including CVP, LAP, RAP, UVP, P1, P2, P3, P4				
	CPP-M (mmHg)	Adult	$CPP \times 0.68 + 8$, no less than 60	$CPP \times 0.86 + 35$, no greater than 90	20 to 235
		Pediatric	$CPP \times 0.68 + 8$, no less than 50	$CPP \times 0.86 + 35$, no greater than 70	25 to 175
		Neonate	$(CPP - 15)$ or 35, (whichever is greater, no less than 40)	$(CPP + 15)$ or 95, (whichever is smaller, no greater than 70)	25 to 100
CO ₂	EtCO ₂ (mmHg)	All	0 to 32: remains the same	0 to 32: remains the same	Same as measurement range
			33 to 35: 29 36 to 45: (EtCO ₂ - 6) 46 to 48: 39 >48: remains the same	33 to 35: 41 36 to 45: (EtCO ₂ + 6) 46 to 48: 51 >48: remains the same	
	FiCO ₂	All	None	Same as default alarm limit	Same as measurement range
	awRR (rpm)	Adult/ Pediatric	$awRR \times 0.5$ or 6 (whichever is greater)	$awRR \times 1.5$ or 30 (whichever is smaller)	6 to 55
		Neonate	$(awRR - 10)$ or 30 (whichever is greater)	$(awRR + 25)$ or 85 rpm (whichever is smaller)	10 to 90

6.6.3 Initiating Auto Alarm Limits

The monitor provides the auto alarm limits function to automatically adjust alarm limits according to the patient's vital signs. When auto limits are selected, the monitor calculates safe auto limits based on the latest measured values. To get accurate auto alarm limits, collect a set of measured vital signs as a baseline.

To initiate auto alarm limits, follow this procedure:

1. Select the **Main Menu** quick key → from the **Alarm** column select **Limits**.
2. From the **Limits** page, select **Auto Limits** at the left bottom.
3. Select **Ok** from the popup dialog box.

6.7 Combined alarms

The combined alarm is produced when a configured set of physiological alarms occur, patient values change significantly over a short time, or a set threshold remains exceeded for an extended period of time. Combined alarms may provide early indication of patient deterioration, leading to improved response times, earlier clinical intervention, and improved patient outcomes. The monitor provides a set of predefined combined alarms as well as custom combined alarms for department and patient needs.

The following operations related to combined alarms are password protected:

- Selecting combined alarms that can be displayed and modified from the Combined Alarm setup of the *Alarm* menu.
- Changing the default name of a combined alarm.
- Changing the notification type of a combined alarm.
- Changing the default delay time of a combined alarm.
- Adding and deleting custom combined alarms.
- Setting the refractory period for combined alarms.

For more information on setting the combined alarms, see 21.3.5 *Setting Combined Alarms*.

•

NOTE

- **The predefined combined alarms are intended for adult patients only.**
 - **If the N1 is connected to the CMS via WMTS, when an combined alarm is triggered, the alarm message displayed on the CMS is "XX Combined Physiological Alarm", where "XX" refers to the alarm priority of the corresponding combined alarm.**
-

6.7.1 Configuring Combined Alarms

The monitor provides combined alarms of multiple parameter measurements and trends.

To set the properties of combined alarms, follow this procedure:

1. Select the **Main Menu** quick key → from the **Alarm** column select **Setup** → **Combined Alarm** tab.
2. Set alarm properties as desired.

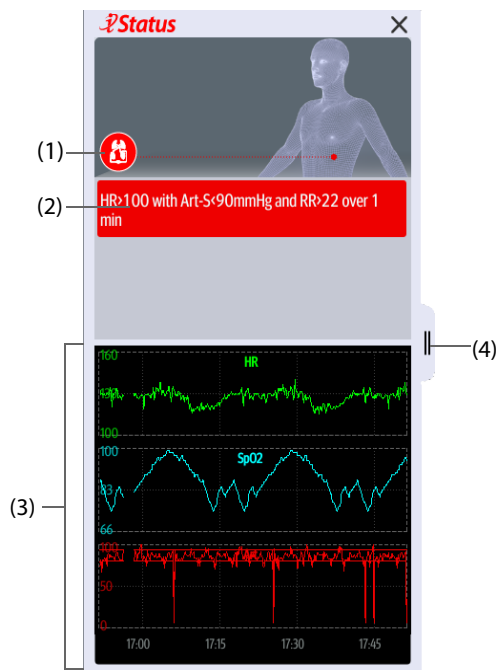
From the Combined Alarm setup of the *Alarm* menu, you can change the settings of parameter threshold, alarm switch, alarm priority, and alarm output switch.

6.7.2 iStatus Window (only available for the independent external display)

The *iStatus* window (*iStatus*) displays the current physiological alarms, alarmed systems or organs, and parameter trends over the last one hour.

If a combined alarm is configured to notify by popup, the *iStatus* window pops up when this combined alarm is triggered. For more information on alarm notification, see Notification from 21.3.10.4 *Setting the Notify Alarm Setting Change Switch*.

The following figure is an example of the *iStatus* window.



- (1) Currently alarmed systems or organs
- (2) Active alarms
- (3) Parameter trends of one hour
- (4) Select here or swipe to the right in the *iStatus* window with one finger to review longer parameter trends, additional parameters, and alarm statistics information. Swiping left on the longer trend window with one finger closes the extended trend window.

To close the *iStatus* window, select the close symbol **X** or swipe left with a single finger. If a combined alarm is active but the *iStatus* window is closed, the **i** button or the **!** button flashes at the left side in a color corresponding with the alarm priority. To open the *iStatus* window, select the **i** button or the **!** button.

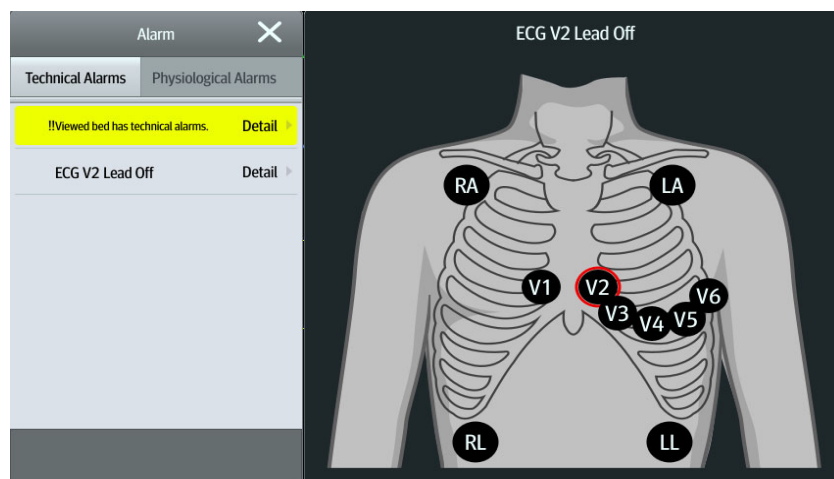
6.8 Accessing On-screen Help for Technical Alarms (AlarmSight)

In the technical alarm list, alarm messages followed by **Detail** include help messages or pictures to help you identify the problem. This function is called AlarmSight. To access AlarmSight, follow this procedure:

1. Select an alarm displaying in the technical alarm information area to enter the **Alarms** dialog.
2. From the alarm list select the desired alarm.

NOTE

- If there are no displayed alarms, then selecting the technical alarm area will not open any dialogs.



6.9 Checking the Physiological Alarms List

If the patient monitor has more than one physiological alarm, you can see the physiological alarm list by selecting the physiological alarm information area to enter the **Alarms** dialog. If there is only one physiological alarm, selecting the physiological alarm information area enters the **Review** dialog for the event created by this alarm.

6.10 Changing Alarm Settings

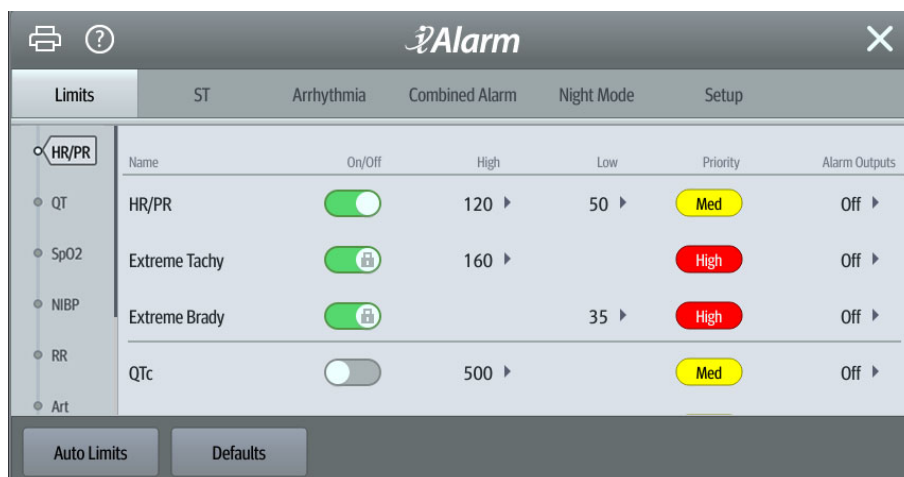
Alarms settings can be changed by selecting the **Main Menu** quick key and choosing from the list in the Alarm column.

6.10.1 Setting Parameter Alarm Properties

To set parameter alarm properties, follow this procedure:

1. Select the **Main Menu** quick key → from the **Alarm** column select **Limits**.
2. Enter the password if required.
3. Select a parameter tab and set alarm properties as desired.

You can also change the alarm properties of individual parameter from the corresponding parameter dialog.



NOTE

- The monitor can be configured to require an password or login to change alarm settings. For more information, refer to 21.13.3 *Selecting Password for User Authentication*.

6.10.2 Changing the Alarm Volume

To change the alarm volume, follow this procedure:

1. Select the **Main Menu** quick key → from the **Alarm** column select **Setup**.
2. Set **Alarm Volume**. The alarm volume can be set from X to 10, in which X is the minimum volume allowed by your department, and 10 is the maximum volume.
3. Select **High Alarm Volume** to set the volume of the high priority alarm.
4. Select **Reminder Volume** to set the volume of the reminder tone.

NOTE

- When the alarm volume is set to 0, the alarm sound is turned off and the audio off symbol appears on the screen.
- You cannot set the volume of high priority alarms if Alarm Volume is set to 0.
- You can set the Alarm Volume to 0 only when your monitor is connected to the CMS. If your monitor is not connected to the CMS, the lowest setting of Alarm Volume is 1.

- **When the monitor is connected to the CMS and Alarm Volume is set to 0, Alarm Volume automatically changes to 2 if the CMS is disconnected.**
-

6.10.3 Setting the Apnea Delay Time

To set the apnea delay time, follow this procedure:

1. Select the **Main Menu** quick key → from the **Alarm** column select **Setup**.
2. Select **Apnea Delay** to set the apnea delay time.

6.10.4 Switching On or Off V-Tach Latching

When **V-Tach Latching Lock** is switched on, you can switch on or off **V-Tach Latching**. To do so, follow this procedure:

1. Select the **Main Menu** quick key → from the **Alarm** column select **Setup**.
2. Switching on or off **V-Tach Latching**.

For information on the V-Tach Latching function, see *21.3.3 Latching Physiological Alarms*.

6.10.5 Restoring the Default Alarm Limits Settings

To reset all alarm limits settings to the defaults, follow this procedure:

1. Select the **Main Menu** quick key → from the **Alarm** column select **Limits**.
2. On the **Limits** page, select **Defaults** at the bottom.

6.10.6 Setting the Length of Printed Waveforms

You can define the length of printed waveforms when an alarm is triggered. To do so, follow this procedure:

1. Select the **Main Menu** quick key → from the **Alarm** column select **Setup**.
2. Set **Printing Duration On Alarm**.

6.11 Pausing Alarms/Pausing Alarm Tones

You can either pause alarms or pause alarm tones. This depends on the pause setting. To set the pause function, refer to *21.3.2.1 Defining the Pause Function*.

6.11.1 Pausing Alarms

If the Pause function is configured to alarm pause, pressing the **Alarm Pause** quick key can temporarily disable alarm indicators. For the configuration of the pause function, see *21.3.2.1 Defining the Pause Function*. When alarms are paused, the following rules are followed:

- No physiological alarm will be presented.
- Except battery-related technical alarms, sounds of other technical alarms are paused, but alarm lamps and alarm messages continue to be presented.
- The remaining alarm pause time is displayed in the physiological alarm information area.
- The alarm pause symbol is displayed in the system information area.

When the alarm pause time expires, the alarm paused state is automatically deactivated. You can also cancel the alarm paused state by pressing the **Alarm Pause** quick key again.

6.11.1.1 Prolonging the Alarm Pause Time

If enabled, you can temporarily prolong the alarm pause time after the monitor enters the alarm paused state. This capability is disabled by default. To prolong the alarm pause time, follow this procedure:

1. In the physiological alarm information area, select the alarm pause countdown.

2. Select **Pause 5 min**, **Pause 10 min**, or **Pause 15 min**.

NOTE

- **Prolonging alarm pause time does not affect the setting of alarm pause time.**

6.11.1.2 Switching Off All Alarms

If **Pause Time** is set to **Permanent** (see section 21.3.2.2 *Setting the Alarm Pause Time/Alarm Tone Pause Time*), pressing the **Alarm Pause** quick key permanently switches off all alarms. The alarm off state has the following features:

- Physiological alarms are switched off. The alarm lamp does not flash and alarm sound is not issued.
- Alarm sound of technical alarms is switched off, but alarm lamp flashes and alarm messages are presented.
- The message **Alarm Off** with red background is displayed in the physiological alarm information area.
- The alarm off symbol is displayed in the system status information area.

To exit the alarm off state, press the **Alarm Pause** quick key again.

WARNING

- **Pausing or switching off alarms may result in a hazard to the patient.**

6.11.2 Pausing Alarm Sound

If the Pause function is configured to Audio Pause, pressing the **Audio Pause** quick key pauses alarm tone and sets the quick key to be highlighted. For the configuration of the pause function, see section 21.3.2.1 *Defining the Pause Function*. When alarm tones are paused, the following rules are followed:

- The sound of all physiological alarms and technical alarms are switched off.
- The remaining audio pause time is displayed in the physiological alarm information area.
- The audio pause symbol is displayed in the system information area.

When the audio pause time expires, the audio pause state is automatically deactivated. You can also cancel the audio paused state by pressing the highlighted **Audio Pause** quick key again.

6.11.2.1 Prolonging the Alarm Tone Pause Time

If enabled, you can temporarily prolong the alarm tone pause time after the monitor enters the alarm tone paused state. This capability is disabled by default. To prolong the audio pause time, follow this procedure:

1. In the physiological alarm information area, select the alarm pause countdown.
2. Select the alarm tone pause time. Options may include **Pause 5 min**, **Pause 10 min**, or **Pause 15 min**.

NOTE

- **Prolonging alarm pause time does not affect the setting of alarm tone pause time.**

6.11.2.2 Switching Off Alarm Sound

If **Pause Time** is set to **Permanent** (see section 21.3.2.2 *Setting the Alarm Pause Time/Alarm Tone Pause Time*), pressing the **Audio Pause** quick key permanently switches off all alarm sound. The audio off state has the following features:

- Alarm sound of both physiological alarms and technical alarms is switched off.
- The audio off symbol is displayed in the system information area.

To exit the audio off state, press the **Audio Pause** quick key again.

WARNING

- **Pausing or switching off alarm sound may result in a hazard to the patient.**
-

6.12 Resetting Alarms


Press the **Alarm Reset** quick key to reset the alarm system. When the alarm system is reset, the alarm reset symbol displays in the system status information area for alarm symbols.

NOTE

- **If a new alarm is triggered after the alarm system is reset, the alarm reset icon will disappear and the alarm light and alarm tone will be reactivated.**
-


6.12.1 Resetting Physiological Alarms

For physiological alarms, when the alarm system is reset, the following occur:

- The alarm sound is silenced.
- A check mark  appears before the alarm message.
- The color of the parameter numeric background corresponds with the alarm priority, but the parameter numeric does not flash.

6.12.2 Resetting Technical Alarms

For technical alarms, when the alarm system is reset, the following occur:

- Some technical alarms are cleared. The monitor gives no alarm indications.
- Some technical alarms are changed to prompt messages.
- For some technical alarms, the alarm is silenced and a check mark  appears before the alarm message.

For details about the indications of technical alarms when the alarm system is reset, see *D.2 Technical Alarm Messages*.

6.13 Latching Alarms

The latching setting for physiological alarms defines how alarm indicators behave if you do not reset the alarms.

- If you do not “latch” physiological alarms, their alarm indications disappear when the alarm condition ends.
- If you “latch” physiological alarms, all visual and audible alarm indications remain (if configured) until the alarms are reset. For latched alarms the time when the alarm is last triggered is displayed behind the alarm message.

The monitor can be set to separately latch visual indications or simultaneously latch the visual and the audible indications.

- When visual indications are latched, visual indications, including alarm lamp, alarm message and its background remain when the alarm condition ends and the time when the alarm last triggered is displayed behind the alarm message.
- When audible indications are latched, the monitor continues to issues alarm sounds when the alarm condition ends.

To set how you want to latch the physiological alarms, see section *21.3.3 Latching Physiological Alarms*.

NOTE

- **Changing alarm priority may affect the latching status of the corresponding alarm. Determine if you need to adjust the latching status for the specific alarm when you have changed its alarm priority.**
 - **When the alarm system is reset, latched physiological alarms are cleared.**
-

6.14 CPB Mode

The CPB (Cardiopulmonary Bypass) mode is activated only if you set the department to **OR**.

In the CPB mode, all the physiological alarms and technical alarms are switched off. So when performing CPB, you can put the monitor in the CPB mode to inactivate unnecessary alarms.

6.14.1 Entering the CPB Mode

To enter the CPB mode, select the **Main Menu** quick key → from the **Alarm** column select **CPB Mode**.

In the CPB mode, **CPB Mode** is displayed in the physiological alarm area with a red background color.

NOTE

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- **When the CPB mode is entered, the monitor stops all NIBP measurements. You can restart NIBP measurements after entering the CPB mode.**
-

6.14.2 Exiting the CPB Mode

To exit the CPB mode, select the **Main Menu** quick key → from the **Alarm** column select **Exit CPB Mode**.

6.15 Intubation Mode

Intubation mode is available for Resp and CO₂ monitoring. When performing intubation during general anesthesia, you can put the monitor in the intubation mode in order to inactivate unnecessary alarms.

In the intubation mode, Resp and CO₂ related physiological alarms are switched off.

6.15.1 Entering the Intubation Mode

To enter the intubation mode, choose either of the following ways:

- From the bottom of the **Resp** or **CO2** dialog, select **Intubation Mode**.
- Select the **Main Menu** quick key → from the **Alarm** column select **Intubation Mode**.

6.15.2 Exiting the Intubation Mode

To exit the intubation mode, choose either of the following ways:

- From the bottom of the **Resp** or **CO2** dialog, select **Exit Intubation Mode**.
- Select the **Main Menu** quick key from the **Alarm** column → select **Exit Intubation Mode**.

6.16 Testing Alarms

The monitor automatically performs a selftest at startup. Check that an alarm tone is heard, the alarm lamp illuminates, one after the other, in red, yellow, and cyan. This indicates that the visible and audible alarm indicators function correctly.

To further test individual measurement alarms, perform measurements on yourself or using a simulator. Adjust alarm limits and check that appropriate alarm behavior is observed.

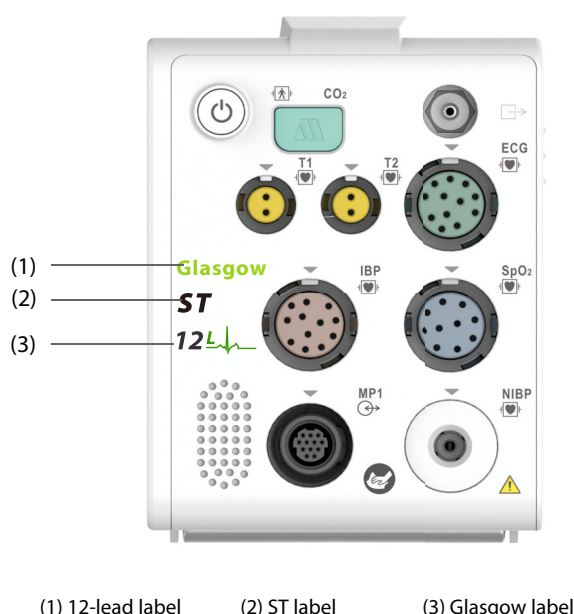
7 Monitoring ECG, Arrhythmia, ST and QT

7.1 ECG Introduction

The electrocardiogram (ECG) measures the electrical activity of the heart and displays it on the monitor as waveforms and numerics. ECG monitoring provides 3-, 5-, 6-, and 12-lead ECG monitoring, ST-segment analysis, arrhythmia analysis, QT/QTc measurements, and optional 12-lead resting analysis via the Glasgow algorithm.

The N1 monitor incorporating ST analysis has the ST label.

The N1 monitor incorporating 12-lead has the 12-lead label.



7.2 ECG Safety Information

WARNING

- This equipment is not intended for direct cardiac application.
- Ensure that the conductive parts of ECG electrodes and associated connectors, including the neutral electrode, do not come into contact with any other conductive parts including earth.
- Always use defibrillation-proof ECG cables during defibrillation.
- Do not touch the patient, or metal devices connected to the patient, during defibrillation.
- To minimize the hazard of burns during high-frequency surgical procedures, ensure that the monitor's cables and transducers never come into contact with the electrosurgery unit (ESU).
- To minimize the hazard of burns during use of high-frequency surgical unit (ESU), the ECG electrodes should not be located between the surgical site and the ESU return electrode.

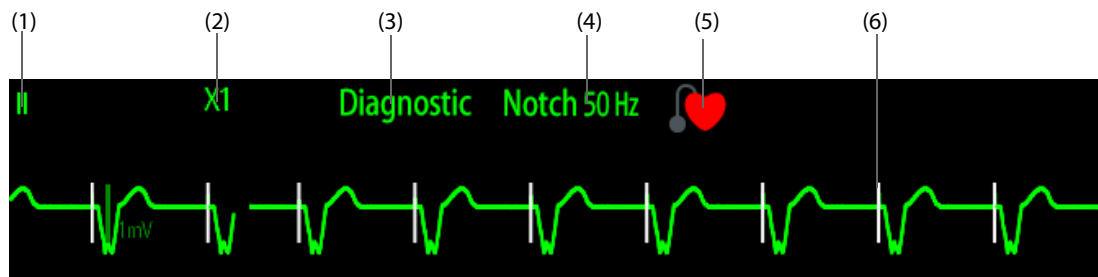
CAUTION

- Only use parts and accessories specified in this manual. Follow the instructions for use and adhere to all warnings and cautions.
- Periodically inspect the electrode application sites to ensure skin integrity. If the skin quality changes, replace the electrodes or change the application site.

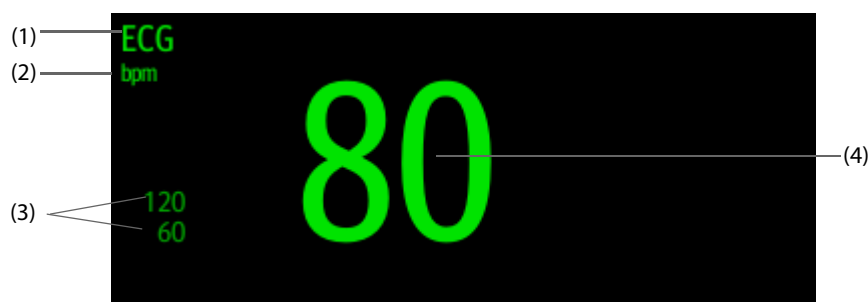
- Interference from an ungrounded instrument near the patient or electrosurgery usage can induce noise and artifact into the waveforms.

7.3 ECG Display

The following figures show the ECG waveform and numeric areas. The display may be configured to look slightly different.



- (1) ECG lead label of the displayed waveform
- (2) ECG waveform gain
- (3) ECG filter mode
- (4) Notch filter status
- (5) Paced status: If **Paced** is set to **Yes**, is displayed. If **Paced** is set to **No**, is displayed.
- (6) Pace pulse marker: If **Paced** is set to **Yes**, pace pulse markers "I" are displayed corresponding to detected pacer for each beat.



- (1) Parameter label
- (2) HR measurement unit
- (3) HR alarm limits
- (4) HR value

7.4 Preparing for ECG Monitoring

7.4.1 Preparing the Patient Skin

Proper skin preparation is necessary to ensure good signal quality at the electrode sites, as the skin is a poor conductor of electricity. To properly prepare the skin, choose flat areas and then follow this procedure:

1. Clip or shave hair from skin at chosen electrode sites.
2. Gently rub skin surface at sites to remove dead skin cells.
3. Thoroughly cleanse the site with a mild soap and water solution. We do not recommend using ether or pure alcohol, because this dries the skin and increases the resistance.
4. Dry the skin completely before applying electrodes.

7.4.2 Applying Electrodes and Connecting the Patient

To connect ECG cables, follow this procedure:

1. Check that electrode packages are intact and the electrodes are not past the expiry date. Ensure the electrode gel is moist. If you are using snap electrodes, attach the snaps to the electrodes before placing electrodes on the patient.

2. Place the electrodes on the prepared sites. Ensure that all electrodes have good skin contact.
3. Connect the leadwires to the patient cable if not already connected.
4. Plug the patient cable into the ECG connector.

CAUTION

- **Never mix patient electrode types or brands. This may lead to impedance mismatches issues.**
-

NOTE

- **When applying the electrodes, avoid bony area, obvious layers of fat, and major muscles. Muscle movement can result in electrical interference. Applying electrodes on major muscles, for example on muscles of the thorax, may lead to erroneous arrhythmia alarms due to excessive muscle movement.**
-

7.4.3 Lead Wire Color Code

The following table lists the color coding of leadwires for AHA standards:

Lead	Label	Color
Right arm	RA	White
Left arm	LA	Black
Right leg (neutral)	RL	Green
Left leg	LL	Red
Chest 1	V1	Brown/Red
Chest 2	V2	Brown/Yellow
Chest 3	V3	Brown/Green
Chest 4	V4	Brown/Blue
Chest 5	V5	Brown/Orange
Chest 6	V6	Brown/Violet

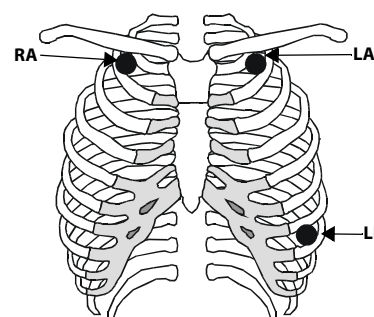
7.4.4 ECG Electrode Placements

In this section, electrode placement is illustrated using the AHA naming convention.

7.4.4.1 3-leadwire Electrode Placement

The following is the electrode configuration when a 3-leadwire cable is used:

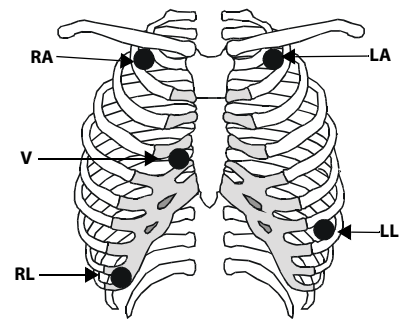
- RA placement: directly below the clavicle and near the right shoulder.
- LA placement: directly below the clavicle and near the left shoulder.
- LL placement: on the left lower abdomen.



7.4.4.2 5-leadwire and 6-leadwire Electrode Placement

The following is the electrode configuration for a 5-leadwires cables:

- RA placement: directly below the clavicle and near the right shoulder.
- LA placement: directly below the clavicle and near the left shoulder.
- RL placement: on the right lower abdomen.
- LL placement: on the left lower abdomen.
- V placement: on the chest in any of the V1 to V6 positions.

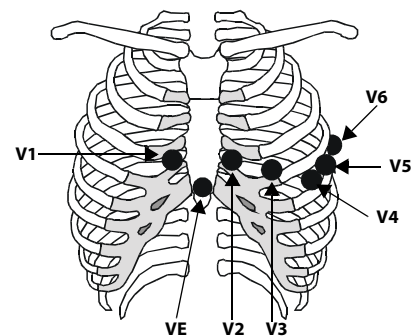


For 6-leadwire placement, you can use the position for the 5 - leadwire placement but with two chest leads. The two chest leads (Va and Vb) can be positioned at any two of the V1 to V6 positions. For more information, see 7.4.4.3 *Chest Electrode Placement*. The Va and Vb lead positions are configurable. For more information, see 7.5.4.3 *Changing Va and Vb Labels*.

7.4.4.3 Chest Electrode Placement

The chest electrode can be placed at the following positions:

- V1 placement: on the fourth intercostal space to the right of the sternum.
- V2 placement: on the fourth intercostal space to the left of the sternum.
- V3 placement: midway between the V2 and V4 electrode positions.
- V4 placement: on the fifth intercostal space at the left midclavicular line.
- V5 placement: on the left anterior axillary line, horizontal with the V4 electrode position.
- V6 placement: on the left midaxillary line, horizontal with the V4 electrode position.
- V3R-V6R placement: on the right side of the chest in positions corresponding to those on the left.

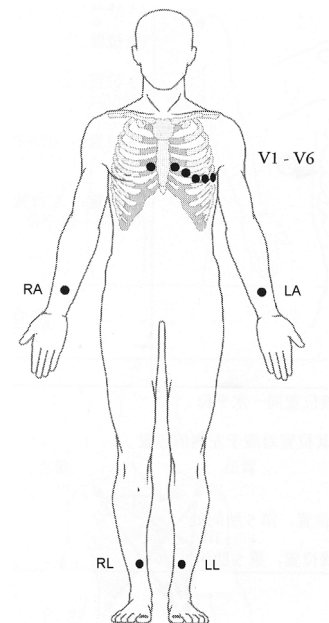


NOTE

- For the 5-leadwire and 6-leadwire placement, place the precordial electrode according to the physician's preference.

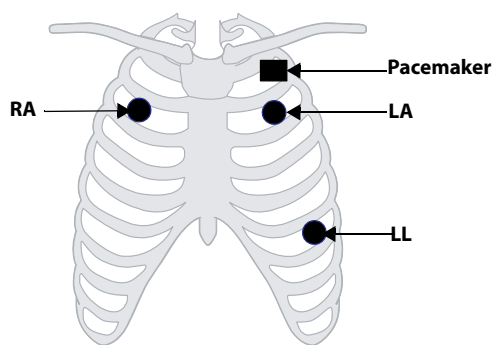
7.4.4.4 10-leadwire Electrode Placement

12-lead ECG uses 10 electrodes, which are placed on the patient's four limbs and chest. The limb electrodes should be placed on the limb extremities and the chest electrodes placed according to the physician's preference. The figure at right illustrates the conventional 10-leadwire electrode placement.

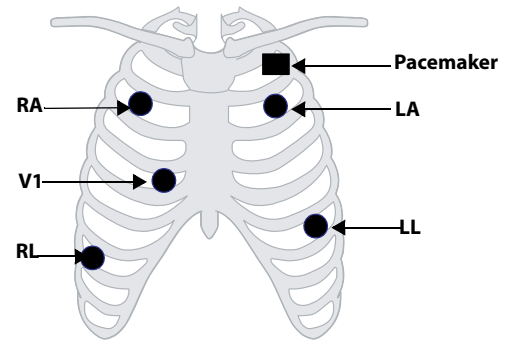


7.4.4.5 Lead Placement for Pacemaker Patients

The recommended lead placement for monitoring a pacemaker patient is as follows.



3-leadwire Electrode Placement



5-leadwire Electrode Placement

A pacemaker patient usually requires a different electrode patch placement configuration than a non-pacemaker patient.

Do not place an ECG electrode directly over the pacemaker generator. Place the electrode patches 2 to 3 inches away from the pacemaker generator area. For example, if the pacemaker generator is located in the left subclavian area, relocate the Left Arm electrode closer in towards the center of the chest.

7.4.4.6 Lead Placement for Surgical Patients

The surgical site should be taken into consideration when placing electrodes on a surgical patient. For example, for open-chest surgery, the chest electrodes can be placed on the lateral chest or back. To reduce artifacts and interference from electrosurgical units, you can place the limb electrodes close to the shoulders and lower abdomen and the chest electrodes on the left side of the mid-chest. Do not place the electrodes on the upper arm. Otherwise, the ECG waveform will be very small.

WARNING

- To reduce the hazard of burns during use of electrosurgical units (ESU), the ECG electrodes should not be located between the surgical site and the ESU return electrode.
- Never entangle the ESU cable and the ECG cable together.

- When using ESU, never place ECG electrodes near the grounding plate of the ESU, as this can cause a lot of interference on the ECG signal.
- When using ESU, ensure proper contact of the ESU return electrode to the patient to avoid burns at monitor measurement sites. Also ensure that the ESU return electrode is near the operating area.

7.4.5 Choosing the ECG Lead Type



To choose ECG lead type, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **Setup** tab.
3. Set **Lead Set** according to the lead type you are going to use. The default lead type is **Auto**. In this case, the monitor automatically detects the lead type.

NOTE

- If the N1 is connected to the CMS via WMTS, waveforms of V3, V4, V5, and V6 (if configured) will not be displayed at the CMS.


7.4.6 Checking Paced Status

It is important to correctly set the patient's paced status before you start monitoring ECG. The paced symbol  is displayed when **Paced** is set to **Yes**. Pace pulse markers "I" are displayed on each ECG waveform whenever a pacer signal is detected. If **Paced** is set to **No** or unspecified, the symbol  will be shown in the ECG waveform area.

To change the paced status, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **Pacer** tab.
3. Set **Paced** to **Yes** or **No**.

You can also change the patient's paced status from the **Patient Management** dialog. For more information, see *5.2.1 Entering the Patient Management Dialog*.

If you did not set the paced status, the monitor issues a prompt tone when pace pulse is detected. At the same time, the paced symbol  flashes and the message **Please check if the patient has a pacemaker?** appears in the ECG waveform area. Check and set the patient's paced status.

WARNING

- For paced patients, you must set **Paced** to **Yes**. If it is incorrectly set to **No**, the monitor could mistake a pace pulse for a QRS complex and fail to alarm when the ECG signal is too weak. On ventricular paced patients, episodes of ventricular tachycardia may not always be detected. Do not rely entirely upon the system's automated arrhythmia detection algorithm.
- False low heart rate or false asystole alarms may result with certain pacemakers because of pacemaker artifacts, such as electrical overshoot of the pacemaker overlapping the true QRS complexes.
- Do not rely entirely on rate meter alarms when monitoring patients with pacemakers. Always keep these patients under close surveillance.
- The auto pacer recognition function is not applicable to pediatric patients and neonatal patients.

7.4.7 Enabling Pacer Rejection

To eliminate the pacing pulse from the ECG waveform of paced patients, it is recommended to enable the pace pulse rejection function. The pace pulse rejection function is disabled by default. To enable this function, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **Pacer** tab.

3. Switch on **Pacer Reject**.

NOTE

- When pace pulses are detected, the pace pulse markers “|” are shown on the ECG waveforms. Pacer Rejection setting has no impact on the display of pace pulse markers “|”.
- You can switch on pacer rejection only when Paced is set to Yes. If Paced is set to no, the Pacer Reject function is disabled.

7.5 Changing ECG Settings

7.5.1 Choosing an ECG Screen

When monitoring ECG, several display options are available.

- For 3-lead ECG monitoring, only normal screen is available.
- For 5-lead ECG monitoring, besides the normal screen, you can also choose Full-screen (7-lead).
- For 6-lead ECG monitoring, besides the normal screen, you can also choose Full-screen (8-lead).
- For 12-lead ECG monitoring, besides the normal screen, you can also choose Full-screen (7-lead), or 12-Lead (12-lead analysis).

To choose the desired screen configuration, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select **Full-Screen** or **12-Lead**.

To return to the normal screen, press the highlighted button to unselect that screen.

Alternately you can choose the desired screen configuration as follows:

1. Select the **Screen Setup** quick key → **Choose Screen** or select the **Main Menu** quick key → from the **Display** column select **Choose Screen**.
2. Select **ECG Full-Screen** or **ECG 12-Lead**.

7.5.2 Setting ECG Alarm Properties

To select the desired ECG alarm options, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **Alarm** tab.
3. Select the desired alarm options.

7.5.3 Setting the Analysis Mode

Analyzing multiple leads enhances detection sensitivity and reduces false alarms. The monitor supports ECG analysis using either four leads (ECG1 to ECG4) or a single lead (ECG1).

To set the ECG analysis mode, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **Setup** tab.
3. Set **Analysis Mode**.
 - ◆ **Multiple Leads**: the monitor uses four leads (ECG1 to ECG 4) as calculation leads.
 - ◆ **Single Lead**: the monitor uses one lead (ECG1) as the calculation lead.

NOTE

- When most leads are noisy or with low amplitude, choosing the optimal lead as the calculation lead and setting Analysis Mode to Single Lead is recommended.

- It is difficult for the monitor to differentiate an aberrantly conducted beat from a ventricular beat. An aberrantly conducted beat may be misclassified as a ventricular beat. In this case, choose the lead with a narrow R-wave for ECG1 and select the Single Lead analysis mode.
 - When a 3-lead ECG cable is used, the monitor always uses a single lead (ECG1) as the calculation lead and the Analysis Mode option is not available.
-

7.5.4 Changing ECG Wave Settings

7.5.4.1 Selecting the Leads of Displayed ECG Waveforms

To select the desired ECG waveforms to be displayed, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **Setup** tab.
3. Select **ECG** to set the lead of each displayed ECG waveform.
4. If more than three ECG waveforms are to be displayed, select the **More Leads** tab, and then select **ECG** to set leads of other ECG waveforms.

For optimal ECG analysis, select leads with the following characteristics:

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

CAUTION

- Ensure that you have selected the optimal leads with the best waveform amplitude and the highest signal-to-noise ratio. Selecting the optimal leads is important for detecting beats, classifying beats, and detecting ventricular fibrillation.
-

7.5.4.2 Changing ECG Waveform Size

If the ECG waveform is too small or clipped, you can change its size by selecting the appropriate **Gain** setting. To do so, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **Setup** tab.
3. Select **ECG Gain** to set the size of each ECG waveform.
4. If more than three ECG waveforms are displayed, select the **More Leads** tab, and then select **ECG Gain** to change the sizes of other ECG waveforms. If you select **Auto**, the monitor automatically adjusts the size of the ECG waveforms for all the leads.

7.5.4.3 Changing Va and Vb Labels

When monitoring ECG with 6-leadwire. You can change the labels of Va and Vb leads. To do so, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **Setup** tab.
3. Set **Va** and **Vb** according to the locations of the Va and Vb electrode sites. Default settings are **Va** and **Vb**.

7.5.4.4 Changing ECG Waveform Speed

To change ECG waveform speed, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **Setup** tab.
3. Set the desired **Speed**.

7.5.4.5 Setting the ECG Filter

To set the appropriate ECG waveform filter mode, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **Setup** tab.
3. Set **Filter**.
 - ◆ **Diagnostic**: use when diagnostic quality ECG is required. The unfiltered ECG waveform is displayed so that changes such as R-wave notching or discrete elevation or depression of the ST segment are visible.
 - ◆ **Monitor**: use under normal monitoring conditions.
 - ◆ **Surgery**: use when the signal is distorted by high frequency or low frequency interference. High frequency interference usually results in large amplitude spikes making the ECG signal look irregular. Low frequency interference usually leads to wandering or rough baseline. The surgery filter reduces artifacts and interference from electrosurgical units. Under normal measurement conditions, selecting **Surgery** may suppress certain features or details of the QRS complexes.
 - ◆ **ST**: recommended for ST monitoring.

7.5.4.6 Switching On or Off the Notch Filter

The notch filter removes the line frequency interference. To switch on or off the notch filter, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **Setup** tab.
3. Switch on or off **Notch Filter**.

NOTE

- The notch filter can only be switched on or off when ECG Filter is set to Diagnostic. In other filter modes, the notch filter is always on.

7.5.5 Disabling the Smart Lead Off Function

The monitor provides the smart lead off function. When the lead corresponding to the first ECG wave gets detached but another lead is available, the monitor automatically switches to the available lead to recalculate heart rate, and to analyze and detect arrhythmias. When you reconnect the detached leads, the monitor automatically switches back to the original lead.

The smart lead off function is enabled by default. To disable this function, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **Setup** tab.
3. Switch off **Smart Lead**.

7.5.6 Adjusting the QRS Volume

To adjust the QRS volume, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **Setup** tab.
3. Set **QRS Volume**.

When valid SpO₂ measurements are available, the monitor adjusts the pitch of QRS tone based on the SpO₂ value.

7.5.7 Adjusting the Minimum QRS Detection Threshold

To avoid false asystole alarm due to low R wave amplitude, and to avoid tall T waves and P waves being mistaken for QRS complexes, the monitor provides a means to manually adjust the minimum QRS detection threshold.

To adjust the minimum QRS detection threshold, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **Setup** tab and set **Filter** to **Monitor**.
3. Select the **QRS Threshold** tab.
4. Select up or down arrow buttons to adjust the minimum threshold for QRS detection. Selecting **Default** resets the QRS threshold to the default value (0.16 mV).

CAUTION

- The setting of the QRS detection threshold can affect the sensitivity for arrhythmia, ST, QT/QTc detection, and heart rate calculation.
 - If the QRS amplitude is low, the monitor might not be able to detect the beats and false asystole calls may occur.
-

NOTE

- The minimum QRS detection threshold can only be adjusted when the ECG filter is set to Monitor.
-

7.6 Monitoring Arrhythmia

Arrhythmia monitoring is intended for adult, pediatric, and neonatal patients.

7.6.1 Arrhythmia Safety Information

WARNING

- Heart rate reading may be affected by cardiac arrhythmias. Do not rely entirely on heart rate alarms when monitoring patients with arrhythmias. Always keep these patients under close surveillance.
 - The arrhythmia analysis program may incorrectly identify the presence or absence of an arrhythmia. Therefore, a physician must analyze the arrhythmia information with other clinical findings.
 - Pacer not Capture and Pacer not Pacing detection functions are not intended for neonatal patients.
 - Atrial fibrillation (A-Fib) detection function is not intended for pediatric and neonatal patients.
-

CAUTION

- Since the arrhythmia detection algorithm sensitivity and specificity are less than 100%, it is possible for false arrhythmias to be detected and true arrhythmia events to not be detected. The possibility increases when the signal is noisy.
 - The ECG size and minimum QRS detection threshold settings affect arrhythmia detection and heart rate calculation sensitivity.
 - If QRS amplitude is low, the monitor might be unable to calculate heart rate and thus create false asystole calls. During the learning phase of the algorithm, arrhythmia detection may not be available. It is recommended to closely monitor patient condition during, and for several minutes after, the learning phase to allow the algorithm to reach optimal detection performance.
-

7.6.2 Arrhythmia Events

This section lists all arrhythmia events and their criteria.

7.6.2.1 Lethal Arrhythmia Events

Arrhythmia message	Description
Asystole	No QRS complex detected within the set time interval in the absence of ventricular fibrillation or chaotic signal.
V-Fib/V-Tach	A fibrillatory wave for 6 consecutive seconds. A dominant rhythm of adjacent PVCs and the ventricular rate is greater than the V-tach rate limit.
V-Tach	The number of consecutive PVCs is greater than or equal to the V-Tach PVCs limit, and the ventricular rate is greater than or equal to the V-Tach rate limit.

7.6.2.2 Nonlethal Arrhythmia Events

Arrhythmia message	Description
Vent Brady	The number of consecutive PVCs is greater than or equal to V brady PVC limit and the ventricular rate is less than the V-Brady Rate limit.
Extreme Tachy	The heart rate is greater than the extreme tachycardia limit.
Extreme Brady	The heart rate is less than the extreme bradycardia limit.
R on T	R on T PVC is detected.
Run PVCs	More than two consecutive PVCs, but lower than the V-Brady PVCs limit, and the ventricular rate is lower than the V-Tach rate limit.
Couplet	A Pair of PVCs detected in between normal beats.
Multiform PVC	Multiform PVCs detected in Multif. PVC's Window (which is adjustable).
PVC	One PVC detected in between normal beats.
Bigeminy	A dominant rhythm of N, V, N, V, N, V*.
Trigeminy	A dominant rhythm of N, N, V, N, V, N, V*.
Tachy	The heart rate is greater than the tachycardia limit.
Brady	The heart rate is lower than the bradycardia limit.
Pacer Not Capture	No QRS complex detected for 300 ms following a pace pulse (for paced patients only).
Pacer Not Pacing	No pace pulse detected for 1.75 x average R-to-R intervals following a QRS complex (for paced patients only).
Missed Beat	At least 3 consecutive Ns*, and The current RR interval is greater than 1.5 x previous RR interval, and The next RR interval is lower than 1.5 x average RR interval, and HR lower than 100 and the current RR interval is greater than 1.75 x average RR interval , or HR is greater than or equal to 100 and the current RR interval is greater than 1000 ms.
Nonsus V-Tach	The number of consecutive PVCs is lower than the V-Tach PVCs limit but greater than 2, and the ventricular rate is greater than or equal to the V-Tach Rate limit.
Vent Rhythm	The number of consecutive PVCs is greater than or equal to the V-Brady PVCs limit, and ventricular rate is greater than or equal to the V-Brady Rate limit but lower than V-Tach Rate limit.
Pause	No QRS complex is detected within the set pause time threshold.
Irr Rhythm	Consistently irregular rhythm (N*, irregular RR interval change is greater than 12.5%)
A-Fib (for adult only)	P wave is absent and normal beat RR intervals are irregular.
PVCs/min	PVCs/min exceeds high limit.
Pauses/min	Pauses/min exceeds high limit.
Irr Rhythm End	Irregular rhythm no longer detected for the irregular rhythm end delay time.

Arrhythmia message	Description
A-Fib End (for adult only)	Atrial fibrillation no longer detected for the A-Fib end delay time.
SVT	The number of consecutive SVCs is greater than or equal to the SVT SVCs limit, and the supraventricular HR is greater than or equal to the SVT HR limit.
SVCs/min	SVCs/min exceeds the high limit.

*N: normal beat; V: ventricular beat

7.6.3 Displaying Arrhythmia Information

You can display the arrhythmia information in the numeric area. To do so, follow this procedure:

1. Access **Tile Layout** using either of the following ways:
 - ◆ Select the **Screen Setup** quick key → select the **Tile Layout** tab.
 - ◆ Select **Main Menu** quick key → from the **Display** column select **Tile Layout**.
2. Click the numeric area where you want to display the arrhythmia information, and then select ECG → **Arrhythmia**.

7.6.4 Changing Arrhythmia Settings

7.6.4.1 Changing Arrhythmia Alarm Settings

To set the arrhythmia alarm properties, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **Arrhythmia** tab → **Alarm** tab.
3. Set alarm properties as desired.

NOTE

- You can switch off lethal arrhythmia alarms only when you have configured the monitor to allow lethal arrhythmia alarms to be turned off. For more information, see 21.3.4 *Setting Guard Limits*.
- The priority of lethal arrhythmia alarms is always high. It cannot be altered.

7.6.4.2 Changing Arrhythmia Alarm Threshold Settings

You can change threshold settings for certain arrhythmia alarms. When an arrhythmia exceeds its threshold, an alarm will be triggered. To do so, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **Arrhythmia** tab → select the **Threshold** tab.
3. Enter the password if required. For more information, refer to 21.13.3 *Selecting Password for User Authentication*.
4. Set the threshold for the desired arrhythmia alarms.

NOTE

- The asystole delay time relates to ECG relearning. When heart rate is less than 30 bpm, it is recommended to set Asystole Delay to 10 sec.

7.6.4.3 Arrhythmia Threshold Range

Arrhythmia	Threshold Range
Asystole Delay	3 sec to 10 sec

Arrhythmia	Threshold Range
Tachy (HR High)	60 bpm to 295 bpm
Brady (HR Low)	16 bpm to 120 bpm
Extreme Tachy	65 bpm to 300 bpm
Extreme Brady	15 bpm to 115 bpm
Multif PVCs Window	3 beats to 31 beats
V-Tach Rate	100 bpm to 200 bpm
V-Brady Rate	15 bpm to 60 bpm
V-Tach PVCs	3 beats to 99 beats
V-Brady PVCs	3 beats to 99 beats
PVCs/min	1 to 100
Pauses/min	1 to 15
Pause Threshold	1.5 sec, 2.0 sec, 2.5 sec, 3.0 sec
AF/Irr Rhy End Time	0 min, 1 min, 2 min, 3 min, 4 min, 5 min, 10 min, 15 min, 30 min
SVT SVCs	3 beats to 99 beats
SVT HR	100 bpm to 300 bpm
SVCs/min	1 to 100

7.6.4.4 Setting Thresholds for PVC-Related Alarms

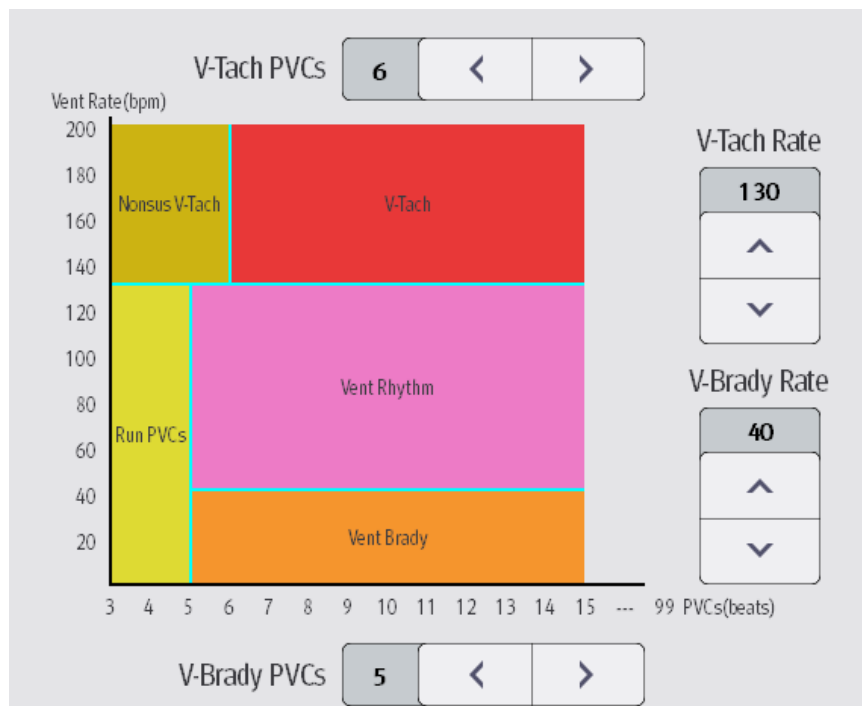
PVC-related alarms are detected on the basis of the current PVC rate and the number of consecutive PVCs.

To set the required thresholds for PVC-related alarms, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **Arrhythmia** tab → select the **More Threshold** tab.
3. Enter the password if required. For more information, refer to *21.13.3 Selecting Password for User Authentication*.

Adjust **V-Tach PVCs**, **V-Tach Rate**, **V-Brady PVCs**, and **V-Brady Rate** as necessary to set the thresholds for the desired PVC-related alarms.

The following figure illustrates the conditions under which PVC alarms will be generated if **V-Tach PVCs** is set to 6, **V-Tach Rate** is set to 130, **V-Brady PVCs** is set to 5, and **V-Brady Rate** is set to 40.



- If the number of consecutive PVCs is greater than or equal to the V-Tach PVCs limit (6), and the ventricular rate (Vent Rate) is greater than or equal to the V-Tach Rate limit (130), a V-Tach alarm is generated.
- If the number of consecutive PVCs is lower than the V-Tach PVCs limit (6) but greater than 2, and the ventricular rate is greater than or equal to the V-Tach Rate limit (130), a Nonsus V-Tach alarm is generated.
- If the number of consecutive PVCs is greater than or equal to the V-Brady PVCs limit (5), and the ventricular rate is lower than the V-Tach Rate limit (130) but greater than or equal to the V Brady Rate limit (40), a Vent Rhythm alarm is generated.
- If the number of consecutive PVCs is lower than the V-Brady PVCs limit (5) but greater than 2, and the ventricular rate is lower than the V-Tach Rate limit (130), a Run PVCs alarm is generated.
- If the number of consecutive PVCs is greater than or equal to the V-Brady PVCs limit (5), and the ventricular rate is lower than the V Brady Rate limit (40), a Vent Brady alarm is generated.

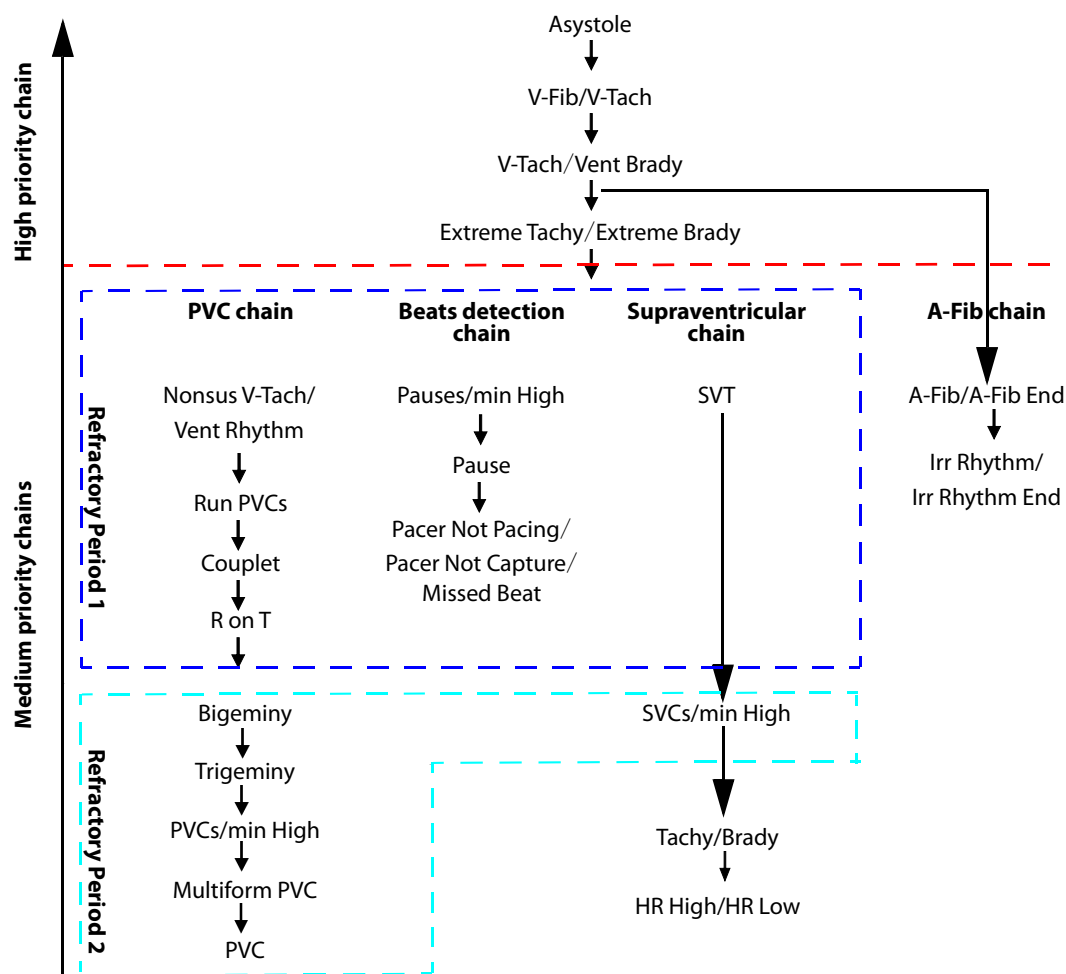
7.6.5 Intelligent Arrhythmia Alarm

Normally, an arrhythmia alarm is presented when an alarm condition is detected. However, the monitor can be configured to deactivate some arrhythmia alarms and disable alarm light and alarm tone for a designated period of time when certain arrhythmia alarms are detected. For more information, see 7.6.5.2 *Arrhythmia Alarm Shielding Rules* and 7.6.5.3 *Setting Arrhythmia Refractory Periods*.

7.6.5.1 Arrhythmia Alarm Chains

If multiple arrhythmia alarms occur simultaneously, announcing all of the detected alarm conditions would be confusing, and a more serious condition might be overlooked. So arrhythmia alarms are prioritized by alarm "chains".

The alarm chains are as follows:



Note:The refractory periods have no impact on Tachy, Brady, HR High, and HR Low.

7.6.5.2 Arrhythmia Alarm Shielding Rules

The following table explains how audible and visual alarms are indicated during arrhythmia alarm shielding period.

Previous alarm	Current alarm	Alarm indication
Alarm in high priority chain	Alarm in high priority chain	Alarm light and alarm tone
	Alarm in medium priority chain	During the shielding period, alarm light and alarm tone are disabled. When the shielding period is reached, alarm light and alarm tone are reactivated.
Alarm in medium priority chain	Alarm in high priority chain	Alarm light and alarm tone
	Alarm in the same medium priority chain, but with higher priority	Alarm light and alarm tone
	The same alarm reoccurs	During the shielding period, alarm light and alarm tone are disabled. When the shielding period is reached, alarm light and alarm tone are reactivated.
	Alarm in the same medium priority chain, but with lower priority	During the shielding period, alarm light and alarm tone are disabled. When the shielding period is reached, alarm light and alarm tone are reactivated.
	Alarm in other medium priority chain	Alarm light and alarm tone

7.6.5.3 Setting Arrhythmia Refractory Periods

For some arrhythmias in the medium priority chain, an arrhythmia and arrhythmias with lower priority in the same alarm chain can be deactivated for a designated period of time. This period is called the refractory period. When an arrhythmia is detected, the refractory period automatically starts. During the refractory period, the same alarm condition does not trigger an alarm. If the condition of an arrhythmia with lower priority in the same alarm chain appears, the monitor does not generate an alarm either.

To set arrhythmia refractory periods, follow this procedure:

1. Access arrhythmia alarm setup by either of the following ways:
 - ◆ Select the ECG numeric area or waveform area to enter the **ECG** dialog → select the **Arrhythmia** tab.
 - ◆ Select the **Alarm Setup** quick key → select the **Arrhythmia** tab.
2. Select the **Threshold** tab.
3. Set **Refractory Period 1** and **Refractory Period 2**. The default refractory period 1 is 3 minutes. The default refractory period 2 is 10 minutes. To disable a refractory period, set it to **Off**.

See the figure of arrhythmia alarm chain in 7.6.5.1 *Arrhythmia Alarm Chains* for arrhythmias applying to Refractory Period 1 and Refractory Period 2.

NOTE

- **Refractory periods are only applicable to arrhythmias in the medium priority chains.**
- **Refractory periods have no impact on Tachy, Brady, HR High, HR Low, A-Fib/A-Fib End, Irr Rhythm/Irr Rhythm End.**

7.7 ST Segment Monitoring

ST segment analysis is intended for adult, pediatric and neonatal patients. To use this feature, the N1 must be labeled to support ST analysis, see 7.1 *ECG Introduction*.

7.7.1 ST Safety Information

WARNING

- **ST segment deviation values may be affected by such factors as certain drugs or metabolic and conduction disturbances.**
- **ST deviation is often calculated at a fixed offset from the J point. Changes in heart rate may affect ST.**
- **The significance of ST segment changes needs to be determined by a physician.**
- **This monitor provides information regarding changes in ST deviation levels. The clinical significance of the ST level change information should be determined by a physician.**

7.7.2 Enabling ST Monitoring

The ST monitoring function is disabled by default. Before you start ST monitoring, enable the ST function. To do so, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **ST** tab→ select the **Setup** tab.
3. Switch on **ST Analysis**.

Reliable ST monitoring cannot be ensured under the following situations:

- You are unable to get a lead that is not noisy.
- Arrhythmias, such as atrial fibrillation or atrial flutter, which may cause an irregular baseline.
- The patient is continuously ventricularly paced.
- The patient has left bundle branch block.

In these cases, you may consider switching off ST monitoring.

7.7.3 Displaying ST Deviation Numerics

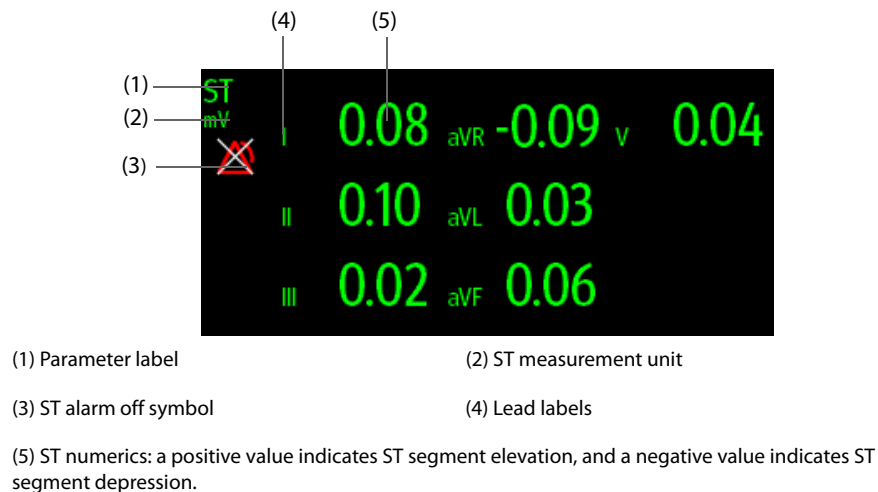
To display ST numerics, follow this procedure:

1. Access **Tile Layout** by either of the following ways:
 - ◆ Select the **Screen Setup** quick key → select the **Tile Layout** tab.
 - ◆ Select **Main Menu** quick key → from the **Display** column select **Tile Layout**.
2. Click the numeric area where you want to display the ST numerics, and then select **ECG** → **ST**.

The ST parameter display area is configured differently according to the ECG cable used:

- When you are using the 3-lead ECG leadwires, a separate ST numeric area does not appear on the display. The ST deviation value displays in the ECG numeric area.
- When you are using the 5-lead ECG leadwires, the ST numeric area displays 7 ST deviation values: ST-I, ST-II, ST-III, ST-aVR, ST-aVL, ST-aVF, ST-V.
- When you are using the 6-lead ECG leadwires, the ST numeric area displays 8 ST deviation values: ST-I, ST-II, ST-III, ST-aVR, ST-aVL, ST-aVF, ST-Va, ST-Vb.
- When you are using the 12-lead ECG leadwires, the ST numeric area displays 12 ST deviation values: ST-I, ST-II, ST-III, ST-aVR, ST-aVL, ST-aVF, ST-V1, ST-V2, ST-V3, ST-V4, ST-V5, ST-V6.

This example shows the ST numeric area when 5-lead ECG cable is used. The monitor screen may look slightly different:

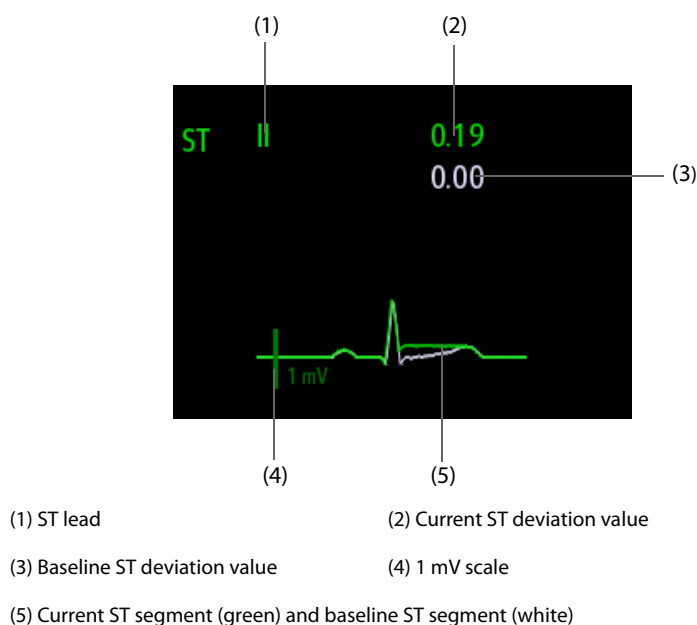


7.7.4 Displaying ST Segments in the Waveform Area

You can display ST segments in the waveform area. To do so, follow this procedure:

1. Access **Tile Layout** by either of the following ways:
 - ◆ Select the **Screen Setup** quick key → select the **Tile Layout** tab.
 - ◆ Select **Main Menu** quick key → from the **Display** column select **Tile Layout**.
2. Select the waveform area where you want to display the ST segments, and then select **ECG** → **ST**.

ST segment shows a QRS complex segment for each measured ST lead. The current ST segment is drawn in the same color as the ECG wave, usually green, superimposed over the stored reference segment, drawn in a different color. The information is updated once every ten seconds.



7.7.5 Entering the ST View

In ST View mode a complete QRS segment for each ST lead is displayed. The color of the current ST segments and ST deviation values is consistent with the color of the ECG waveforms, normally green. The color of the baseline ST segments and ST deviation values is white.

To enter the ST View, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **ST** tab.
3. From the bottom of the dialog, select **ST View**.

NOTE

- If the N1 is connected to the CMS via WMTS, ST segments of V3, V4, V5, and V6 (if configured) will not be displayed in at the CMS.

7.7.6 Saving the Current ST Deviation and Segment as Baseline

ST deviation is typically monitored as a relative change from a baseline value. Set an ST baseline when ST deviation values become stable. If you did not set the ST baseline, the monitor automatically saves the baseline when valid ST deviation values appear for 5 minutes. To set the ST baseline, follow this procedure:

1. From the **ST View**, select **Set Baseline**.
2. From the pop-up dialog box, select **Ok** to set the current ST segments and values as the baseline.

From the **ST View**, you can also perform the following operations:

- Display or hide ST baseline by selecting **Display Baseline** or **Hide Baseline**.
- Display or hide the position of ISO point, J point and ST point by selecting **Display Marker** or **Hide Marker**.

CAUTION

- Updating ST baseline affects ST alarms.

NOTE

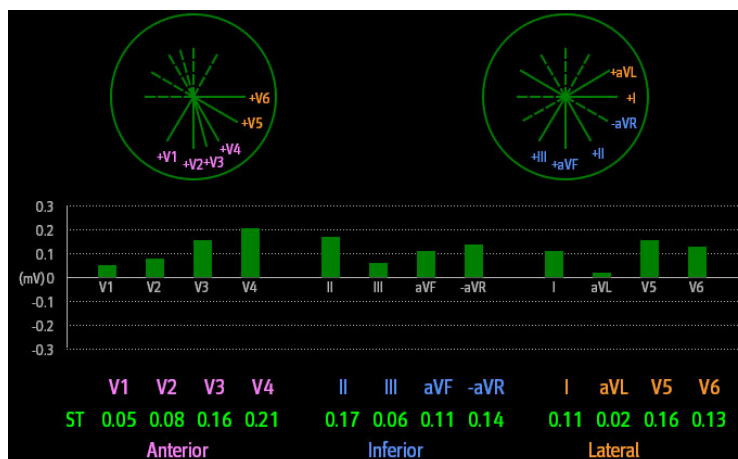
- If the N1 is connected to the CMS via WMTS, baselines of the configured ST leads will not be displayed at the CMS.

7.7.7 Entering the ST Graphic (only available when the N1 is used with the independent external display)

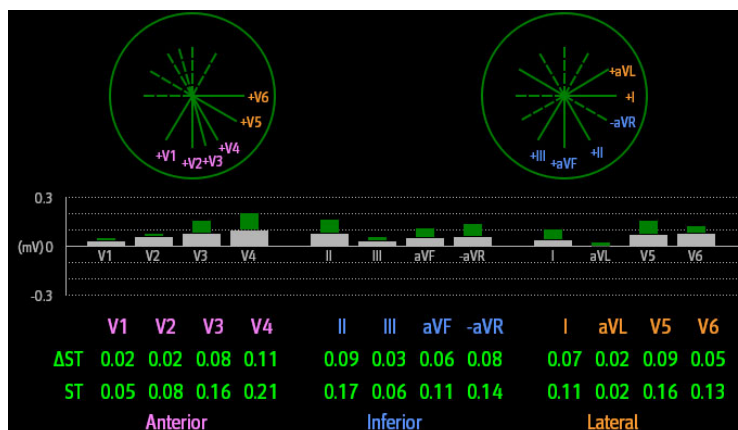
To display **ST Graphic**, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **ST** tab.
3. Select **ST Graphic**.

The following figure shows the ST Graphic when **ST Alarm Mode** is set to **Absolute**. The height of the bar indicates the ST deviation value of corresponding ST lead. The color of the bar indicates ST alarm status: green indicates that corresponding ST deviation value is within alarm limits; cyan, yellow and red indicate that the ST deviation value exceeds the alarm limits. The color matches ST alarm priority.



The following figure shows the ST Graphic when **ST Alarm Mode** is set to **Relative**. The height of grey bar indicates the baseline ST deviation value and the green bar (cyan, yellow or red if an alarm occurs) indicates relative ST from that baseline.



7.7.8 Changing ST Settings

7.7.8.1 Setting ST Alarm Properties

To set ST alarm properties, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **ST** tab→ **Alarm** tab.
3. Set **ST Alarm Mode** to **Absolute** or **Relative**.
 - ◆ **Absolute**: you can separately set the alarm properties for each ST alarm for each lead.
 - ◆ **Relative**: you can set the alarm properties for **ST Single** and **ST Dual** alarms.
4. Set ST alarm properties.

7.7.8.2 Changing Leads for ST Display

The monitor automatically selects the three most deviated leads for ST display. You can also manually select the leads. To do so, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **ST** tab → select the **Setup** tab.
3. Set **ST Segment**. You can select up to 3 leads.

7.7.8.3 Showing ISO Point, J Point, and ST Point Markers

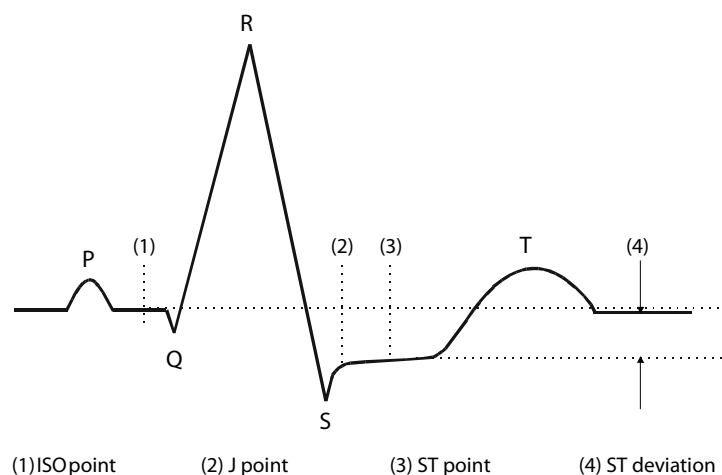
In the waveform area, the ISO point, J point, and ST point marker do not display on the ST segments by default. To display these markers, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **ST** tab → select the **Setup** tab.
3. Switch on **Show Markers**.

7.7.9 Adjusting ST Measurement Points

7.7.9.1 About ST Point, ISO Point, and J Point

The ST deviation value for each beat is the potential difference between the isoelectric (ISO) point and the ST point. The ISO point provides the baseline. The ST point is located between the J point and the start of the T-wave. The J point is the end of the QRS complex. As the ST point is at a fixed distance away from the J point (40, 60, 80 etc msec), manually adjusting the J point helps you correctly position the ST point.



7.7.9.2 Setting ST Point, ISO Point, and J Point

CAUTION

- If **Auto Adjust** is Off, or if the patient's heart rate or ECG morphology changes significantly, the **ISO** and **ST** points need to be occasionally adjusted because this may affect the QT interval and thus the location of the ST point. False ST segment depression or elevation may occur if the isoelectric point or the ST point is incorrectly set.
- Always ensure that the locations of ST points are appropriate for the patient.

To set the ST point, ISO point, and J point, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **ST** tab → select the **Adjust** tab.
3. Set **ST Point**.

The setting for **Auto Adjust** defines the method of adjusting the ISO and J point locations. **Auto Adjust** is enabled by default. In this case, the locations of the ISO point and J point are automatically determined by the

algorithm. When **Auto Adjust** is disabled, you need to manually adjust the position of the ISO point and J point using the arrows at the right sides of **ISO** and **J**.

- The ISO point (isoelectric) location shown is relative to the R-wave peak. Position the ISO point in the middle of the flattest part of the waveform (between the P and Q waves).
- The J point location is indicated relative to the R-wave peak. Position the J point at the end of the QRS complex and the beginning of the ST segment.
- The ST point is positioned a fixed distance from the J point. Position the ST point relative to the J point at **J+60/80ms**, **J+40ms**, **J+60ms** or **J+80ms**. When **J+60/80ms** is selected, the ST point will be positioned 80 ms (heart rate 120 bpm or less) or 60 ms (heart rate more than 120 bpm) from the J point.

7.8 QT/QTc Interval Monitoring

The QT interval is the time between the beginning of the Q-wave and the end of the T-wave. It represents the total duration of the depolarization (QRS duration) and repolarization (ST-T) phases of the ventricles. QT interval monitoring can assist in the detection of long QT syndrome.

The QT interval has an inverse relationship to heart rate. Faster heart rates shorten QT interval and slower heart rates prolong QT interval. Therefore, several formulas are commonly used to correct the QT interval for heart rate. The heart rate corrected QT interval is abbreviated as QTc.

QT/QTc interval monitoring is intended for adult, pediatric, and neonatal patients.

7.8.1 QT/QTc Monitoring Limitations

Some conditions may make it difficult to achieve reliable QT/QTc monitoring, for example:

- R-wave amplitudes are too low
- The presence of frequent ventricular ectopic beats
- RR intervals are unstable
- P-waves tending to encroach on the end of the previous T-wave at high heart rates
- The T-wave is very flat or T-wave are not well defined
- The end of the T-wave is difficult to delineate because of the presence of U-waves
- QTc measurements are not stable
- In the presence of noise, asystole, ventricular fibrillation, atrial fibrillation, or ECG lead off

For reliable QT/QTc monitoring, choose lead with good T-wave amplitude and no visible flutter activity, and without a predominant U-wave or P-wave.

Some conditions such as left or right bundle branch block or ventricular hypertrophy can lead to a widened QRS complex. If a long QTc is observed you should verify it to ensure that it is not caused by QRS widening.

Because normal beats followed by ventricular beats are not included in the analysis, no QT measurement will be generated in the presence of a bigeminy rhythm.

If the heart rate is extremely high (over 150 bpm for adults and over 180 bpm for pediatrics and neonates), QT will not be measured. When the heart rate changes, it can take several minutes for the QT interval to stabilize. For reliable QTc calculation it is important to avoid measurements when the heart rate is changing.

7.8.2 Enabling QT/QTc Monitoring

The QT monitoring function is disabled by default. Before you start QT monitoring, enable the QT function. To do so, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **QT** tab→ select the **Setup** tab.
3. Switch on **QT Analysis**.

7.8.3 Displaying QT Numerics and Segments

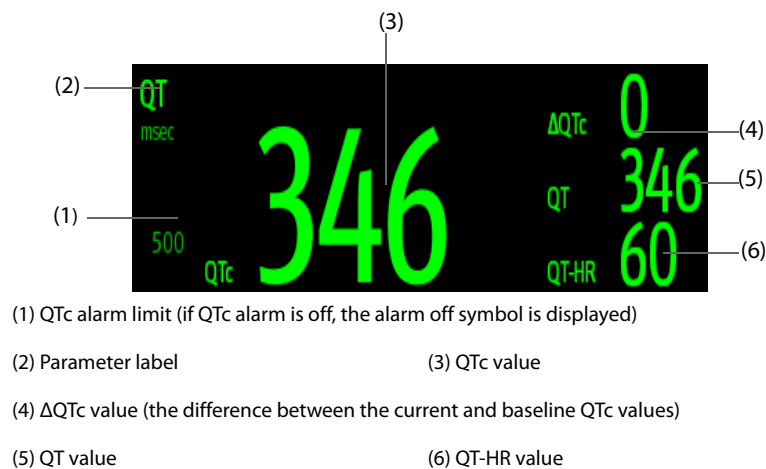
To display QT numerics and Segments, follow this procedure:

1. Access **Tile Layout** by either of the following ways:
 - ◆ Select the **Screen Setup** quick key → select the **Tile Layout** tab.
 - ◆ Select **Main Menu** quick key → from the **Display** column select **Tile Layout**.
2. Click the parameter numeric area where you want to display the QT numerics, and then select **ECG** → **QT/QTc**.

NOTE

- **QTc values are calculated based on the QT-HR, not the ECG HR. To view the QT-HR, open the QT View. For more information, see 7.8.4 Entering the QT View.**

The following picture shows the QT numeric area. The monitor screen may look slightly different:



(1) QTc alarm limit (if QTc alarm is off, the alarm off symbol is displayed)

(2) Parameter label

(3) QTc value

(4) Δ QTc value (the difference between the current and baseline QTc values)

(5) QT value

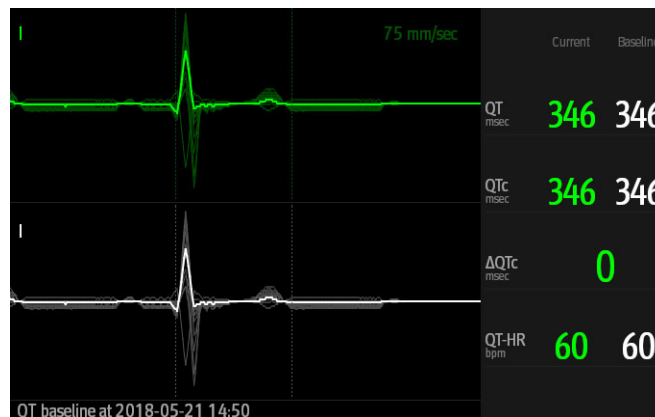
(6) QT-HR value

7.8.4 Entering the QT View

QT View shows the current and baseline QT parameter values and waveforms. To enter QT View, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **QT** tab.
3. Select **QT View**.

The following picture shows a typical QT view.



- The current waveform is shown in the upper half in green.
- The baseline waveform is shown below in white.

- The waveform of selected lead is highlighted, while the waveforms of other leads are in light green or light gray.
- The start of the QRS complex and the end of the T wave are marked with a vertical line.
- In some conditions, no QT measurement can be made. Then the cause of failed QT measurement is shown at the bottom of the QT numerics area and the message “Cannot Analyze QT” is shown in the technical alarm area.

Select the left or right arrow to switch leads, and the corresponding waveform will be highlighted.

NOTE

- If the N1 is connected to the CMS via WMTS, QT parameter values and waveforms of V3, V4, V5, and V6 (if configured) will not be displayed at the CMS.

7.8.5 Saving the Current QTc as Baseline

In order to quantify changes in the QTc value, you can set a QTc baseline. If no baseline has been set for this patient within the first five minutes after getting valid QT values, the monitor will automatically set a baseline. To set the current values as baseline, follow this procedure:

1. From the **QT View**, select **Set Baseline**.
2. From the pop-up dialog box, select **Ok**. This baseline will then be used to calculate Δ QTc.

If you set a new baseline the previous baseline is discarded.

From the **QT View**, you can also perform the following operations:

- Select the left or right arrow to select a lead label to highlight corresponding waveform.
- Select **Display Baseline** or **Hide Baseline** to display or hide the baseline waveform.

CAUTION

- Updating QTc baseline affects the Δ QTc value and alarm.

NOTE

- If the N1 is connected to the CMS via WMTS, baselines of the configured QT leads will not be displayed at the CMS.

7.8.6 Changing QT Settings

7.8.6.1 Setting QT Alarm Properties

To set QT alarm properties, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **QT** tab→ select the **Alarm** tab.
3. Set QTc and Δ QTc alarm properties.

7.8.6.2 Selecting Leads for QT Calculation

You can select one lead or all leads for QT calculation. To do so, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **QT** tab→ select the **Setup** tab.
3. Set **QT Leads**. **All** is selected by default. This means all leads are used for QT calculation.

7.9 ECG Relearning

Changes in ECG beat morphology could result in incorrect arrhythmia alarms and/or inaccurate heart rate. ECG relearning allows the monitor to learn the new dominant beat morphology and thus reduce false arrhythmia alarms and inaccurate HR values. Once learning is complete, the dominant QRS complex is stored as a reference template. The reference template is used as the normal morphology of that patient and it is compared with incoming beats to identify possible arrhythmias.

7.9.1 Auto ECG Relearning

Auto arrhythmia relearning happens in the following situation:

- The ECG lead type or lead label is changed.
- ECG leads are off and are not reconnected within 60 seconds.
- The patient's paced status is changed.

7.9.2 Initiating an ECG Relearning Manually

If you suspect that false arrhythmia alarms are presented, you may need to manually initiate an ECG relearn. To do so, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select **Relearn**.

CAUTION

- **Initiate ECG relearning only during periods of predominantly normal rhythm and when the ECG signal is relatively noise-free. If ECG learning takes place during arrhythmias, the ectopic beats may be incorrectly learned as normal QRS complexes. This may result in missed detection of subsequent arrhythmia events.**
-

7.10 Defibrillation Synchronization Pulse Output

The 12-lead N1 monitor provides an analog out connector to output synchronization pulses for defibrillators. If a defibrillator is connected, it receives a synchronization pulse (100 ms, +5 V) through the multifunction connector each time an R-wave is detected. The 3/5/6 lead N1 monitor does not offer this output.

WARNING

- **According to IEC 60601-2-4: 2010, the peak of the synchronized defibrillator discharge should be delivered within 60 ms of the peak of the R wave. The signal at the ECG output (sync pulse) on the monitor is delayed by maximum of 30 ms. the biomedical engineer should verify that the ECG/ Defibrillator combination does not exceed recommended maximum delay of 60 ms.**
 - **Before defibrillation, ensure that both defibrillator and monitor have passed the system test and can be safely used together.**
-

7.11 ECG Troubleshooting

This section lists some of the problems that might be encountered during ECG monitoring. If you encounter problems when using the monitor or accessories, check the table below before requesting for services. If the problem persists after you have taken corrective actions, contact the service personnel.

NOTE

- **For the physiological and technical alarm messages, see *D Alarm Messages*.**
-

Problem	Corrective Actions
Noisy ECG traces	<ol style="list-style-type: none"> 1. Check that the electrodes are not detached or dry. Replace with fresh and moist electrodes if necessary. 2. Check that leadwires are not defective. Replace leadwires if necessary. 3. Check that the patient cable or leadwires are not routed too close to other electrical devices. Move the patient cable or leadwires away from electrical devices and their cables if necessary.
Excessive electrosurgical Interference	Use ESU-proof ECG cables. For more information, see <i>25.1 ECG Accessories</i> .
Muscle Noise	<p>Inadequate skin preparation, tremors, tense subject, and/or poor electrode placement.</p> <ol style="list-style-type: none"> 1. Perform skin preparation again and re-place the electrodes. For more information, see <i>7.4.1 Preparing the Patient Skin</i> and <i>7.4.2 Applying Electrodes and Connecting the Patient</i>. 2. Apply fresh, moist electrodes. Avoid muscular areas.
Intermittent Signal	<ol style="list-style-type: none"> 1. Check that cables are properly connected. 2. Check that electrodes are not detached or dry. Perform skin preparation again as described in <i>7.4.1 Preparing the Patient Skin</i> and apply fresh and moist electrodes. 3. Check that the patient cable or leadwires are not damaged. Change them if necessary.
Excessive alarms: heart rate, lead fault	<ol style="list-style-type: none"> 1. Check that electrodes are not dry. Perform skin preparation again and re-place the electrodes. For more information, see <i>7.4.1 Preparing the Patient Skin</i> and <i>7.4.2 Applying Electrodes and Connecting the Patient</i>. 2. Check for excessive patient movement or muscle tremor. Reposition the electrodes. Replace with fresh and moist electrodes if necessary.
Low Amplitude ECG Signal	<ol style="list-style-type: none"> 1. Check that the ECG gain is not set too low. Adjust the gain as required. For more information, see <i>7.5.4.2 Changing ECG Waveform Size</i>. 2. Perform skin preparation again and re-place the electrodes. For more information, see <i>7.4.1 Preparing the Patient Skin</i> and <i>7.4.2 Applying Electrodes and Connecting the Patient</i>. 3. Check electrode application sites. Avoid bone or muscular area. 4. Check that electrodes are not dry or used for a prolonged time. Replace with fresh and moist electrodes if necessary.
No ECG Waveform	<ol style="list-style-type: none"> 1. Check that the ECG gain is not set too low. Adjust the gain as required. For more information, see <i>7.5.3 Setting the Analysis Mode</i>. 2. Check that the leadwires and patient cables are properly connected. 3. Change cable and lead wires if necessary. 4. Check that the patient cable or leadwires are not damaged. Change them if necessary.
Base Line Wander	<ol style="list-style-type: none"> 1. Check for excessive patient movement or muscle tremor. Secure leadwires and cable. 2. Check that electrodes are not detached or dry and replace with fresh and moist electrodes if necessary. For more information, see <i>7.4.1 Preparing the Patient Skin</i> and <i>7.4.2 Applying Electrodes and Connecting the Patient</i>. 3. Check for ECG filter setting. Set ECG Filter mode to Monitor to reduce baseline wander on the display.

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8 Resting 12-Lead ECG Analysis

8.1 Resting 12-Lead ECG Analysis Introduction

The monitor can be configured with the Glasgow 12-lead resting ECG analysis algorithm. The monitor incorporating the Glasgow algorithm is labeled with the logo of Glasgow as shown in *7.1 ECG Introduction*.

The Glasgow algorithm is intended for adult, pediatric, and neonatal patients.

8.2 Entering the 12-Lead Screen

To enter the 12-Lead screen, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. From the bottom of the **ECG** dialog, select **12-Lead**.

You can also enter the 12-Lead screen by following this procedure:

- Select the **Screen Setup** quick key → select the **Choose Screen** tab → select **ECG 12-Lead**.
- Select **Main Menu** quick key → from the **Display** column select **Choose Screen** → select **ECG 12-Lead**.

NOTE

- **The ECG 12-Lead screen is available only when the Glasgow algorithm is configured (associated module has the Glasgow label) and Lead Set is set to Auto or 12-Lead.**

8.3 Initiating Resting 12-Lead ECG Analysis

Before initiating 12-lead ECG analysis, check that all electrodes are correctly connected to the lead wires and the ECG trunk cable is properly connected. Check that patient information is correct. Keep the patient still.

To initiate 12-Lead ECG analysis, select **Analyze** from the bottom left of the 12-Lead screen.

NOTE

- **If the N1 is connected to the CMS via WMTS, the 12-lead analysis results will not be sent to the CMS.**

8.4 Changing 12-Lead ECG Analysis Settings

On the ECG 12-Lead screen, you can set the high frequency filter, baseline drift removal (BDR) filter, and the waveform layout.

8.4.1 Setting the High Frequency Filter

The high frequency filter attenuates muscle artifact by restricting the included frequencies. The setting of the high frequency filter is 35 Hz by default. To change the setting, follow this procedure:

1. On the ECG 12-Lead screen, select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **Setup** tab.
3. Set **High-Freq Cut-off**.

The high frequency filter is a low-pass filter. That is to say, signal frequencies higher than the set frequency are filtered out. For example, if you set **High-freq Cutoff** to **35 Hz**, then signal below 35 Hz is kept in the signal and signal exceeding 35 Hz is attenuated.

8.4.2 Setting the Baseline Drift Removal Filter

The baseline drift removal (BDR) filter suppresses most baseline drift interference and also is able to preserve the fidelity of the ST-segment level. BDR is switched on by default. To set the BDR, follow this procedure:

1. On the ECG 12-Lead screen, select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **Setup** tab.
3. Switch on or off **Baseline Drift Removal** as desired. If BDR is switched off, the 0.05 Hz high pass filter is used.

NOTE

- **BDR introduces around 1-second delay. Using BDR is recommended except when the delay is unacceptable.**

8.4.3 Setting the 12-Lead Waveform Layout

To set the 12-lead waveform layout, follow this procedure:

1. On the ECG 12-Lead screen, select the ECG numeric area or waveform area to enter the **ECG** dialog.
2. Select the **Setup** tab.
3. Set **Waveform Layout**.

◆ **Standard:** the waveform sequence is I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6.

◆ **Cabrera:** the waveform sequence is aVL, I, -aVR, II, aVF, III, V1, V2, V3, V4, V5, V6.

For the Glasgow algorithm, the sequence of the chest leads depends on the setting of **V3 Placement**. If **V3 placement** is set to **V4R**, the sequence of chest leads is V4R, V1, V2, V4, V5, V6.

8.4.4 Editing Patient Information

Some patient information may directly affect ECG analysis. Complete and correct patient information is helpful for accurate diagnosis and treatment of the patient. Enter patient information before starting a resting ECG analysis.

To enter patient information, follow this procedure:

1. On the ECG 12-Lead screen, select **Setup** to enter the **12-Lead Setup** dialog.
2. On the **Patient Demographics** page, input or edit patient information.

NOTE

- **Saving information will also save the information as though it was entered in the Patient Management dialog.**
- **Changes are not saved until you press Save. So changing to another tab without saving and then pressing the exit button "X" will lose any changes.**
- **Check that patient information is correct before starting a resting 12-lead analysis.**
- **Using pediatric lead placement V4R, V1, V2, V4 - V6 is recommended if the patient is under 16 years of age. Please record V4R using the V3 electrode. Also set V3 Electrode to V4R. This is a normal practice for a patient of this age.**

8.4.5 Setting Tachycardia and Bradycardia Thresholds

To set tachycardia and bradycardia thresholds, follow this procedure:

1. On the ECG 12-Lead screen, select **Setup** to enter the **12-Lead Setup** dialog.
2. Select the **Setup** tab.
3. Set **Tachy** and **Brady**.

NOTE

- The tachycardia threshold only applies to patients whose age exceeds 180 days.
 - The bradycardia threshold only applies to patients whose age exceeds 2191 days (6 years).
-

8.4.6 Setting the 12-Lead Interpretation Report

To set the 12-lead interpretation report, follow this procedure:

1. On the ECG 12-Lead screen, select **Setup** to enter the **12-Lead Setup** dialog.
2. Select the **Report** tab.
3. Set the format and items included in the 12-lead interpretation report.

8.5 Saving the 12-Lead Interpretation Report

At the completion of 12-lead ECG interpretation, select **Save** to save the report. You can review the saved 12-lead interpretation reports. For more information, see *15.2.10 12-Lead ECG Review Page*.

8.6 Printing the 12-Lead Interpretation Report

At the completion of 12-lead ECG interpretation, select **Print** to output the report via the printer.

8.7 Exiting the ECG 12-Lead Screen

To exit the ECG 12-Lead screen, select **Exit** on the ECG 12-Lead screen.

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9 Monitoring Impedance Respiration (Resp)

9.1 Resp Introduction

Impedance respiration is measured across the thorax. When the patient is breathing or ventilated, the volume of air changes in the lungs, resulting in impedance changes between the electrodes. Impedance respiration rate (RR) is calculated from the signal representing these impedance changes, and a respiration waveform is displayed on the patient monitor screen.

Impedance respiration monitoring is intended for adult, pediatric and neonatal patients.

Respiration may also be measured using a CO₂ module. Refer to *14 Monitoring Carbon Dioxide (CO₂)* for respiration information specific to the CO₂ module.

9.2 Impedance Resp Safety Information

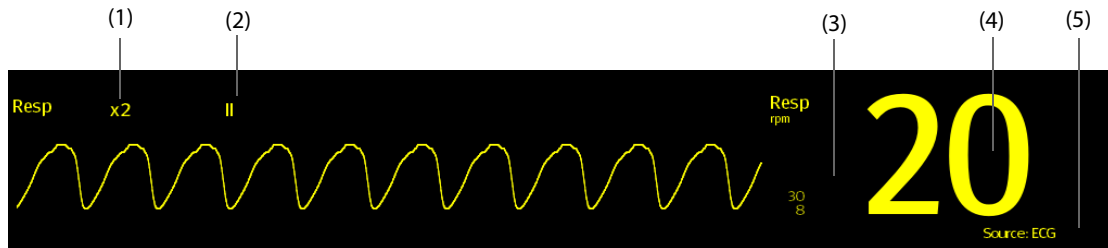
WARNING

- When monitoring the patient's impedance respiration, do not use ESU-proof ECG cables. The monitor cannot measure impedance respiration with ESU-proof ECG cables.
 - If you do not set the detection level for the respiration correctly in manual detection mode, it may not be possible for the monitor to detect apnea. If you set the detection level too low, the monitor is more likely to detect cardiac activity, and to falsely interpret cardiac activity as respiratory activity in case of apnea.
 - The respiration measurement does not recognize the cause of apnea. It only indicates an alarm if a pre-adjusted time has elapsed without a breath being detected since the last detected breath. Therefore, it cannot be used for diagnostic purpose.
 - The current used to measure impedance respiration may cause rate changes in Minute Ventilation Rate Responsive Pacemakers. If you suspect the patient monitor is affecting the pacemaker rate then replace the ECG cable with an ECG cable that contains ESU filters.
-

CAUTION

- Only use parts and accessories specified in this manual.
 - Impedance respiration monitoring is not for use on patients while they are active, as this can cause false alarms.
-

9.3 Resp Display



- | | | |
|---------------------------|---------------------|------------------|
| (1) Resp waveform gain | (2) Resp lead label | (3) Alarm limits |
| (4) Respiration rate (RR) | (5) RR source | |

NOTE

- If ESU-proof ECG cables are used, the Resp waveform area will display the message “Check Leads”. Replace the ECG cable if necessary.

9.4 Preparing for Impedance Resp Monitoring

9.4.1 Preparing the Patient

Follow this procedure to prepare the patient:

1. Clip or shave hair from skin at chosen sites.
2. Gently rub skin surface at sites to remove dead skin cells.
3. Thoroughly cleanse the site with a mild soap and water solution.
4. Dry the skin completely before applying the electrodes.

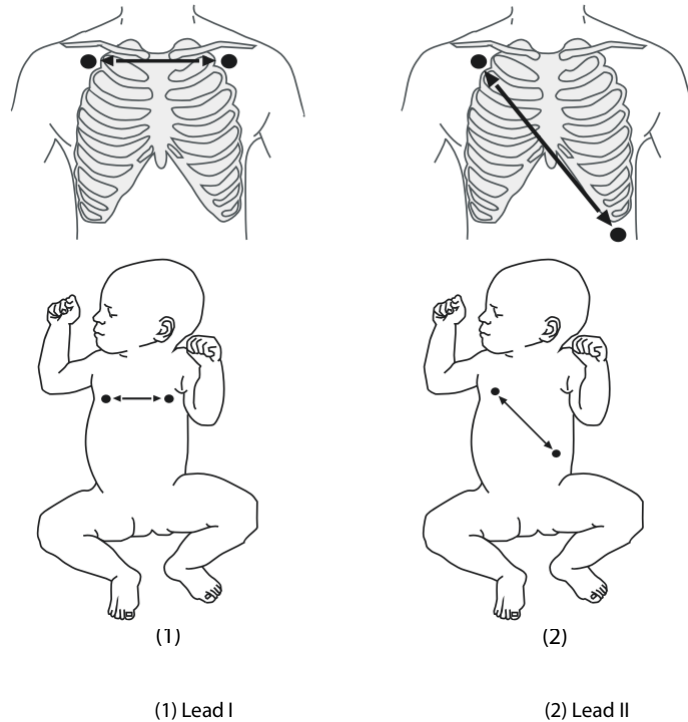
CAUTION

- Proper skin preparation is necessary for good signal quality at the electrode site, as the skin is a poor conductor of electricity.

9.4.2 Placing the Electrodes

Impedance respiration is acquired using standard ECG electrodes and cables. Either lead I (RA-LA) or lead II (RA-LL) can be used.

For more information, see 7.4.4 ECG Electrode Placements.



CAUTION

- **Correct electrode placement can help to reduce interference from cardiac related impedance changes: avoid including the liver area and the ventricles of the heart between the respiratory electrodes. This is particularly important for neonates.**
- **Some patients with restricted movements breathe mainly abdominally. In these cases, you may need to place the left leg electrode on the left abdomen at the point of maximum abdominal expansion to optimize the respiratory waveform.**
- **Some patients (especially neonates) expand their chests laterally, causing a negative intrathoracic pressure. In these cases, it is better to place the two respiration electrodes in the right midaxillary and the left lateral chest areas at the patient's maximum point of the breathing movement to optimize the impedance respiration waveform.**
- **To optimize the impedance respiration waveform, place the RA and LA electrodes horizontally when monitoring respiration with ECG Lead I; place the RA and LL electrodes diagonally when monitoring respiration with ECG Lead II.**
- **Periodically inspect electrode application sites to ensure skin integrity. If the skin quality changes, replace the electrodes or change the application site.**

NOTE

- **Store the electrodes at room temperature. Open the electrode package immediately prior to use.**
 - **Check that the electrode packages are intact and that the electrodes are not past the expiration date. Ensure the electrode gel is moist.**
-

9.5 Changing Resp Settings

9.5.1 Setting the Resp Alarm Properties

To set the Resp alarm properties, follow this procedure:

1. Select the Resp numeric area or waveform area to enter the **Resp** dialog.
2. Select the **Alarm** tab.
3. Enter the password if required. For more information, refer to *21.13.3 Selecting Password for User Authentication*.
4. Set alarm properties as desired.

9.5.2 Setting the RR Source

To set RR source, follow this procedure:

1. Select the Resp numeric area or waveform area to enter the **Resp** dialog.
2. Select the **Setup** tab.
3. Choose **RR Source** from the dropdown list.

When you select **Auto**, the monitor automatically selects the RR source following order of priority: first **CO2**, and then **ECG**. When the manually selected RR source is not available, the monitor automatically switches the **RR Source** to **Auto**.

9.5.3 Choosing the Respiration Lead

To set the respiration lead, follow this procedure:

1. Select the Resp numeric area or waveform area to enter the **Resp** dialog.
2. Select the **Setup** tab.
3. Set **Resp Lead**.

If you cannot get an acceptable impedance Resp waveform or you suspect the veracity of the Resp value after choosing the Resp lead, you may need to adjust the electrode placement.

9.5.4 Setting the Resp Waveform Size

To set the Resp waveform size, follow this procedure:

1. Select the Resp numeric area or waveform area to enter the **Resp** dialog.
2. Select the **Setup** tab.
3. Set **Gain**.

9.5.5 Setting the Resp Waveform Speed

To set the Resp waveform speed, follow this procedure:

1. Select the Resp numeric area or waveform area to enter the **Resp** dialog.
2. Select the **Setup** tab.
3. Set **Speed**.

9.5.6 Setting the Auto Detection Switch

To set the auto detection switch, follow this procedure:

1. Select the Resp numeric area or waveform area to enter the **Resp** dialog.
2. Select the **Setup** tab.
3. Switch on or off **Auto Threshold Detection**.
 - ◆ If **Auto Threshold Detection** is switched on, the monitor automatically adjusts the Resp waveform detection level, or threshold.
 - ◆ If **Auto Threshold Detection** is switched off, you have to manually adjust the Resp waveform threshold. For more information, see 9.5.7 *Adjusting the Resp Waveform Detection Threshold*.

In the auto threshold detection mode, if you are monitoring Resp and the ECG parameter is switched off, the monitor cannot compare the heart rate and Resp rates to detect cardiovascular artifact. The respiration detection level is automatically set higher to prevent the detection of cardiovascular artifact as respiration.

In the manual detection mode (where auto threshold detection is off), cardiovascular artifact can, in certain situations, trigger the respiration rate counter. This may lead to a false indication of a high respiration or an undetected apnea condition. If you suspect that cardiovascular artifact is being registered as respiratory activity, raise the detection level above the zone of cardiovascular artifact. If the Resp wave is so small that raising the detection level is not possible, you may need to optimize the electrode placement.

9.5.7 Adjusting the Resp Waveform Detection Threshold

Use the manual detection mode (where auto threshold detection is off) in the following situations:

- The respiration rate and the heart rate are close.
- Patients have intermittent mandatory ventilation.
- Respiration is weak. Try repositioning the electrodes to improve the signal.

To set the Resp waveform threshold to the desired level, follow this procedure:

1. Select the Resp numeric area or waveform area to enter the **Resp** dialog.
2. Select the **Threshold** tab.
3. Select the up and down arrows below **Upper Line** and **Lower Line** to define the Resp waveform threshold.

Once set, the detection level will not adapt automatically to different respiration depths. It is important to remember that if the depth of breathing changes, you may need to change the detection level.

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10 Monitoring Pulse Oxygen Saturation (SpO₂)

10.1 SpO₂ Introduction

Pulse Oxygen Saturation (SpO₂) monitoring is a non-invasive technique used to measure the amount of oxygenated hemoglobin and pulse rate by measuring the absorption of selected wavelengths of light. The light generated in the emitter side of the probe is partly absorbed when it passes through the monitored tissue. The amount of transmitted light is detected in the detector side of the probe. When the pulsative part of the light signal is examined, the amount of light absorbed by the hemoglobin is measured and the pulse oxygen saturation can be calculated. This device is calibrated to display functional oxygen saturation.

SpO₂ monitoring is intended for adult, pediatric and neonatal patients.

The monitor can be configured with Masimo SpO₂ or Nellcor SpO₂:

- Masimo SpO₂: the connector is purple and the logo of Masimo SET is on the monitor.
- Nellcor SpO₂: the connector is grey and the logo of Nellcor is on the monitor.

NOTE

- **The SpO₂ extension cable used must be compatible with the SpO₂ sensor connectors used. For example, only the Masimo SpO₂ extension cable can be connected to the Masimo SpO₂ sensor connectors.**
- **Measurement accuracy verification: The SpO₂ accuracy has been verified in human experiments by comparing with arterial blood sample reference measured with a CO-oximeter. Pulse oximeter measurement are statistically distributed and about two-thirds of the measurements are expected to come within the specified accuracy range compared to CO-oximeter measurements.**
- **A functional tester or SpO₂ simulator can be used to determine the pulse rate accuracy.**
- **A functional tester or SpO₂ simulator cannot be used to assess the SpO₂ accuracy.**

10.2 SpO₂ Safety Information

WARNING

- When a trend toward patient deoxygenation is indicated, analyze the blood samples with a laboratory co-oximeter to completely understand the patient's condition.
 - Do not use SpO₂ sensors during magnetic resonance imaging (MRI). Induced current could potentially cause burns. The sensor may affect the MRI image, and the MRI unit may affect the accuracy of the oximetry measurements.
 - Prolonged continuous monitoring may increase the risk of undesirable changes in skin characteristics, such as irritation, reddening, blistering or burns. Inspect the sensor site every two hours and move the sensor if the skin quality changes. Change the application site every four hours. For neonates, or patients with poor peripheral blood circulation or sensitive skin, inspect the sensor site more frequently.
 - If the sensor is too tight because the application site is too large or becomes too large due to edema, excessive pressure for prolonged periods may result in venous congestion distal from the application site, leading to interstitial edema and tissue ischemia.
 - 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.
 - Setting alarm limits to extreme values may cause the alarm system to become ineffective. For example, high oxygen levels may predispose a premature infant to retrolental fibroplasia. If this is a consideration, do not set the high alarm limit to 100%, which is equivalent to switching off the alarm.
 - SpO₂ is empirically calibrated in healthy adult volunteers with normal levels of carboxyhemoglobin (COHb) and methemoglobin (MetHb).
 - To protect from electric shock, always remove the sensor before bathing the patient.
 - The pulse oximetry function of the bedside monitor should not be used for apnea monitoring.
 - The pulse oximetry function of the bedside monitor should not be used for arrhythmia analysis.
-

CAUTION

- Change the application site or replace the sensor and/or patient cable when a persistent SpO₂ Low Signal Quality message is displayed on the equipment. These messages may indicate that patient monitoring time is exhausted on the patient cable or sensor.
 - Replace the cable or sensor when a "SpO₂ Sensor Off", "SpO₂ No Sensor", or "SpO₂ Low Signal Quality" message is consistently displayed while monitoring consecutive patients after completing troubleshooting steps listed in this manual.
 - Variation in measurements may be profound and may be affected by sampling technique as well as the patient's physiological conditions. Any results exhibiting inconsistency with the patient's clinical status should be repeated and/or supplemented with additional test data. Blood samples should be analyzed by laboratory instruments prior to clinical decision making to completely understand the patient's condition.
 - Use only SpO₂ sensors specified in this manual. Follow the SpO₂ sensor's instructions for use and adhere to all warnings and cautions.
 - SpO₂ sensors and extension cables are designed for use with specific monitors.
 - Do not place the patient monitor where the controls can be changed by the patient.
 - If using pulse oximetry during full body irradiation, keep the sensor out of the radiation field. If the sensor is exposed to the radiation, the reading might be inaccurate or the device might read zero for the duration of the active irradiation period.
-

NOTE

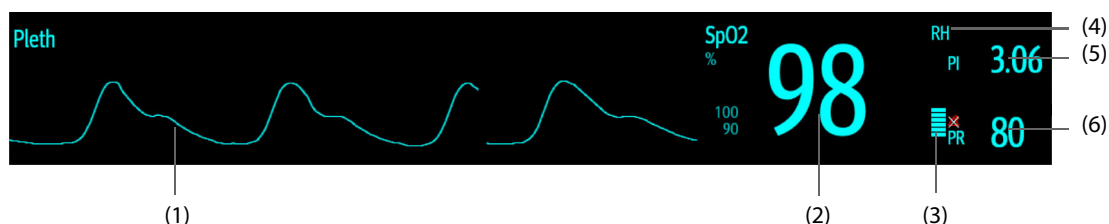
- **Additional information specific to the Masimo sensors compatible with the equipment, including information about parameter/measurement performance during motion and low perfusion, may be found in the sensor's directions for use (DFU).**
- **Masimo cables and sensors are provided with X-Cal™ technology 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.**

10.3 SpO₂ Measurement Limitations

The following factors may influence the accuracy of SpO₂ measurement:

- Patient physiological characteristics:
 - ◆ Cardiac arrest
 - ◆ Hypotension
 - ◆ Darkly pigmented skin
 - ◆ Shock
 - ◆ Severe vasoconstriction
 - ◆ Hypothermia
 - ◆ Severe anemia
 - ◆ Ventricular septal defects (VSDs)
 - ◆ Venous pulsations
 - ◆ Poor perfusion
 - ◆ Dysfunctional hemoglobin, such as carboxyhemoglobin (COHb) and methemoglobin (MetHb)
 - ◆ Elevated levels of bilirubin
 - ◆ Vasospastic disease, such as Raynaud's, and peripheral vascular disease
 - ◆ Hemoglobinopathies and synthesis disorders such as thalassemias, Hb s, Hb c, sickle cell, etc.
 - ◆ Hypocapnic or hypercapnic conditions
 - ◆ Birthmark(s), tattoos, skin discolorations, moisture on skin, deformed or abnormal fingers. etc.
- Interfering substances:
 - ◆ Intravascular dyes (such as indocyanine green, methylene blue, indigo carmine, etc.)
 - ◆ Dyes in the measure site, such as nail polish
- Environmental conditions:
 - ◆ Excessive ambient light
 - ◆ Electrosurgery equipment
 - ◆ Defibrillation (may cause inaccurate reading for a short amount of time)
 - ◆ Excessive patient/sensor motion
 - ◆ Electromagnetic field
 - ◆ Arterial catheters and intra-aortic balloon
- Others
 - ◆ Inappropriate positioning of the SpO₂ sensor, or use of incorrect SpO₂ sensor
 - ◆ Cuff or arterial blood pressure measurement device on the same limb as the SpO₂ sensor

10.4 SpO₂ Display



- (1) Pleth waveform (Pleth): visual indication of patient's pulse. The waveform is not normalized.
- (2) Oxygen saturation of arterial blood (SpO₂): percentage of oxygenated hemoglobin in relation to the sum of oxyhemoglobin and deoxyhemoglobin.
- (3) Perfusion indicator: the pulsatile portion of the measured signal caused by arterial pulsation.
- (4) Measurement site: displays if you have set the measurement site as described in *10.6.9 Setting the Measurement Site*.
- (5) Perfusion index (PI): gives the numerical value for the pulsatile portion of the measured signal caused by arterial pulsation. PI is an indicator of the pulsatile strength. You can also use it to assess the SpO₂ signal strength. When PI is too low, the message "SpO₂ Low Perfusion" is given to prompt SpO₂ signal inadequacy.
- (6) Pulse rate (derived from the pleth wave): detected pulsations per minute.

NOTE

- **PI is displayed for Masimo SpO₂.**

10.5 Preparing for SpO₂ Monitoring

To prepare to monitor SpO₂, follow this procedure:

1. Select an appropriate sensor according to the module type, patient category and weight.
2. Clean the contact surface of the reusable sensor.
3. Remove colored nail polish from the application site.
4. Apply the sensor to the patient according to the instruction for use of the sensor.
5. Select an appropriate extension cable according to the connector type and plug the cable into the SpO₂ connector.
6. Connect the sensor to the extension cable.

CAUTION

- **Do not apply sensor too tightly as this results in venous pulsation which may severely obstruct circulation and lead to inaccurate measurements.**
- **At elevated ambient temperatures, be careful with measurement sites that are not well perfused, because this can cause burns after prolonged application.**
- **Avoid placing the sensor on extremities with an arterial catheter, an NIBP cuff or an intravascular venous infusion line.**
- **For neonatal patients, make sure that all sensor connectors and adapter cable connectors are outside the incubator. The humid atmosphere inside can cause inaccurate measurements.**

10.6 Changing the SpO₂ Settings

NOTE

- **The settings of in the SpO₂ module and SpO₂b module are linked.**

10.6.1 Changing the SpO₂ Alarm Settings

To change the SpO₂ alarm settings, follow this procedure:

1. Select the SpO₂ numeric area or waveform area to enter the **SpO2** dialog.
2. Select the **Alarm** tab.
3. Enter the password if required. For more information, refer to *21.13.3 Selecting Password for User Authentication*.
4. Set the alarm properties as desired.

NOTE

- **The desat alarm is a high level alarm notifying you of potentially life threatening drops in oxygen saturation. When the SpO₂ value is below the desat alarm limit and desat alarm switch is set on, the message “SpO2 Desat” is displayed.**
- **You can switch off the SpO₂ Desat alarm only when you have configured the monitor to allow the SpO₂ Desat alarm to be turned off. For more information, see section 21.3.4 Setting Guard Limits.**

10.6.2 Nellcor SatSeconds™ Alarm Management

With traditional alarm management, high and low alarm limits are set for monitoring oxygen saturation. During monitoring, once an alarm limit is violated, an audible alarm immediately sounds. When the patient SpO₂ fluctuates near an alarm limit, the alarm sounds each time the limit is violated. Such frequent alarms can be distracting. Nellcor's SatSeconds alarm management technique is used to reduce these nuisance alarms.

The SatSeconds feature is available with the Nellcor SpO₂ to decrease the likelihood of false alarms caused by motion artifacts. With SatSeconds alarm management, high and low alarm limits are set in the same way as those with traditional alarm management. A SatSeconds limit is also set. The SatSeconds limit controls the amount of time that SpO₂ saturation may be outside the set limits before an alarm sounds.

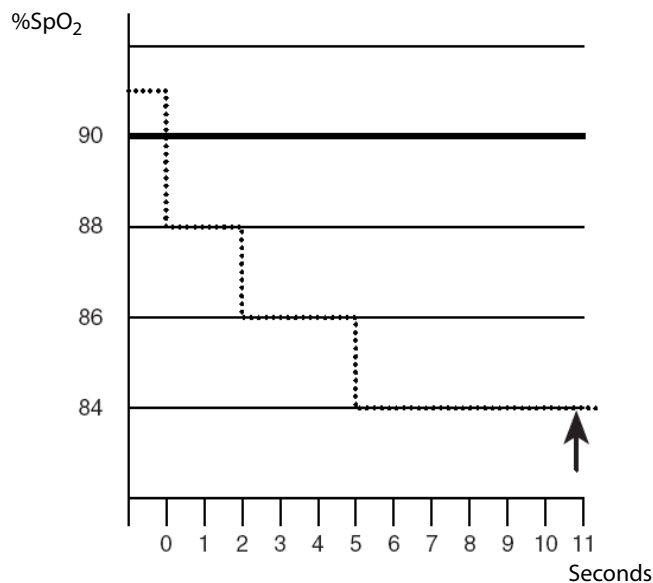
The method of calculation is as follows: the percentage points of the SpO₂ saturation falling outside the alarm limit is multiplied by the number of seconds remaining outside the limit. This can be stated as the equation:

$$\text{SatSeconds} = \text{Points} \times \text{Seconds}$$

Only when the SatSeconds limit is reached, the monitor gives a SatSeconds alarm. For example, the figure below demonstrates the alarm response time with a SatSeconds limit set at 50 and a low SpO₂ limit set at 90%. In this example, the patient SpO₂ drops to 88% (2 points) and remains there for 2 seconds. Then it drops to 86% (4 points) for 3 seconds, and then to 84% (6 points) for 6 seconds. The resulting SatSeconds are:

% SpO ₂	Seconds	SatSeconds
2×	2=	4
4×	3=	12
6×	6=	36
Total SatSeconds=		52

After approximately 11 seconds, a Sat-Second alarm would sound, because the limit of 50 SatSeconds would have been exceeded.



Saturation levels may fluctuate rather than remaining steady for a period of several seconds. Often, the patient SpO_2 may fluctuate above and below an alarm limit, re-entering the non-alarm range several times. During such fluctuation, the monitor integrates the number of SpO_2 points, both positive and negative, until either the SatSeconds limit is reached, or the patient SpO_2 re-enters the non-alarm range and remains there.

NOTE

- **The SpO_2 Too Low or SpO_2 Too High alarm is presented in the case that SpO_2 value violates the alarm limits 3 times within one minute even if the setting of SatSeconds is not reached.**

To set the SatSeconds, follow this procedure:

1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** dialog.
2. Select the **Alarm** tab.
3. Set **Sat-Seconds**.

10.6.3 Setting SpO_2 Sensitivity (for Masimo SpO_2)

For Masimo SpO_2 , select the **Sensitivity** as per signal quality and patient motion.

Normal sensitivity is the recommended for patients who are experiencing some compromise in blood flow or perfusion. It is advisable for care areas where patients are observed frequently, such as the intensive care unit (ICU).

Adaptive Probe Off Detection (APOD) sensitivity is the recommended sensitivity mode where there is a high probability of the sensor becoming detached. It is also the suggested mode for care areas where patients are not visually monitored continuously. This mode delivers enhanced protection against erroneous pulse rate and arterial oxygen saturation readings when a sensor becomes inadvertently detached from a patient due to excessive movement.

Maximum sensitivity is recommended for use on patients with weak signals (e.g. high ambient noise and/or patients with very low perfusion) and for use during procedures or when clinician and patient contact is continuous such as in higher acuity settings.

To set SpO_2 sensitivity, follow this procedure:

1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** dialog.
2. Select the **Setup** tab.
3. Set **Sensitivity** to **Maximum, Normal, or APOD**.

CAUTION

- When using the Maximum Sensitivity setting, performance of "Sensor Off" detection may be compromised. If the equipment and the sensor becomes detached from the patient, the potential for false readings may occur due to environmental noise such as light, and vibration.
 - Configuring the monitor to "Load Latest Configuration" as the default configuration may result in Masimo SpO₂ being set to Maximum sensitivity mode on power up or after admitting a new patient. Maximum sensitivity is recommended for use during procedures or when clinician and patient contact is continuous, such as in higher acuity settings. Maximum sensitivity is not recommended for care areas where patients are not monitored visually as "Sensor Off" detection may be compromised. Refer to *Section 20.4 Setting Default Configuration* for managing configuration.
-

10.6.4 Enabling FastSAT (for Masimo SpO₂)

FastSAT enables rapid tracking of arterial oxygen saturation changes as may be required in urgent situations. When FastSAT is switched on, the averaging algorithm evaluates all the SpO₂ values and provides an averaged SpO₂ value that is a better representation of the patient's current oxygen saturation status.

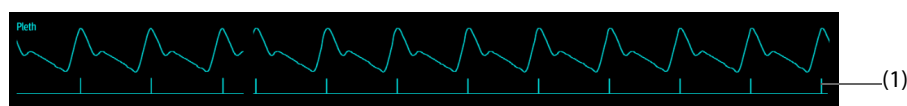
The reliability of FastSAT is dependent on the setting for the averaging time and the input signal. FastSAT is disabled by default. To enable FastSAT, follow this procedure:

1. Select the SpO₂ numeric area or waveform area to enter the **SpO2** dialog.
2. Select the **Setup** tab.
3. Switch on **FastSAT**.

10.6.5 Displaying SIQ (for Masimo SpO₂)

The signal quality indicator (SIQ) displays below the Pleth waveform. The SIQ is conveyed by vertical bars. The height of the bar provides an assessment of the confidence in the displayed SpO₂ value. The SpO₂ SIQ can also be used to identify the occurrence of a patient's pulse.

The following picture shows the SpO₂ SIQ:



(1) Signal quality indicator (SIQ)

To show SpO₂ SIQ, follow this procedure:

1. Select the SpO₂ numeric area or waveform area to enter the **SpO2** dialog.
2. Select the **Setup** tab.
3. Switch on **Display SIQ**.

10.6.6 Changing Averaging Time (for Masimo SpO₂)

The SpO₂ value displayed on the monitor screen is the average of data collected within a specific time. The shorter the averaging time is, the quicker the monitor responds to changes in the patient's oxygen saturation level. Contrarily, the longer the averaging time is, the slower the monitor responds to changes in the patient's oxygen saturation level, but the SpO₂ measurement is more stable. For critically ill patients, selecting a shorter averaging time will help with understanding the patient's state.

To set the averaging time, follow this procedure:

1. Select the SpO₂ numeric area or waveform area to enter the **SpO2** dialog.
2. Select the **Setup** tab.
3. Set **Averaging**.

10.6.7 Monitoring SpO₂ and NIBP Simultaneously

When monitoring SpO₂ and NIBP on the same limb simultaneously, you can switch on **NIBP Simul** to lock the SpO₂ alarm status until the NIBP measurement ends. If you switch off **NIBP Simul**, low perfusion caused by NIBP measurement may lead to inaccurate SpO₂ readings and therefore cause false physiological alarms.

To set the **NIBP Simul**, follow this procedure:

1. Select the SpO₂ numeric area or waveform area to enter the **SpO2** dialog.
2. Select the **Alarm** tab.
3. Set **NIBP Simul**.

10.6.8 Changing the Sweep Speed of the Pleth Waveform

To set the sweep speed of Pleth waveform, follow this procedure:

1. Select the SpO₂ numeric area or waveform area to enter the **SpO2** dialog.
2. Select the **Setup** tab.
3. Set **Speed**.

10.6.9 Setting the Measurement Site

You can set the measurement site based on the application site of SpO₂ sensor. Follow this procedure:

1. Select the SpO₂ numeric area or waveform area to enter the **SpO2** dialog.
2. Select the **Setup** tab.
3. Set **SpO2 Position**.

10.7 Changing the PR Settings

10.7.1 Changing the PR Alarm Settings

To change the PR alarm settings, follow this procedure:

1. Select the SpO₂ numeric area or waveform area to enter the **SpO2** dialog.
2. Select the **PR** tab.
3. Enter the password if required. For more information refer to *21.13.3 Selecting Password for User Authentication*.
4. Set the alarm properties as desired.

10.7.2 Changing the QRS Volume

If the **Alarm Source** is set to **PR**, the QRS tone is derived from PR measurements. To set the QRS volume, follow this procedure:

1. Select the SpO₂ numeric area or waveform area to enter the **SpO2** dialog.
2. Select the **PR** tab.
3. Select the **Setup** tab.
4. Set **QRS Volume**.

If the SpO₂ value is valid, the monitor also adjusts the QRS tone (pitch tone) according to the SpO₂ value. For information, see *21.15.5 Setting the SpO₂ Tone Mode*.

NOTE

- **Changing the QRS volume settings in the PR Setup page also changes the QRS volume settings in the Setup page of the ECG dialog.**

10.7.3 Setting the PR Source

Current pulse source is displayed in the PR numeric area if current PR source is not SpO₂. The PR from current pulse source has the following characteristics:

- PR is stored in the monitor's database and can be reviewed in the graphic and tabular trends. In graphic trends, as the PR curve has the same color as that of current PR source.
- PR is sent via the network to the CMS, if available.

To set which parameter is used as a PR source, follow this procedure:

1. Select the SpO₂ numeric area or waveform area to enter the **SpO2** dialog.
2. Select the **PR** tab.
3. Select the **Setup** tab.
4. Set **PR Source**.

The dropdown list of the **PR Source** displays the currently available PR sources from top to bottom by priority. When you select **Auto**, the system will automatically select the first option as the PR source. If the current PR source is unavailable, the system will automatically switch **PR Source** to **Auto**. When you select **IBP**, the system will automatically select the first pressure label as the PR source.

10.7.4 Showing/Hiding PR

You can set whether to display the PR value in the SpO₂ parameter area. To do so, follow this procedure:

1. Select the SpO₂ numeric area or waveform area to enter the **SpO2** dialog.
2. Select the **PR** tab.
3. Select the **Setup** tab.
4. Switch on or off **Display PR**.

10.8 SpO₂ Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting service. If the problem persists, contact your service personnel.

NOTE

- For the physiological and technical alarm messages, see **Appendix D Alarm Messages**.

Problem	Solution
Do not see SpO ₂ numeric area or waveform area on the main screen	<ol style="list-style-type: none">1. Check that the SpO₂ is set to display in the Screen Setup → Tile Layout page. For more information, see 3.9.2 <i>Displaying Parameter Numerics and Waveforms</i>.2. Check that the SpO₂ parameter switch is enabled. If not, enable the SpO₂ measurement. For more information, see 3.9.1 <i>Switching On or Off a Parameter</i>.3. Check that the cable connections of the SpO₂ sensor and the extension cable are tight. Replace the SpO₂ sensor or the extension cable if needed.
Dashes "- -" display in place of numerics	<ol style="list-style-type: none">1. Check that the cable connections of SpO₂ sensor and the extension cable are tight. Replace the SpO₂ sensor or the extension cable if needed.2. Reconnect the SpO₂ sensor if the alarm SpO2 Sensor Off appears.3. Check the PI value. If the PI value is too low, adjust the SpO₂ sensor, or apply the sensor to a site with better perfusion.4. Move the sensor to a place with weaker ambient light, or cover the sensor to minimize the ambient light if the alarm SpO2 Too Much Light appears.

Problem	Solution
Low amplitude SpO ₂ signal	<ol style="list-style-type: none"> 1. The SpO₂ sensor and NIBP cuff are placed on the same limb. Change the monitoring site if necessary. 2. Check the PI value. If the PI value is too low. Adjust the SpO₂ sensor, or apply the sensor to a site with better perfusion.
SpO ₂ value is inaccurate	<ol style="list-style-type: none"> 1. Check the patient's vital signs. 2. Check for conditions that may cause inaccurate SpO₂ readings. For more information, see <i>10.3 SpO₂ Measurement Limitations</i>. 3. Check the monitor, the SpO₂ module or the MPM for proper functioning.

10.9 Nellcor Information



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11 Monitoring Temperature (Temp)

11.1 Temperature Introduction

The monitor can continuously monitor the patient's skin temperature and core temperature. Thermally sensitive resistors (thermistors) are used, and are based on the principle that electrical resistance of the thermistor changes as temperature changes. The resistance change of the thermistors is used to calculate the temperature.

Up to two temperature sites can be monitored simultaneously and the difference between two measured sites is calculated.

Temperature monitoring is intended for adult, pediatric and neonatal patients.

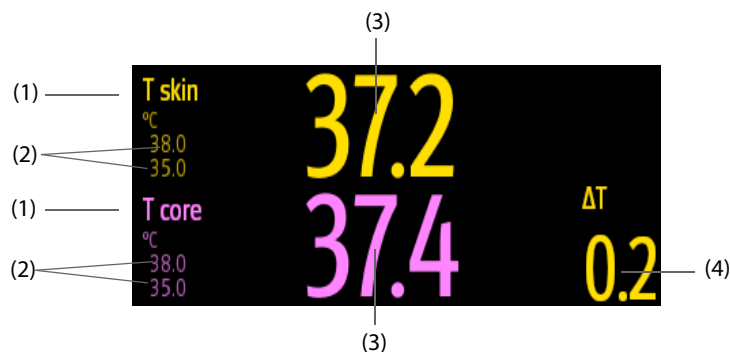
11.2 Temperature Safety Information

CAUTION

- **Verify that the probe detection program works correctly before monitoring. Remove the temperature probe cable from the temperature probe connector, and check that the monitor can display the alarm messages and give alarm tones correctly.**

11.3 Temperature Display

The following figure shows the Temp numeric area for temperature monitoring with the monitor. Your display may be configured to look different.



(1) Temperature site

(2) Temperature alarm limits

(3) Temperature value

(4) Temperature difference (ΔT): Difference between two temperature sites. It displays only when ΔT is switched on.

11.4 Preparing for Temperature Monitoring

To prepare temperature monitoring, follow this procedure:

1. Select an appropriate probe for your patient according to patient category and measured site.
2. Plug the probe or temperature cable to the temperature connector. If using a disposable probe, connect the probe to the temperature cable.
3. Follow the probe manufacturer's instructions to connect the probe to the patient.

11.5 Changing Temperature Settings

11.5.1 Setting the Temperature Alarm Properties

To set the temperature alarm properties, follow this procedure:

1. Select the temperature numeric area to enter the **Temp** dialog.
2. Select the **Alarm** tab.
3. Enter the password if required. For more information, refer to 21.13.3 *Selecting Password for User Authentication*.
4. Set the alarm properties as desired.

11.5.2 Selecting the Temperature Label

Select the temperature label according to the measurement site. To do so, follow this procedure:

1. Select the temperature numeric area to enter the **Temp** dialog.
2. Select the **Setup** tab.
3. Set the temperature label.

Label	Description	Label	Description
T1	Temperature of application site 1	T amb	Ambient temperature
T2	Temperature of application site 2	T airw	Airway temperature
T skin	Skin temperature	T vesic	Vesical temperature
T core	Core temperature	T blood	Blood temperature
T axil	Axillary temperature	T myo	Myocardial temperature
T naso	Nasopharyngeal temperature	T tym	Tympanic temperature
T eso	Esophageal temperature	T cereb	Cerebral temperature
T rect	Rectal temperature		

11.5.3 Displaying the Temperature Difference

To display the temperature difference between two measurement sites monitored by the same temperature module, switch on ΔT . To do so, follow this procedure:

1. Select the temperature numeric area to enter the **Temp** dialog.
2. Select the **Setup** tab.
3. Switch on ΔT .

11.6 Temperature Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting service. If the problem persists, contact your service personnel.

NOTE

- For the physiological and technical alarm messages, see **Appendix D Alarm Messages**.

Problem	Solution
Do not see Temp numeric area on the main screen	<ol style="list-style-type: none"> 1. Check that if the Temp parameter switch is enabled. If not, enable the Temp measurement. For more information, see <i>3.9.1 Switching On or Off a Parameter</i>. 2. Check that the connections of the temperature probe and the temperature cable are tight.
Measurement fails/'--' is displayed in the Temp numeric area	<ol style="list-style-type: none"> 1. If using a disposable probe, check the connection between the probe and the temperature cable. 2. Try using a known good probe in case the sensor is damaged.

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12 Monitoring Noninvasive Blood Pressure (NIBP)

12.1 NIBP Introduction

The monitor uses the oscillometric method for measuring Non-Invasive Blood Pressure (NIBP). NIBP measurement is based on the principle that pulsatile blood flow through an artery creates oscillations of the arterial wall. The oscillometric device uses a blood pressure cuff to sense these oscillations that appear as tiny pulsations in cuff pressure. The oscillometric devices measure the amplitude of pressure changes in the occluding cuff as the cuff deflates from above systolic pressure. The amplitude suddenly increases as the pulse breaks through the occlusion in the artery. As the cuff pressure decreases further, the pulsations increase in amplitude, reach a maximum (which approximates to the mean pressure), and then diminish. The oscillometric method measures the mean pressure and determines the systolic and diastolic pressures.

NIBP monitoring is intended for adult, pediatric, and neonatal patients.

NOTE

- **Blood pressure measurements determined with this device are equivalent to those obtained by a trained observer using the cuff/stethoscope auscultatory method or an intra-arterial blood pressure measurement device, within the limits prescribed by the American National Standard: manual, electronic, or automated sphygmomanometers.**
- **NIBP measurement can be performed during electro-surgery and discharge of a defibrillator.**

12.2 NIBP Safety Information

WARNING

- **Be sure to select the correct patient category setting for your patient before NIBP measurement. Do not apply the higher adult settings for pediatric or neonatal patients. Otherwise, it may present a safety hazard.**
- **Do not measure NIBP on patients with sickle-cell disease or on the limb where skin damage has occurred or is expected.**
- **Use clinical judgment to determine whether to perform frequent unattended blood pressure measurements on patients with severe blood clotting disorders because of the risk of hematoma in the limb fitted with the cuff.**
- **Do not use the NIBP cuff on a limb with an intravenous infusion or arterial catheter in place. This could cause tissue damage around the catheter when the infusion is slowed or blocked during cuff inflation.**
- **Do not apply cuff on the arm on the side of a mastectomy or lymph node clearance.**
- **Continuous cuff pressure due to connection tubing kinking may cause blood flow interference and result in harmful injury to the patient.**
- **NIBP reading can be affected by the measurement site, the position of the patient, exercise, or the patient's physiologic condition. If you doubt the NIBP measurements, determine the patient's vital signs by alternative means, and then verify that the monitor is working correctly.**
- **Devices that exert pressure on tissue have been associated with purpura, ischemia, and neuropathy. Inspect the application site regularly to ensure skin quality and inspect the extremity of the cuffed limb for normal color, warmth and sensitivity. If the skin quality changes, or if the extremity circulation is being affected, move the cuff to another site or stop the blood pressure measurements immediately. Check more frequently when making automatic or STAT measurements. Auto NIBP measurements with one and two minute intervals are not recommended for extended periods of time.**
- **Do not modify or replace connectors of the NIBP air hose except with Mindray approved connectors. Use neonatal and infant cuffs with CM1901 hoses only. Use pediatric/adult cuffs with CM1903 hoses only.**

- **Never connect intra-arterial or intra-venous lines, or any other incompatible connectors to the NIBP hose. This can cause serious injury or death.**
 - **NIBP diagnostic significance must be decided by the hospital's clinician staff.**
-

CAUTION

- **Measuring NIBP on patients connected to an Intra Aortic Balloon Pump (IABP) machine may result in the NIBP measurement, including PR, to be inaccurate or fail.**
 - **Only use parts and accessories specified in this manual. Follow the instructions for use and adhere to all warnings and cautions.**
 - **Accuracy of NIBP measurement depends on using a cuff of proper size. It is essential to measure limb circumference and choose a cuff with proper size.**
-

12.3 NIBP Measurement Limitations

Measurements are impossible with heart rate extremes of less than 30 bpm or greater than 300 bpm, or if the patient is on a heart-lung machine. The measurement may be inaccurate or impossible in the following situations:

- Regular arterial pressure pulses are hard to detect
- Excessive and continuous patient movement such as shivering or convulsions
- Cardiac arrhythmias
- Rapid blood pressure changes
- Severe shock or hypothermia that reduces blood flow to the peripheries
- On an edematous extremity
- Obesity, where a thick layer of fat surrounding a limb dampens the oscillations coming from the artery

NOTE

- **The effectiveness of this sphygmomanometer has not been established in pregnant women, including pre-eclamptic patients.**
-

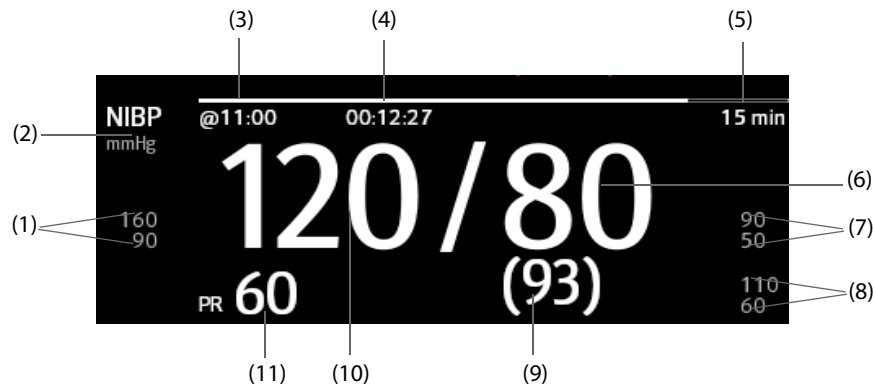
12.4 Measurement Modes

The monitor provides the following NIBP measurement modes:

- Manual: measurement on demand.
- Auto: repeated measurements at set interval.
- STAT: continual rapid series of measurements over a five-minute period.
- Sequence: continually automatic measurement at set durations and intervals.

12.5 NIBP Display

The NIBP display shows only numerics.



- (1) Systolic pressure alarm limits
- (2) NIBP unit: mmHg or kPa
- (3) The last NIBP measurement time
- (4) Time to the next measurement (for Auto mode and Sequence mode)
- (5) Measurement mode: for Auto NIBP, interval is displayed; for Sequence mode, the current phase and interval are displayed
- (6) Diastolic pressure
- (7) Diastolic pressure alarm limits
- (8) Mean pressure alarm limits
- (9) Mean pressure (displayed after measurement completed) or cuff pressure (displayed during the measurement)
- (10) Systolic pressure
- (11) Pulse Rate

NOTE

- If NIBP measurement fails, "XX" is displayed; if NIBP measurement is not taken or NIBP measurement exceeds its measurement ranges, "--" is displayed.
- NIBP numerics in black color with a light outline indicate that the measurement is old and exceeds the configured NIBP Measurement Timeout time (see section 21.5.8 Setting Parameter Measurement Timeout). These NIBP values are not recommended for reference.

12.6 Preparing for NIBP Measurements

12.6.1 Preparing the Patient for NIBP Measurements

In normal use, perform NIBP measurement on a patient who is in the following position:

- Comfortably seated
- Legs uncrossed
- Feet flat on the floor
- Back, arm and feet supported

NOTE

- Per ISO 80601-2-30, it is recommended that the patient remains calm and relaxes as much as possible before performing the measurement, five minutes should elapse before the first reading is taken, and that the patient does not talk during the measurement.
- Other factors that have been shown to result in an overestimation of blood pressure are labored breathing, full bladder, pain etc.

12.6.2 Placing the NIBP Cuff

To place the NIBP cuff, follow this procedure:







1. Verify that the patient category setting is correct.
2. Connect the air tubing to the NIBP connector.
3. Select an appropriately sized cuff for the patient, and then wrap it around the limb directly over the patient's skin as follows:
 - a Determine the patient's limb circumference.
 - b Select an appropriate cuff by referring to the limb circumference marked on the cuff. The width of the cuff should be 40% (50% for neonates) of the limb circumference, or 2/3 of the length of the upper arm or the thigh. The inflatable part of the cuff should be long enough to encircle to overlap at least 50% to 80% of the limb.
 - c Apply the cuff to the patient's upper arm or leg and make sure the Φ marking on the cuff matches the artery location. The cuff should fit snugly, but with enough room for two fingers to be placed between the cuff and the patient's arm (on adults), and loosely on neonates with little or no air present within the cuff. Otherwise it may cause discoloration and ischemia of the extremities. Make sure that the cuff index line falls within the range markings on the cuff. If it does not, use a cuff that fits better.
 - d Middle of the cuff should be at the level of the right atrium of the heart. If it is not, use the measurement correction formula to correct the measurement. For more information, see *12.8.7 Setting the NIBP Display Format*.
4. Connect the cuff to the air tubing. Avoid compression or restriction of pressure tubes. Air must pass unrestricted through the tubing.


CAUTION

- Do not touch or apply external pressure against the cuff and air tubing during NIBP measurement. This may cause inaccurate blood pressure values.
- Use care when placing the cuff on an extremity used for monitoring other patient parameters.

12.7 Starting and Stopping NIBP Measurements

Start and stop NIBP measurement by selecting the NIBP quick keys or from the NIBP dialog.

Task	By Quick Key	From NIBP dialog
Start a manual measurement	NIBP Start/Stop quick key 	Start NIBP button
Start auto NIBP series	NIBP Start/Stop quick key 	Setup tab → set Interval → Start NIBP button
	NIBP Measure quick key  → select Interval	
Start NIBP sequence measurement	NIBP Measure quick key  → Sequence	Sequence tab → set NIBP sequence → Start NIBP button
Start STAT measurement	NIBP Measure quick key  → STAT	STAT button
Stop the current NIBP measurements	NIBP Start/Stop quick key 	Stop NIBP button

Task	By Quick Key	From NIBP dialog
End auto NIBP series or NIBP Sequence	/	NIBP Stop All button
Stop STAT measurement and end series	NIBP Start/Stop quick key 	Stop NIBP or NIBP Stop All button

12.8 Changing NIBP Settings

12.8.1 Setting the NIBP Alarm Properties

To set the NIBP alarm properties, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** dialog.
2. Select the **Alarm** tab.
3. Enter the password if required. For more information, refer to 21.13.3 *Selecting Password for User Authentication*.
4. Set the alarm properties as desired.

12.8.2 Setting the Initial Cuff Inflation Pressure

To set initial cuff inflation pressure, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** dialog.
2. Select **Initial Pressure**, and then select the appropriate setting.

NOTE

- **For known hypertensive patients, you need to set initial cuff pressure to a higher value to reduce the measurement time.**

12.8.3 Setting the NIBP Interval

For auto NIBP measurement, you need to set the interval between two NIBP measurements. To set the NIBP interval, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** dialog.
2. Set **Interval**. Selecting **Manual** switches to manual mode.

NOTE

- **NIBP Measure dialog gives quick access to starting and setting the interval. Selecting an option from the NIBP Measure dialog will change the NIBP interval to that selection and start the NIBP measurement.**

12.8.4 Selecting NIBP Start Mode

Start mode defines how future NIBP measurements are initiated with automatic measurement mode. To set the start mode, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** dialog.
2. Select **Start Mode**.
 - ◆ **Clock:** after the first measurement, the monitor automatically synchronizes NIBP automatic measurements with the real time clock. For example, if **Interval** is set to **20 min**, and NIBP auto measurement is started at 14:03, the next measurement will be taken at 14:20, and then at 14:40, 15:00, and so on.

- ◆ **Interval:** after the first measurement, the monitor automatically repeats measurements at set interval. For example, if **Interval** is set to **20 min**, and NIBP auto measurement is started at 14:03, the next measurement will be taken at 14:23, and then at 14:43, 15:03, and so on.

12.8.5 Enabling the NIBP End Tone

The monitor can issue a reminder tone at the completion of NIBP measurement. The NIBP End Tone is off by default. To switch on the NIBP end tone, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** dialog.
2. Switch on **NIBP End Tone**.

12.8.6 Setting NIBP Sequence

NIBP sequence measurement can have up to five phases: A, B, C, D, and E. The duration and interval of each phase can be set individually.

To set NIBP sequence, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** dialog.
2. Select the **Sequence** tab.
3. Set **Duration** and **Interval** of each phase.

12.8.7 Setting the NIBP Display Format

To set the NIBP display format, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** dialog.
2. Select the **Setup** tab.
3. Set **Display Format**.

12.8.8 Setting the NIBP Alarm Limits Display Switch

To set whether to display the alarm limits of diastolic NIBP and mean NIBP, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** dialog.
2. Select the **Setup** tab.
3. Switch on or off **Display Alarm Limits**.

12.8.9 Showing/Hiding PR

You can set whether to display the PR value in the NIBP parameter area. To do so, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** dialog.
2. Select the **Setup** tab.
3. Switch on or off **Display PR**.

12.8.10 Correcting the NIBP Measurements

The middle of the cuff should be at the level of right atrium. If the limb is not at the heart level, the measurement should be corrected as follows:

- Add 0.75 mmHg (0.10 kPa) to the displayed value for each centimetre higher.
- Deduct 0.75 mmHg (0.10 kPa) to the displayed value for each centimeter lower.

12.9 Assisting Venous Puncture

You can use the NIBP cuff to cause sub-diastolic pressure to block the venous blood vessel and therefore help venous puncture. To assist venous puncture, follow this procedure:

1. Select the NIBP numeric area → **Setup** tab.

2. Set **Venipuncture Pressure**.
3. Select **Venipuncture** at the bottom of the dialog.
4. Puncture vein and draw blood sample.
5. Select the **NIBP Start/Stop** quick key to deflate the cuff. If the cuff is not manually deflated, the cuff automatically deflates after a fixed period of time (170 seconds for adult and pediatric patient, 85 seconds for neonatal patient).

During venous puncture, pay attention to the cuff pressure and the remaining time displayed in the NIBP numerics area.

12.10 NIBP Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting for services. If the problem persists, contact your service personnel.

NOTE

- For the physiological and technical alarm messages, see **Appendix D Alarm Messages**.

Problem	Solution
Cannot see NIBP numeric area on the main screen	<ol style="list-style-type: none"> 1. Check that the NIBP is set to display in the Screen Setup → Tile Layout page. For more information, see <i>3.9.2 Displaying Parameter Numerics and Waveforms</i> 2. Check that if the NIBP parameter switch is enabled. If not, enable the NIBP measurement. For more information, see <i>3.9.1 Switching On or Off a Parameter</i>.

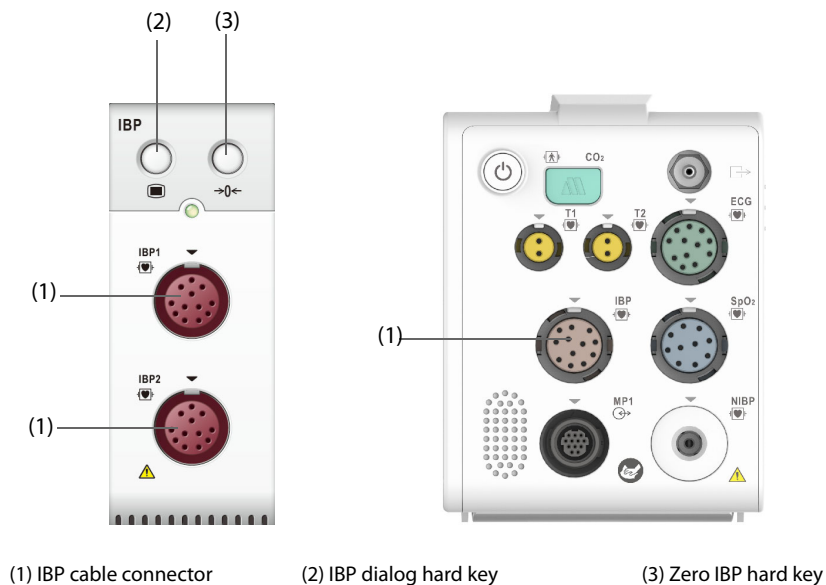
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13 Monitoring Invasive Blood Pressure (IBP)

13.1 IBP Introduction

This patient monitor can monitor up to four invasive blood pressures and displays the systolic, diastolic and mean pressures and a waveform for each pressure.

IBP monitoring is intended for adult, pediatric, and neonatal patients. PAWP monitoring is only intended for adult and pediatric patients.



CAUTION

- The IBP module cannot be used for transport outside the hospital environment.

NOTE

- In order for the N1 to connect to the external IBP module and perform IBP monitoring, the N1 system software V01.11.00 and above is required.
- If the N1 is connected to the CMS via WMTS, the CMS can display IBP measurements from both the MPM module and the IBP module, as well as IBP waveforms from the MPM module.

13.2 IBP Safety Information

WARNING

- Use only accessories specified in this manual. Never reuse disposable pressure transducers. See chapter 25.5 *IBP Accessories* for specified IBP accessories.
- Make sure that the applied parts never contact other conductive parts.
- To reduce the hazard of burns during high-frequency surgical procedures, ensure that the monitor's cables and transducers never come into contact with the high-frequency surgical units.
- When using accessories, their operating temperature should be taken into consideration. For more information, see instructions for use of accessories.
- All invasive procedures involve risks to the patient. Use aseptic technique. Follow catheter manufacturer's instructions.

- Mechanical shock to the invasive blood pressure transducer may cause severe shifts in zero balance and calibration, and cause erroneous readings.
- The neutral electrode of the electro-surgery unit (ESU) shall properly contact the patient. Otherwise, burns may result.

CAUTION

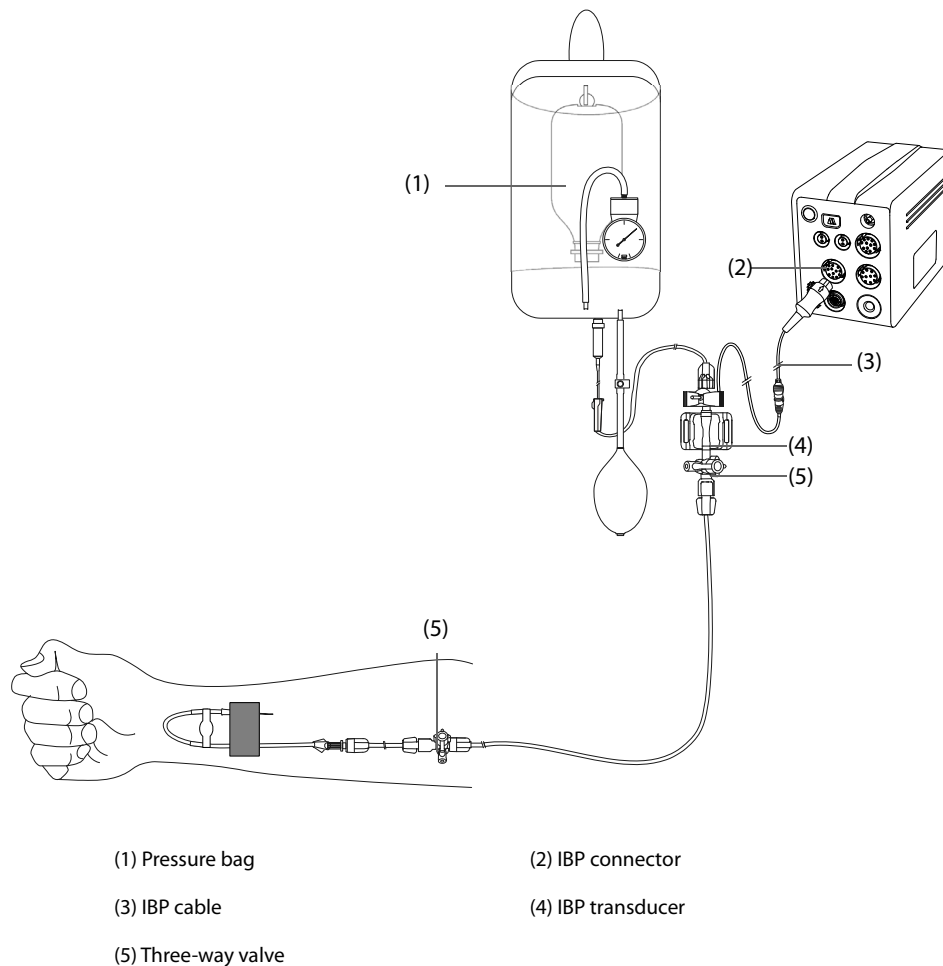
- Measuring IBP on patients connected to an Intra Aortic Balloon Pump (IABP) machine may result in the IBP measurement, including PR, to be inaccurate or fail.

NOTE

- PAWP monitoring is available only when using an external display.
-

13.3 Preparing for IBP Monitoring

13.3.1 IBP Equipment to Patient Connection



13.3.2 Measuring an Invasive Blood Pressure

To monitor IBP, follow this procedure:

1. Connect one end of the IBP cable to the IBP cable connector, and the other end to the IBP transducer.
2. Flush the IBP transducer system to exhaust all air from the tubing according to the manufacturer's instructions. Ensure that the system is free of air bubbles.
3. Connect the IBP transducer to the patient, making sure that the transducer is at the same horizontal level as the heart.

4. Select the proper pressure label for currently measured pressure. For more information, see *13.6.2 Changing the Pressure Label*.
5. Zero the IBP transducer. For more information, see *13.3.3 Zeroing the IBP transducer*. After a successful zeroing, turn off the three-way valve to the air and turn on the three-way valve to the patient.

CAUTION

- **Make sure that all the transducers are zeroed correctly before making IBP measurements.**
- **Make sure that all air bubbles have been flushed from the IBP transducer system before making IBP measurements.**
- **If measuring intracranial pressure (ICP) with a sitting patient, level the transducer with the top of the patient's ear. Incorrect leveling may give incorrect values (not applicable if measuring ICP with the Codman ICP transducer).**

NOTE

- **If two invasive blood pressures measurements are needed, use the IBP extension cable with dual-receptacle (PN: 040-001029-00) instead of the IBP cable.**
-

13.3.3 Zeroing the IBP transducer

To avoid inaccurate pressure readings, the monitor requires a valid zero. Zero the transducer in accordance with your hospital policy. The IBP transducer should be zeroed in the following conditions:

- The IBP transducer or adapter cable is reconnected.
- The monitor restarts.
- The readings are in doubt.
- The monitor displays the prompt message **Zero Required**.

To zero the transducer, follow this procedure:

1. Connect the IBP transducer, the IBP adapter cable and the monitor.
2. Turn off the three-way valve (the one near the transducer) to the patient, in order to vent the transducer to the atmospheric pressure.
3. Select the numeric area (such as the Art numeric area), and then select **Zero** button.
4. After the zero calibration is completed, close the three-way valve to the air and open the three-way valve to the patient.

Zero calibration may fail in case of pressure fluctuation or pressure exceeding the calibration range. If zero calibration fails, follow this procedure:

1. Check that the three-way valve (the one near the transducer) is open to the air.
2. Perform zero calibration again. Do not sway the IBP transducer and tubing during zero calibration.

13.4 Measuring ICP Using the Codman ICP Transducer

13.4.1 Zeroing the Codman ICP transducer

The Codman ICP transducer (Model: 82-6653) must be zeroed before use. To zero the ICP transducer, follow this procedure:

1. Connect the ICP transducer, the ICP adapter cable and the monitor.
2. Follow the manufacturer's instructions to prepare the ICP transducer.
3. Zero the ICP transducer: when the message **Zero Reference** is displayed in the ICP numeric area, select the ICP waveform area or numeric area to enter the **ICP** dialog → select the **Zero** tab → select the **Zero** button.
4. Record the zero reference value on the blank area of the ICP transducer for reference.

If the ICP transducer zero calibration failed or the zero reference value is in doubt, perform the zero calibration again.

13.4.2 Measuring ICP

To perform the ICP measurement, follow this procedure:

1. Zero the Codman ICP transducer. For more information, see section *13.4.1 Zeroing the Codman ICP transducer*.
2. Disconnect the ICP transducer and ICP adapter cable. Follow the manufacturer's instructions to apply the ICP transducer to the patient.
3. Reconnect the ICP transducer and ICP adapter cable.
4. Check that the zero reference value displayed on the monitor is consistent with that recorded on the ICP transducer.
 - ◆ Consistent: select **Accept**.
 - ◆ Inconsistent: input the zero reference value recorded on the ICP transducer, and select **Accept**.

If the patient being monitored for ICP must be transported, and N1 is not used for transport, check that the transport monitor supports the Codman ICP transducer. If the transport monitor does not support the Codman ICP transducer, do not use it for ICP monitoring.

If the transport monitor supports the Codman ICP transducer, follow this procedure to transport the patient:

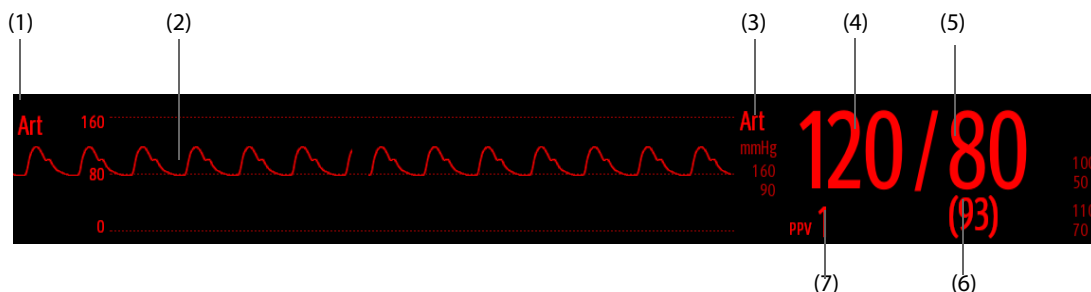
1. Disconnect the ICP adapter cable from the N1.
2. Connect the ICP adapter cable and the transport monitor.
3. Check that the zero reference value displayed on the monitor is consistent with that recorded on the ICP transducer.
 - ◆ Consistent: select **Accept**.
 - ◆ Inconsistent: input the zero reference value recorded on the ICP transducer, and select **Accept**.

CAUTION

- If monitors of different brands are used to zero the Codman ICP transducer, the zero reference values can be different. Use a Mindray monitor to Zero the Codman ICP transducer if you will take ICP measurement using a Mindray monitor. Otherwise the ICP measurement could be inaccurate.
-

13.5 IBP Display

The IBP measurement is displayed on the monitor as a waveform and numeric pressures. For arterial pressure, the IBP numeric area displays systolic pressure, diastolic pressure and mean pressure. For venous pressure, the IBP numeric area displays only the mean pressure. The figure below shows the waveform and numerics for the Art pressure.




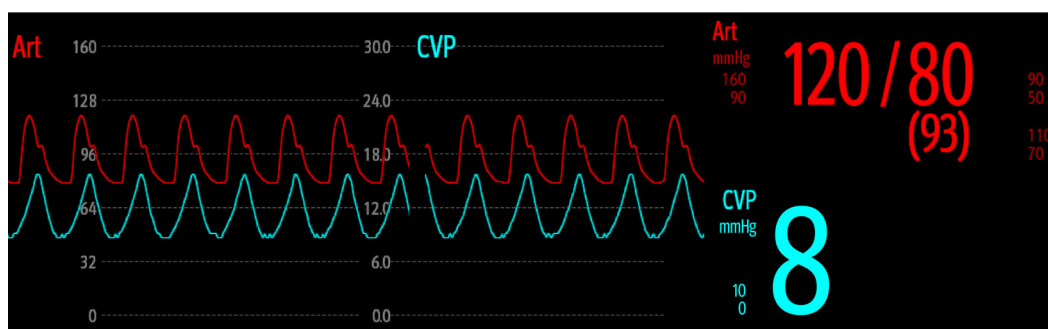
- | | |
|------------------------|-----------------------|
| (1) Pressure label | (2) Waveform |
| (3) Pressure Unit | (4) Systolic pressure |
| (5) Diastolic pressure | (6) Mean pressure |
| (7) PPV measurement | |

For some pressures, the parameter window may show the mean pressure only. For different pressures, their defaults unit may be different. If the Art and ICP pressures are measured simultaneously, the ICP parameter area will display numeric CPP, which is obtained by subtracting ICP from the Art mean.

13.5.1 Overlapping IBP Waveforms

The IBP waveforms can be displayed together. To combine IBP waveforms, follow this procedure:

1. Access **Tile Layout** by either of the following ways:
 - ◆ Select the **Screen Setup** quick key → select the **Tile Layout** tab.
 - ◆ Select **Main Menu** quick key → from the **Display** column select **Tile Layout**.
2. Select the waveform area where you want to display the overlapped IBP waveforms, and then select the IBP waves to be overlapped on the left side of the same line.
3. Repeat step 2 in another waveform area if needed.
4. Select  to save the setting and exit the screen. The main screen will display the overlapped IBP waves.



Selecting the overlapped IBP waveforms on the main screen opens the **Overlapping Waveform Setup** dialog, where you can make the following settings:

- **Scale**
 - ◆ Set **Left Scale** for the arterial pressure.
 - ◆ Set **Right Scale** for the venous pressure.
 - ◆ Set **CVP Scale** individually if the CVP waveform is combined and CVP unit is different from IBP unit.
 - ◆ Set **ICP Scale** individually if the ICP waveform is combined and ICP unit is different from IBP unit.
 - ◆ Set **PA Scale** individually if the PA waveform is combined.
- Switch on or off **Gridlines** to show or hide gridlines in the overlapped waveform area.
- Set **Speed** for the overlapped waveforms.

NOTE

- The unit of CVP scale is consistent with the CVP parameter unit.

13.6 Changing IBP Settings

13.6.1 Changing the IBP Alarm Settings

To change the IBP alarm settings, follow this procedure:

1. Select the IBP numeric area or waveform area to enter the corresponding pressure dialog.
2. Select the **Alarm** tab.
3. Enter the password if required. For more information, refer to 21.13.3 *Selecting Password for User Authentication*.
4. Set the alarm properties of pressure.

13.6.2 Changing the Pressure Label

The pressure label is a unique identifier for each type of pressure. Therefore, it is recommended to select the proper pressure label for the source of the pressure being monitored.

To select the pressure label, follow this procedure:

1. Select the IBP numeric area or waveform area to enter the corresponding pressure dialog.
2. Select the **Setup** tab.
3. Set **IBP1 Label** or **IBP2 Label**.

Label	Description	Label	Description
Art	Arterial blood pressure	PA	Pulmonary artery pressure
Ao	Aortic pressure	UAP	Umbilical arterial pressure
BAP	Brachial arterial pressure	FAP	Femoral arterial pressure
CVP	Central venous pressure	LAP	Left atrial pressure
RAP	Right atrial pressure	ICP	Intracranial pressure
UVP	Umbilical venous pressure	LV	Left ventricular pressure
P1 to P4	Non-specific pressure label		

NOTE

- **The same label cannot be selected for different pressures. When two pressures are detected having the same label, the monitor automatically changes one pressure label to a currently unused one.**

13.6.3 Setting the Pressure Type for Display

For the non-specific pressure (P1, P2, P3 or P4), the displayed pressure type is configurable. To set the displayed pressure type, follow this procedure:

1. Select the numeric area or waveform area of the non-specific pressure to enter the corresponding pressure dialog.
2. Select the **Setup** tab.
3. Set **Measure**:
 - ◆ If this non-specific pressure is arterial pressure, set the **Measure** to **All**. In this case, its corresponding numeric area displays systolic pressure, diastolic pressure and mean pressure.
 - ◆ If this non-specific pressure is venous pressure, set the **Measure** to **Mean Only**. In this case, its corresponding numeric area displays only the mean pressure.

13.6.4 Changing the Sensitivity

The IBP value displayed on the monitor screen is the average of data collected within a specific time. The shorter the averaging time is, the quicker the monitor responds to changes in the patient's blood pressure, and the higher the sensitivity. Contrarily, the longer the averaging time is, the slower the monitor responds to changes in the patient's blood pressure, the lower the sensitivity, but the measurement accuracy will be improved. For critically ill patients, selecting higher sensitivity will help with understanding the patient's state.

To set the sensitivity, follow this procedure:

1. Select the IBP numeric area or waveform area to enter the corresponding pressure dialog.
2. Select the **Setup** tab.
3. Set **Sensitivity**.

13.6.5 Setting the IBP Waveform

To set the IBP waveform, follow this procedure:

1. Select the IBP numeric area or waveform area to enter the corresponding pressure dialog.
2. Select the **Setup** tab.
3. Set the following properties of the IBP waveform:
 - ◆ **Speed**
 - ◆ **Scale**: if **Auto** is selected, the size of the pressure's waveform will be adjusted automatically.

13.6.6 Setting the Display Format of Artery Pressure

To set the display format of the artery pressure, follow this procedure:

1. Select the numeric area or waveform area of any arterial pressure to enter the corresponding dialog.
2. Select the **Setup** tab.
3. Set **Display Format**.

13.6.7 Showing/Hiding the Alarm Limits of Artery Pressure

To set whether to display the alarm limits of the arterial pressure, follow this procedure:

1. Select the numeric area or waveform area of any arterial pressure to enter the corresponding dialog.
2. Select the **Setup** tab.
3. Switch on or off **Display Alarm Limits**.

13.6.8 Setting the Use PA-D as PAWP Switch (only available when the N1 is used with the independent external display)

The PA-D value can be configured to replace the PAWP value for hemodynamic calculation. To do so, follow this procedure:

1. Select the PA numeric area or waveform area to enter the **PA** dialog.
2. Select the **Setup** tab.
3. Switch on or off **Use PA-D as PAWP**.

For more information on hemodynamic calculation, see *17.4 Hemodynamic Calculations*.

13.6.9 Enabling PPV Measurement

PPV indicates pulse pressure variation. When measuring the arterial pressure (except PA), the PPV measurement is available. To enable the PPV measurement, follow this procedure:

1. Select the IBP numeric area or waveform area to enter the corresponding pressure dialog.
2. Select the **PPV Setup** tab.
3. Switch on **PPV Measure**.

You can select PPV source after enabling the PPV measurement.

WARNING

- **This monitor can calculate PPV from beat-to-beat values of any arterial pulsatile pressure. The circumstances under which the calculation of a PPV value is clinically meaningful, appropriate and reliable must be determined by a physician.**
- **The clinical value of the derived PPV information must be determined by a physician. According to recent scientific literature, the clinical relevance of PPV information is restricted to sedated patients receiving controlled mechanical ventilation and mainly free from cardiac arrhythmia.**
- **PPV calculation may lead to inaccurate values in the following situations:**
 - ◆ **at respiration rates below 8 rpm**
 - ◆ **during ventilation with tidal volumes lower than 8 ml/kg**
 - ◆ **for patients with acute right ventricular dysfunction (cor pulmonale).**

- The PPV measurement has been validated only for adult patients.

13.7 PAWP (only available when the N1 is used with the independent external display)

Pulmonary Artery Wedge Pressure (PAWP) values, used to assess cardiac function, are affected by fluid status, myocardial contractility, and valve and pulmonary circulation integrity.

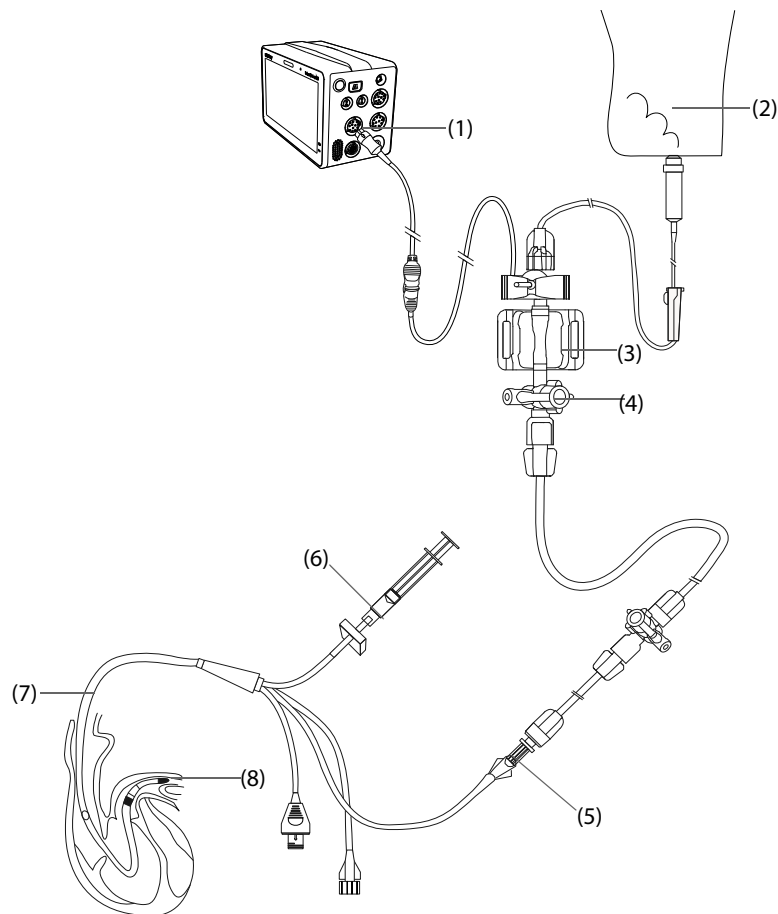
Obtain the measurement by introducing a balloon-tipped pulmonary artery flotation catheter into the pulmonary artery. When the catheter is in one of the smaller pulmonary arteries, the inflated balloon occludes the artery allowing the monitor to record changes in the intrathoracic pressures that occur throughout the respiration cycle.

The pulmonary wedge pressure is the left ventricular end diastolic pressure when the airway pressure and valve function are normal. The most accurate PAWP values are obtained at the end of the respiration cycle when the intrathoracic pressure is fairly constant and the artifact caused by respiration is minimal.

WARNING

- PAWP monitoring is not intended for neonatal patients.

13.7.1 PAWP Equipment to Patient Connection



- | | |
|-----------------------------|-------------------------------|
| (1) IBP connector | (2) Flush bag |
| (3) IBP transducer | (4) Three-way valve |
| (5) PA distal port | (6) Balloon inflation syringe |
| (7) Thermodilution catheter | (8) Balloon |

13.7.2 Preparing to Measure PAWP

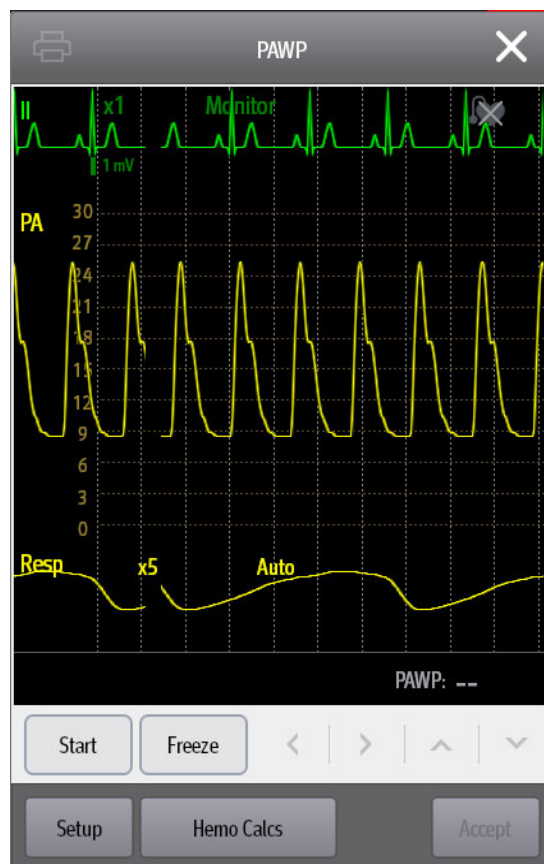
To prepare to monitor PAWP, follow this procedure:

1. Connect one end of the IBP cable to the IBP cable connector, and the other end to the IBP transducer. For more information, see *13.3.2 Measuring an Invasive Blood Pressure*.
2. Follow the manufacturer's instructions to connect the PA port of the thermodilution catheter and the patient end of the IBP transducer.
3. Zero the IBP transducer. For more information, see *13.3.3 Zeroing the IBP transducer*.
4. Set the IBP label to **PA** since the PAWP is measured on PA. For more information, see *13.6.2 Changing the Pressure Label*.

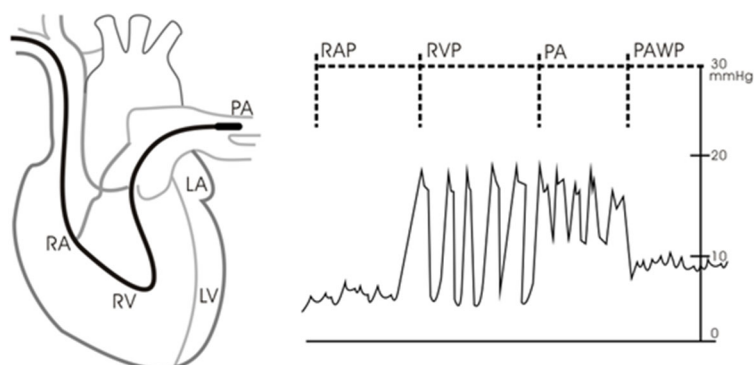
13.7.3 Measuring PAWP

To measure the PAWP, follow this procedure:

1. Select the PA numeric area or waveform area to enter the **PA** dialog, and then select **PAWP**.



2. Wedge the flotation catheter into the pulmonary artery by observing the PA waveform changes on the screen, referring to the following figure.



3. Select **Start**.

4. Inflate the balloon and pay attention to PA waveform changes on the screen when the prompt message **Ready For Balloon Deflation** appears.
5. Deflate the balloon when the prompt message **Ready For Balloon Deflation** appears. If the PA waveform is stable, but the monitor is still not showing the prompt message **Ready For Balloon Deflation**, select **Freeze** to freeze the waveform, and deflate the balloon.
6. Select **Accept** to save the PAWP value.
7. If you need to start a new measurement, repeat step 3 to step 6.

If the measurement fails or you need to adjust the PAWP value, you can use the following buttons to adjust the PAWP waveform and measurement.

- Select the up or down arrow button to adjust the PAWP value.
- Select the left or right arrow button to view the frozen waveforms of 40 seconds.
- Select **Accept** to save the PAWP value.

WARNING

- **Prolonged inflation can cause pulmonary hemorrhage, infarction or both. Inflate the balloon for the minimum time necessary to get an accurate measurement.**
 - **If the PAWP is greater than the PA (systolic), deflate the balloon and report the incident in accordance with hospital policy. Because the pulmonary artery could be accidentally ruptured, and the PAWP value derived will not reflect the patient's hemodynamic state, but will merely reflect the pressure in the catheter or balloon.**
 - **If the flotation/thermodilution catheter drifts into the wedge position without inflation of the balloon, the PA waveform assumes a wedged appearance. Take appropriate action, in accordance with standard procedures, to correct the situation.**
-

NOTE

- **The PA alarm is turned off automatically when the monitor enters the PAWP screen.**
-

13.7.4 Setting the Waveforms of the PAWP Screen

On the **PAWP** screen, select **Setup** to enter the **PAWP Setup** dialog. In the **PAWP Setup** dialog, you can make the following settings:

- Select **Reference Waveform 1** to set an ECG lead wave as the first reference wave.
- Select **Reference Waveform 2** to set a respiration wave as the second reference wave.
- Select **Speed** to set a sweep speed for the displayed waveforms on the **PAWP** screen.
- Select **Scale** to set the size of the PA waveform on the **PAWP** screen.

13.7.5 Performing Hemodynamic Calculation (only available when the N1 is used with the independent external display)

On the **PAWP** screen, select **Hemo Calcs** to enter the **Calculations** dialog. For more information, see *17.4 Hemodynamic Calculations*.

13.8 IBP Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting service. If the problem persists, contact your service personnel.

NOTE

- **For the physiological and technical alarm messages, see Appendix D Alarm Messages.**
-

Problem	Solution
Cannot see IBP numeric area or waveform area on the main screen	<ol style="list-style-type: none"> 1. Check that the IBP is set to display in the Screen Setup dialog. For more information, see 3.9.2 <i>Displaying Parameter Numerics and Waveforms</i>. 2. Check that if the IBP parameter switch is enabled. If not, enable the IBP measurement. For more information, see 3.9.1 <i>Switching On or Off a Parameter</i>. 3. Check the connection of IBP cable, IBP transducer and module. 4. Check that the three-way valve is turned to the correct position. 5. Check that the IBP transducer has been zeroed. For more information, see 13.3.3 <i>Zeroing the IBP transducer</i>.
Cannot see systolic pressure and diastolic pressure for P1/P2/P3/P4	Set Measure to All in the P1/P2/P3/P4 setup page. For more information, see 13.6.3 <i>Setting the Pressure Type for Display</i> .
IBP readings seem unstable	<ol style="list-style-type: none"> 1. Make sure there are no air bubbles in the transducer systems. 2. Check that the transducer is properly fixed. 3. Zero the transducer again. 4. Replace the transducer.
Zeroing of IBP channel(s) fails.	<ol style="list-style-type: none"> 1. Ensure that the channels are open to air. 2. Perform zero calibration again. Do not sway the IBP transducer and tubing during zero calibration. For more information, see 13.3.3 <i>Zeroing the IBP transducer</i>. 3. If zero calibration still fails, replace the transducer.

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14 Monitoring Carbon Dioxide (CO₂)

14.1 CO₂ Introduction

CO₂ monitoring is a continuous, non-invasive technique for determining the concentration of CO₂ in the patient's airway by measuring the absorption of infrared (IR) light of specific wavelengths. CO₂ has its own absorption characteristic and the amount of light passing the gas probe depends on the concentration of the measured CO₂. When a specific band of IR light passes through respiratory gas samples, some of IR light will be absorbed by the CO₂ molecules. The amount of IR light transmitted after it has been passed through the respiratory gas sample is measured with a photodetector. From the amount of IR light measured, the concentration of CO₂ is calculated.

CO₂ measurement is used to monitor the patient's respiratory status. The sidestream/Microstream™ CO₂ measurement takes a sample of the respiratory gas with a constant sample flow from the patient's airway and analyzes it with a remote CO₂ sensor built into the sidestream or Microstream™ CO₂ module.

The sidestream and Microstream™ CO₂ measurement can be used, with specified accessories, with intubated and non-intubated adult, pediatric, and neonatal patients. With intubated patients, a sample of the respiratory gas is drawn from the patient's breathing circuit through an airway adapter and a gas sampling line. With non-intubated patients, the gas sample is drawn through a nasal cannula.

Both sidestream and Microstream™ CO₂ modules have the function of automatic barometric pressure compensation (the system automatically measures the barometric pressure to which the patient monitor is exposed).

CO₂ monitoring is intended for adult, pediatric and neonatal patients.

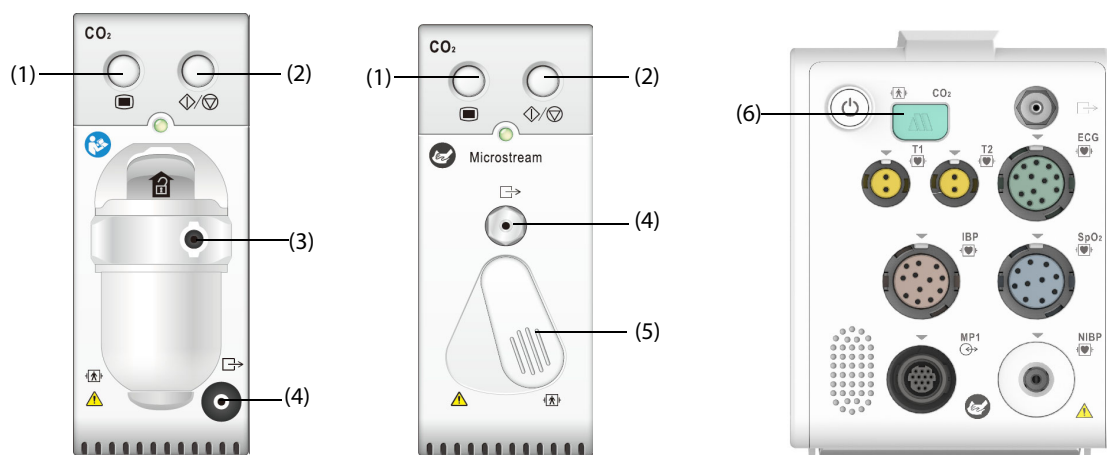
WARNING

- **The N1 monitor does not support CO₂ measurements when used for transporting patients by rotary or fixed-wing ambulance.**
 - **It is not recommended to measure O₂ when transporting a patient with the N1 monitor. Shaking the CO₂ module during O₂ measurement may lead to a distorted O₂ waveform or inaccurate O₂ measurement.**
-

14.2 Identifying CO₂ Modules

To measure CO₂, use either the internal CO₂ module or the external CO₂ module. The external CO₂ module is connected to the N1 through the Modular Rack. For the connection of the N1 and the external CO₂ module, see section 2.8.1 *Installing the N1 or External Parameter Module into the Modular Rack*.

In sequence from left to right, the following are sidestream CO₂ external module, Microstream™ CO₂ external module, and N1 monitor with internal CO₂ module.



(1) CO₂ dialog hard key

(2) CO₂ Measure/standby hard key

(3) CO₂ watertrap seat

(4) Gas outlet

(5) Sample line connector

(6) Internal CO₂ adapter connector

14.3 CO₂ Safety Information

WARNING

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

CAUTION

- Remove the airway sample line from the patient's airway while nebulized medications are being delivered. Measuring CO₂ during nebulization may lead to inaccurate CO₂ readings.
- EtCO₂ values measured from the CO₂ module may differ from those from the blood gas analysis.
- Avoid mechanical shock to the sidestream CO₂ module.
- Shaking the CO₂ module during O₂ measurement may lead to a distorted O₂ waveform or inaccurate O₂ measurement

NOTE

- The CO₂ module automatically suppresses physiological alarms until breathing waves have been detected. Ensure that the patient is properly connected when using the CO₂ module.

14.4 CO₂ Measurement Limitations

The following factors may influence the measurement accuracy:

- Leaks or internal venting of sampled gas
- Mechanical shock
- Cyclic pressure up to 10 kPa (100 cmH₂O)
- Other sources of interference, if any

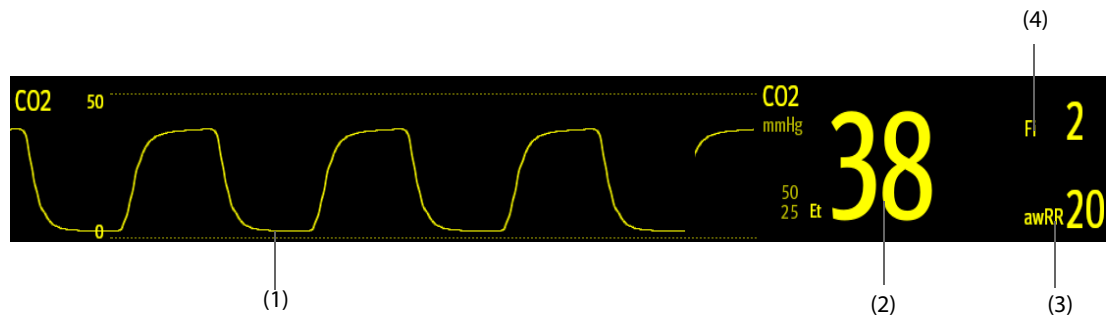
For more information, see A.15.8 CO₂ Specifications.

CAUTION

- Measurement accuracy of the sidestream CO₂ module may be affected by the breath rate and inspiration/expiration (I/E) ratio.
- Measurement accuracy of the Microstream™ CO₂ module may be affected by the breath rate.

14.5 CO₂ Display

The CO₂ numeric and waveform areas provide FiCO₂ measurement, EtCO₂ measurement, awRR measurement, and a CO₂ waveform.



(1) CO₂ waveform

(2) End tidal CO₂ value (EtCO₂)

(3) Airway respiration rate (awRR)

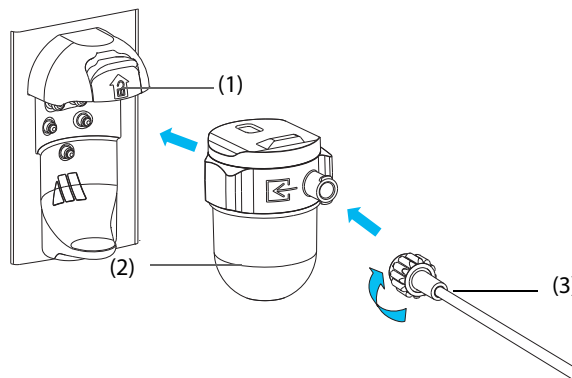
(4) Fraction of inspired CO₂ (FiCO₂)

14.6 Measuring CO₂ Using the Sidestream/Microstream™ CO₂ Module

14.6.1 Preparing to Measure CO₂ Using the Sidestream CO₂ Module

To prepare the CO₂ measurement, follow this procedure:

1. Select the appropriate gas sample line and watertrap according to the patient category.
2. Connect one end of the gas sample line to the watertrap or to the CO₂ adapter.
 - ◆ If using the sidestream CO₂ module, connect the watertrap to the CO₂ module, and connect the gas sample line to the watertrap.

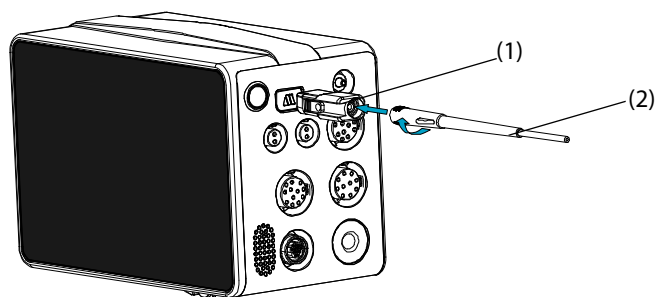


(1) Watertrap receptacle

(2) DRYLINE II watertrap

(3) Gas sample line

- ◆ If using the N1 monitor for CO₂ measurement, connect one end of the gas sample line to the CO₂ adapter. Refer to the *CO₂ Adapter User Manual* (PN: H-046-009994-00) for the connection of the CO₂ adapter and the gas sampling line.

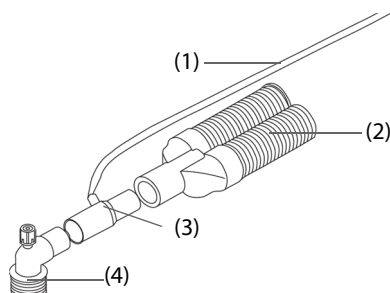


(1) CO₂ adapter

(2) Gas sample line

3. Connect the other end of the gas sample line to the patient.

- ◆ For intubated patients requiring an airway adapter, install the airway adapter between the patient circuit and the ventilator Y-piece.



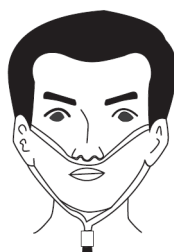
(1) Sample line

(2) Connection to the ventilator

(3) Airway adapter

(4) Connection to the patient

- ◆ For non-intubated patients, place the nasal cannula onto the patient.



4. Connect the gas outlet to the scavenging system using an exhaust tube.

After the CO₂ module is connected, it enters measure mode by default and the monitor displays **CO2 Starting**. CO₂ can be measured after the start-up sequence is complete.

WARNING

- Do not use the adult or pediatric watertrap with a neonate patient. Otherwise, patient injury could result.
 - Connect the gas outlet to the scavenging system when measuring CO₂ using the sidestream CO₂ module.
-

CAUTION

- Check the compatibility of the CO₂ adapter and the sampling line before use. The CO₂ adapter is intended for connecting the Oridion CO₂ sampling line.

- Leakage in the breathing or sampling system may cause the displayed EtCO₂ values to be significantly low. Always make sure that all components are securely connected.
- Inspect the airway adapter for a tight connection and proper operation before attaching it to the patient.
- Squeezing or bending the sample line during sidestream or Microstream™ CO₂ measurement may cause inaccurate CO₂ readings or no reading.
- To avoid blocking the airway, empty the DRYLINE II watertrap container whenever half full. Replacing the DRYLINE II watertrap once a month is recommended. Dispose of accumulated fluids in accordance with hospital policy or your local regulations.
- The DRYLINE II watertrap has a filter preventing bacterium, water and secretions from entering the module. Extended use could destroy the filter in watertrap and fail to stop the bacterium, water and secretions entering the module, result in damaging the gas module and having infection risk.

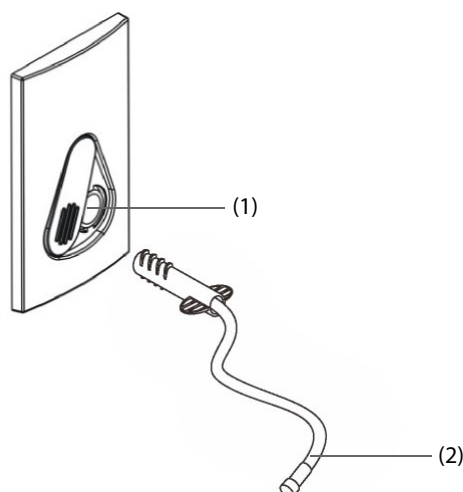
NOTE

- It is recommended to replace the CO₂ adapter at least once a year.
 - To extend the lifetime of the watertrap and module, disconnect the watertrap from the module and set the operating mode to Standby mode when CO₂ monitoring is not required.
 - The sample rates are different when different types of watertraps are used.
 - The emptying interval of the DRYLINE II adult/pediatric watertrap is 26 hours @ 120 ml/min, sample gas of 37 °C, room temperature of 23 °C, and 100% RH.
 - The emptying interval of the DRYLINE II neonatal watertrap is 35 hours @ 90 ml/min, sample gas of 37 °C, room temperature of 23 °C, and 100% RH.
-

14.6.2 Preparing to Measure CO₂ Using the Microstream™ CO₂ Module

To prepare the CO₂ module for measurement, follow this procedure:

1. Connect one end of the sample line to the Microstream™ CO₂ module.



(1) Sample line connector

(2) Sample line

2. Connect the other end of the sample line to the patient.
 - ◆ For intubated patient requiring an airway adapter, install the airway adapter between the patient circuit and the ventilator Y-piece.
 - ◆ For non-intubated patient, place the nasal cannula onto the patient.
 - ◆ For patient prone to mouth breathing, place the oral-nasal cannula onto the patient.
3. Connect the gas outlet to the a scavenging system using an exhaust tube.

After the CO₂ module is connected, it enters measure mode by default and the monitor displays **CO2 Sensor Warmup**. CO₂ can be measured after the start-up sequence is complete.

WARNING

- **Connect the gas outlet to the scavenging system when measuring CO₂ using the Microstream™ CO₂ module.**
-

NOTE

- **Disconnect the sample line from the module when CO₂ monitoring is not required.**
-

14.6.3 Zeroing the Sidestream/Microstream™ CO₂ Module

The sidestream and Microstream™ CO₂ modules perform a zero calibration automatically when needed. Once the zero calibration is started, the CO₂ module stops measuring and **"Zeroing"** is displayed in the CO₂ numeric area.

After the zero calibration is completed, the CO₂ module reacquires the CO₂ readings. During the reacquisition period, **"Zero Recovering"** is displayed in the CO₂ numeric area. Valid data will reappear 30 seconds after the zero calibration is started. You can hide the display of the **"Zero Recovering"** message, but values displayed during the reacquisition period may not be accurate. See *21.5.7 Hiding the Invalid Display after Zeroing the CO₂ Module* for more information.

The automatic zero calibration will not start under the following conditions:

- Physiological alarms related to CO₂ are active.
- An apnea alarm is active.
- No breath has been detected for over 30 seconds.

You can also perform the zero calibration manually. For more information, see *21.5.6 Manually Zeroing the CO₂ Module*.

14.7 Changing Settings for All CO₂ Modules

14.7.1 Changing CO₂ Alarm Settings

To change the CO₂ alarm settings, follow this procedure:

1. Select the CO₂ numeric area or waveform area to enter the **CO2** dialog.
2. Select the **Alarm** tab.
3. Enter the password if required. For more information, refer to *21.13.3 Selecting Password for User Authentication*.
4. Set alarm properties as desired.

14.7.2 Setting the CO₂ Waveform

To set the CO₂ waveform, follow this procedure:

1. Select the CO₂ numeric area or waveform area to enter the **CO2** dialog.
2. Select the **Setup** tab.
3. Set **Waveform Type**, **Speed**, **Scale**, or **CO2 Scale** of the CO₂ waveform.

14.7.3 Setting the RR Source

To set the respiration rate (RR) source, follow this procedure:

1. Select the CO₂ numeric area or waveform area to enter the **CO2** dialog.
2. Select the **Setup** tab.

3. Set **RR Source**.

When you select **Auto**, the system automatically selects the RR source according to the priority. The priority of RR source is first CO₂, and then ECG. When the current RR source does not have valid measurement, the system automatically switches the **RR Source** to **Auto**.

14.7.4 Entering the Standby Mode

Set the CO₂ module to one of the following modes according to the module status:

- Select **Measure** mode when using the CO₂ module for monitoring.
- Select **Standby** mode to prolong the CO₂ module service life when not using the CO₂ module.

The default operating mode is **Measure**. When not using the CO₂ module, proceed as follows to enter the Standby mode:

1. Select the CO₂ numeric area or waveform area to enter the **CO2** dialog.
2. Select the **Setup** tab.
3. Set **Operating Mode** to **Standby**.

14.7.5 Entering the Intubation Mode

When performing intubation during general anesthesia, enter the intubation mode to reduce unnecessary alarms. To enter the intubation mode, follow this procedure:

1. Select the CO₂ numeric area or waveform area to enter the **CO2** dialog.
2. Select **Intubation Mode**.

To exit the intubation mode, choose either of the following ways:

- From the bottom of the **CO2** dialog, select **Exit Intubation Mode**.
- Select the **Main Menu** quick key → from the **Alarm** column select **Exit Intubation Mode**.

For the details of the intubation mode, see 6.15 *Intubation Mode*.

NOTE

- When the configured intubation period is over, the monitor automatically exits the intubation mode and gives two alert sounds.

14.7.6 Setting the Auto Standby

The monitor enters standby mode automatically if no breath is detected after the configured period of time. To set the auto standby, follow this procedure:

1. Select the CO₂ numeric area or waveform area to enter the **CO2** dialog.
2. Select the **Setup** tab.
3. Set **Auto Standby**.

14.7.7 Setting Humidity Compensation

Sidestream and Microstream™ CO₂ modules are configured to compensate CO₂ readings for either Body Temperature and Pressure, Saturated Gas (BTPS), to account for humidity in the patient's breath, or Ambient Temperature and Pressure, Dry Gas (ATPD).

- ATPD: $P_{CO_2}(mmHg) = CO_2(vol\%) \times P_{amb}/100$
- BTPS (sidestream): $P_{CO_2}(mmHg) = CO_2(vol\%) \times (P_{amb} - 47)/100$
- BTPS (Microstream™): $P_{CO_2}(mmHg) = CO_2(vol\%) \times (1 - 0.03) \times P_{amb}/100$

Where, $P_{CO_2}(mmHg)$ = partial pressure, $vol\%$ = CO₂ concentration, P_{amb} = ambient pressure, and unit is mmHg.

For the sidestream and Microstream™ CO₂ module, set the humidity compensation on or off according to the actual condition.

To set the humidity compensation, follow this procedure:

1. Select the CO₂ numeric area or waveform area to enter the **CO2** dialog.
2. Select the **Setup** tab.
3. Set **BTPS Compensation**.
 - ◆ Switch on for BTPS.
 - ◆ Switch off for ATPD.

14.8 Setting the Gas Compensation

The presence of interfering gas affects the CO₂ measurement. To get the best possible measurement result, it is recommended to set the gas compensation. The configured concentration of the interfering gas should be in accordance with its actual proportion.

For the Microstream™ CO₂ module, gas compensations are not required.

CAUTION

- **Make sure to use the appropriate compensations. Inappropriate compensations may cause inaccurate measurement values and result in misdiagnosis.**
-

For the sidestream CO₂ module, follow this procedure to set the gas compensation:

1. Select the CO₂ numeric area or waveform area to enter the **CO2** dialog.
2. Select the **Setup** tab.
3. Set the compensation according to the actual condition.

14.9 Choosing a Time Interval for Peak-Picking


For Microstream™ CO₂ modules, select a time interval for picking the highest CO₂ as the EtCO₂ and the lowest as the FiCO₂.

To set the time interval, follow this procedure:

1. Select the CO₂ numeric area or waveform area to enter the **CO2** dialog.
2. Select the **Setup** tab.
3. Set **Maximum Hold**.
4. Toggle between **Single Breath, 10 s** and **20 s**.
 - ◆ **Single Breath:** EtCO₂ and FiCO₂ are calculated for every breath.
 - ◆ **10 s and 20 s:** EtCO₂ and FiCO₂ are calculated using 10 or 20 seconds of data.

14.10 Performing the Leakage Test

When measuring CO₂ using the internal CO₂ module or the external sidestream CO₂ module, the leakage test is required every time before the CO₂ measurement. To perform the CO₂ leakage test, follow this procedure:

1. Connect the measuring accessories as per section *14.6.1 Preparing to Measure CO₂ Using the Sidestream CO₂ Module*.
2. Wait until the startup finishes. Completely block the gas inlet on the sidestream CO₂ module or on the N1. The alarm message "**CO2 Airway Occluded**" will appear on the screen.
3. Continue to block the gas inlet for another one minute.
4. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
5. Select the **Module** tab → **CO2** tab.
6. Check that the current flow rate is less than 10ml/min, and the alarm message "**CO2 Airway Occluded**" does not disappear.

This indicates that the module does not leak. If the alarm message disappears, or the flow rate is equal to 10ml/min or greater, it indicates that the module leaks. Perform the leakage test again. If the problem remains, contact your service personnel for help.

14.11 CO₂ Calibration

For sidestream and Microstream™ CO₂ modules, a calibration is needed every year or when the measured values have a great deviation.

To calibrate the CO₂ module, contact your service personnel.

CAUTION

- **Connect the gas outlet to the scavenging system when calibrating the CO₂ module.**
-

14.12 Test Method Used to Determine the Respiration Rate Measuring Range

To determine the RR measurement range, follow this procedure:

1. Connect the 5% CO₂ + N₂ (BAL) gas cylinder, reduction valve, rhythm generator and gas sampling path of a monitor.
2. Respectively set the rhythm generator to generate a respiration rate of 0 rpm, 6 rpm, 20 rpm, 60 rpm, 120rpm, and 150 rpm.
3. Verify that it meets the specifications.

NOTE

- **The rhythm generator mentioned above is a sensor/sampling site in Figure 201.101 – Test apparatus for the TOTAL SYSTEM RESPONSE TIME of an RGM of ISO 80601-2-55.**
-

14.13 CO₂ Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting service. If the problem persists, contact your service personnel.

NOTE

- **For the physiological and technical alarm messages, see Appendix D Alarm Messages.**
-

14.13.1 Troubleshooting the Sidestream/Microstream™ CO₂ Module

Problem	Solution
EtCO ₂ measurements too low	<ol style="list-style-type: none">1. Check the patient status.2. Check the sample line and connectors for leakage.3. Ventilate the room if the environmental CO₂ concentration is too high.

14.14 Oridion Information

Microstream

Oridion Patents

This posting serves as notice under 35 U.S.C. §287(a) for Covidien patents: <http://www.covidien.com/patents>.

No Implied License

Possession or purchase of this device does not convey any express or implied license to use the device with unauthorized CO₂ sampling consumables which would, alone, or in combination with this device, fall within the scope of one or more of the patents relating to this device and/or CO₂ sampling consumable.

15 Review

15.1 Review Overview

Trends are patient data collected over time and displayed in graphic, tabular, or other forms to give you a picture of how the patient's condition is developing. The **Review** dialog also enables access to review the events, 12-lead ECG analysis results and waveforms, full disclosure waveforms, and so on.

15.2 Review Dialog

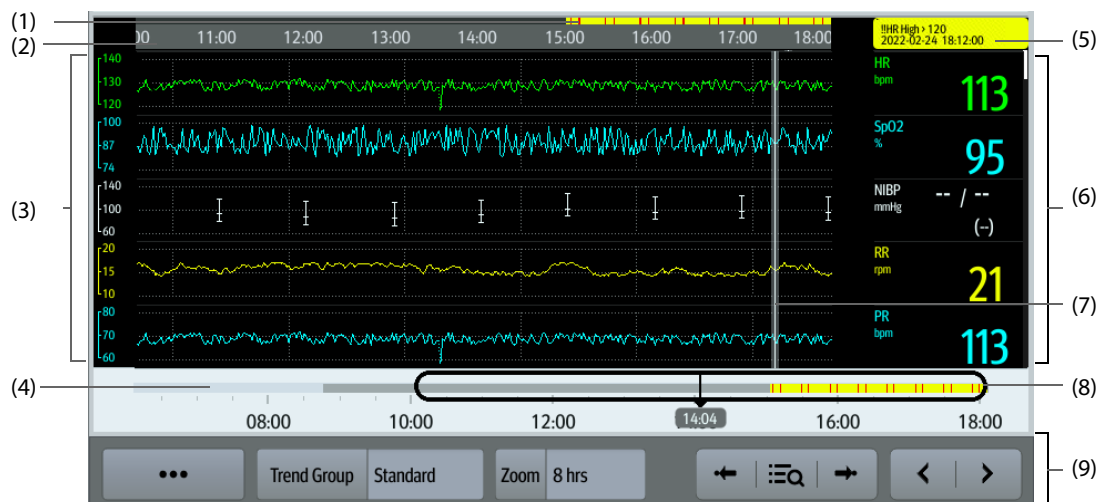
The **Review** dialog contains tabs to display trend data in tabular, graphic, or other forms.

15.2.1 Accessing the Review Dialog

To enter the review dialog, select the **Main Menu** quick key → from the **Review** column select the desired option. If reviewing patient data is password protected, input the monitor's clinical password (local password).

15.2.2 Example Review Dialog

The review pages have a common structure. The graphic trends review page is taken as an example:








- (1) Event type indicator: different color blocks match different types of events:
 - Red: high priority alarm event
 - Yellow: medium priority alarm event
 - Cyan: low priority alarm event
 - Green: manual event
 - White: operation-related event
- (2) Current screen time line: indicates the time length of the current screen.
- (3) Waveform area: displays trend curves. The color of trend curves is consistent with the color of parameter labels.
- (4) Time line: indicates the entire time length.
 - : indicates the time length of trend data. can be moved within this time length.
 - : indicates the time length of no trend data. cannot be moved within this time length.
 - Different color blocks along the time line indicate events of different types. See the color definition for the event type indicator.

- (5) Event area: displays the event of the cursor time. Selecting the event accesses the event list. If there is no event at the cursor time, the cursor time is displayed.
- (6) Numeric area: displays numeric values at the cursor indicated time. The background color of numeric values matches the alarm priority.
- (7) Cursor: this is adjusted by touching different locations. Adjusting this changes the data displayed in the Event area and Numeric area.
- (8) Slider: indicates the position of current screen time in the entire time length. Dragging this button left or right enables you to locate the trend data at a specific time and also refreshes trend data in current screen accordingly.
- (9) Button area.

15.2.3 Symbols on Review Pages

The following table lists the symbols on review pages.


Symbol	Description
	Slider: indicates the position of current screen time in the entire time length. Dragging the slider left or right enables you to locate the trend data at a specific time and also refreshes data in current screen accordingly.
 or 	Goes to the previous or next event.
	Event list: displays events in a chronological order. The most recent event is displayed at the top. The number of asterisk symbols before an event indicates alarm priority.
	Print button: select it to output patient information and data through the printer.

15.2.4 Common Operations

This section describes common operations for all review pages.

15.2.4.1 Browsing Trend Data

Browse trend data in one of the following ways:




- Move the cursor.
- Move the slider .
- Slide your finger on the screen.

15.2.4.2 Viewing Events

You can view the following types of events:

- Manually triggered events
- Parameter-related operation events and alarm-related events, such as starting NIBP measurement
- Operation events not related to parameters, such as system time change

View events in either of the following ways:

- Select  and select the desired event.
- Select  or  to jump to the previous event or next event.

Events are displayed in a chronological order. The most recent event is displayed at the top. The number of asterisk symbols before an event indicates alarm priority as follows:

- ***: high priority alarm
- **: medium priority alarm
- *: low priority alarm

15.2.5 Tabular Trends Review Page

The tabular trends review page displays trend data in a tabular form.

15.2.5.1 Entering the Tabular Trends Review Page

To enter the tabular trends review page, select the **Main Menu** quick key → from the **Review** column select **Tabular Trends**.



15.2.5.2 Changing the Tabular Trend Group

To change the tabular trend group, follow this procedure:

1. Enter the tabular trends review page.
2. Set **Trend Group**.

15.2.5.3 Editing the Tabular Trend Group

The setting of the **Trend Group** defines the contents of displayed trends. It is possible to edit any trend group except for the **All** and **Standard** trend groups. To do so, follow this procedure:

1. Enter the tabular trends review page:
2. Select **Group Setup** → select the desired tab.
 - ◆ Rename the trend group (optional): select the  symbol at the upper left corner and input the desired name.
 - ◆ Add parameters: select desired parameters from the **Choices** column, and then select **Add**. Selecting **Add All** adds all parameters (up to the maximum of 83).
 - ◆ Delete parameters: select desired parameters from the **Selected** column, and then select **Delete**. Selecting **Delete All** deletes all parameters except for HR.
 - ◆ Move the position of parameters displayed on the trend page: select desired parameters from the **Selected** column, and then select **Move up**, **Move Down**, **Move to Top**, or **Move to Bottom**.
 - ◆ Display two parameters side by side: select two parameters from the **Selected** column, and then select **Overlap**. Then, the symbol  appears at the right of the overlapped parameters. The overlapped parameters will be displayed side by side in one numerics area and waveform area.
 - ◆ Unoverlap two parameters: select the overlapped parameters from the **Selected** column, and then select **Unoverlap**.

Selecting **Default** will restore the trend group settings to factory defaults.

NOTE

- **Trend groups labeled All or Standard cannot be edited.**
- **The HR parameter and waveform are always displayed in the first row on the trend page. It cannot be deleted or moved.**

15.2.5.4 Changing the Resolution of Tabular Trend Data

The interval of tabular trends defines the interval of displaying trend data. A short interval is especially suited for neonatal applications, where the clinical situation may change very quickly. In adult monitoring, where the patient's status typically changes more gradually, a longer interval may be more informative.

To change the interval of trend data, follow this procedure:


1. Enter the tabular trends review page.
2. Select **Interval**.
 - ◆ **5 sec or 30 sec**: select to view up to 4 hours of tabular trends at an interval of 5 seconds or 30 seconds.
 - ◆ **1 min, 5 min, 10 min, 15 min, 30 min, 1 hr, 2 hrs, or 3 hrs**: select to view up to 120 hours of tabular trends at selected interval.
 - ◆ Select parameters, such as NIBP, or GCS, to view the tabular trends when these parameter measurements are acquired.

NOTE

- **Changing between intervals does not typically change the position of the slider or cursor except to round it to the nearest interval, however changing intervals to be 30 seconds or less will move any cursor position more than 4 hours ago to the oldest data less than 4 hours ago.**

15.2.5.5 Printing a Tabular Trends Report

To print a tabular trends report, follow this procedure:

1. Enter the tabular trends review page.
2. Select  to enter the **Print Setup** dialog.
3. Set the tabular trends report as described in *18.6.3 Configuring Tabular Trends Reports*.
4. Select **Print** or **Print (All)**.
 - ◆ **Print**: the trend data before the above set **Time**, for the above set **Period**, and at the above set **Interval** will be printed.
 - ◆ **Print (All)**: all the stored trend data will be printed at the review interval.

15.2.6 Graphics Trends Review Page


The graphic trends review page displays trend data in a visual format.

15.2.6.1 Entering the Graphic Trends Review Page


To enter the graphic trends review page, select the **Main Menu** quick key → from the **Review** column select **Graphic Trends**.

15.2.6.2 Changing the Graphic Trend Group

To change the graphic trend group, follow this procedure:

1. Enter the graphic trends review page.
2. Select  and set **Trend Group**.

15.2.6.3 Editing the Graphic Trend Group

1. Enter the graphic trends review page.
2. Select  and select **Group Setup**.

For more information, see *15.2.5.3 Editing the Tabular Trend Group* for detail on how to edit the group.


15.2.6.4 Changing the Resolution of Trend Data

To change the length of trend data displayed on the current screen, follow this procedure:

1. Enter the graphic trends review page.
2. Select **Zoom**.
 - ◆ **8 min**: the screen displays eight minutes of trend data. You can view the most recent one hour of data.
 - ◆ **30 min, 1 hr, 2 hrs, 4 hrs**: the screen displays 30 minutes, one hour, two hours, or four hours of trend data. You can view the most recent four hours of data.
 - ◆ **8 hrs, 12 hrs, 24 hrs, 48 hrs**: the screen displays 8 hours, 12 hours, 24 hours, or 48 hours of trend data. You can view the most recent 120 hours of data.


15.2.6.5 Changing the Number of Waveforms

To change the number of waveforms displayed on the trend review page, follow this procedure:

1. Enter the graphic trends review page.
2. Select  and set **Trend Group**.

15.2.6.6 Printing a Graphic Trends Report

To print a graphic trends report, follow this procedure:

1. Enter the graphic trends review page.
2. Select  to enter the **Print Setup** dialog.
3. Set the graphic trends report as described in *18.6.4 Configuring Graphic Trends Reports*.
4. Select **Print** to print the graphic trend data before the above set **Time** and for the above set **Period**.

15.2.7 Events Review Page

The monitor stores events in real time, including technical alarm events, physiological alarm events, manual events, and operational events. When an event occurs, all the measurement numerics and three event-related waveforms 16 seconds before and after the event are stored.

NOTE

- **Alarms are saved as events and will be maintained if the equipment is powered down. The time of equipment power down is not recorded as an event and cannot be reviewed.**
- **Earlier events will be overwritten by later ones if the storage capacity is reached.**
- **A total loss of power does not affect the events already stored.**

15.2.7.1 Entering the Events Review Page

To enter the events review page, select the **Main Menu** quick key → from the **Review** column select **Events**.

The **Event** page displays the event list. Events are displayed in descending chronological order, with the most recent displayed at the top. The number of asterisk symbols before an event indicate alarm priority as described in *6.5 Alarm Indicators*.

Different color blocks are displayed on the left of each event to indicate different event types.

- Red: high priority alarm event
- Yellow: medium priority alarm event
- Cyan: low priority alarm event
- Green: manual event
- White: operation-related event

The number of currently selected events and the total number of events are displayed at the top right corner of the event list. For example, 2/4 indicates that the selected event is the second event in the filtered events and the total number of filtered events is 4. **Total** indicates the total number of events. For example: **Total: 28** means that there are a total of 28 events.


15.2.7.2 Configuring the Filter

You can filter events to facilitate event review. To configure the filter, follow this procedure:

1. Enter the **Events** page.
2. Select **Filter**. From the drop-down list, select the desired filter item.

You can create up to two sets of custom filter. To do so, follow this procedure:


1. From the **Filter** drop-down list, select **Custom 1** or **Custom 2** to enter the **Filter Setup** dialog.
2. Select the **Name** field to edit the name of the custom filter criterion.
3. Select the desired items.

If you want to review events which happened around certain time, select the  button → set the time → select **Ok**. The cursor then jumps to the event happened closest to the time entered.

15.2.7.3 Editing Events

To edit events, follow this procedure:

1. Enter the **Events** page and tick off the desired events.

2. Select  to edit the selected events.
 - ◆ **Lock:** manually lock the event. Locked events cannot be deleted.
 - ◆ **Note:** enter comments for the event.
 - ◆ **Rename:** allow renaming an event name. Only manual events and arrhythmia events can be renamed if enabled by the hospital's settings. For more information, see *21.6.2 Renaming Events*.

15.2.7.4 Viewing Event Details

To view waveforms and parameter values at the event time, follow this procedure:

1. Enter the **Events** page.
2. Select **Detail**.


To display beat labels on the first ECG waveform, switch on **Beat Anno**. The white beat labels indicate heart beats classification and may explain suspected, missed, or false arrhythmia calls. Heart beats are classified as follows:

- N = Normal
- V = Ventricular ectopic
- S = Supraventricular premature
- P = Paced
- L = Learning
- ? = Insufficient information to classify beat
- I = Inoperative (for example, Lead Off)
- M = Missed beat

If you switch on **Beat Anno** on the **Events** page, beat labels will also be displayed on the **Full Disclosure** page, and vice versa. Beat labels can be printed out.

15.2.7.5 Printing Event Reports

To print event reports via a printer, follow this procedure:

1. Enter the events review page.
2. Select  to enter the **Print Setup** dialog.
3. Select the desired options.
 - ◆ **Print All Event List:** print the entire event list.
 - ◆ **Print List of Selected Events:** print the list of selected events.
 - ◆ **Print Detail of Selected Events:** print the details of selected events.
 - ◆ **Print Displayed Event Detail:** print the waveforms and parameters of the currently displayed event.
4. Select **Print**.

15.2.8 Full Disclosure Review Page


You can review up to 48 hours of waveform data on the full disclosure review page. You can view both the compressed waveforms and numeric values.

15.2.8.1 Entering the Full Disclosure Review Page

To enter the full disclosure review page, select the **Main Menu** quick key → from the **Review** column select **Full Disclosure**.

15.2.8.2 Selecting Waveforms

You can select the waveforms to be displayed and stored. Up to 48 hours of waveforms for all parameters can be stored. When closing the **Select Waveform** dialog, a prompt will inform you of the duration of waveforms that can be saved if the amount is less than 48 hours. To save and display the desired waveforms, follow this procedure:

1. Enter the full disclosure review page.
2. Select  and select **Setup** to enter the **Select Waveform** page.
3. Select the **Storage** tab and set the desired waveforms to be stored in the monitor. Select the **Display (Maximum: 3)** tab and set the desired waveforms to be displayed on the **Full Disclosure** page.

NOTE


- **Storing more waveforms may shorten the storage time to less than 48 hours. Please adjust the waveforms stored with this consideration.**
- **Parameter labels from external devices are prefixed with the plus sign (+).**

In case of alarms, the background of the compressed waveform is highlighted with a colored block during the alarm time:

- Red: high alarm priority
- Yellow: medium alarm priority
- Cyan: low alarm priority

15.2.8.3 Setting the Scale and Duration

To set the length and size of displayed compressed waveforms, follow this procedure:


1. Enter the full disclosure review page.
2. Select **Overview**. If there is no **Overview** button in the Full disclosure page, skip this step.
3. Set the waveforms scale in either of the following ways:
 - ◆ Select the **Scale** button. If you do not see **Scale**, select the  button to show it.
 - ◆ Select the waveform label.
4. Select **Duration** to set the length of displayed waveforms.
5. Select the parameter label beside the waveforms to set scale for each parameter.

15.2.8.4 Viewing Details of Compressed Waveforms

To view the full waveforms and numeric values, follow this procedure:


1. Enter the full disclosure review page.
2. Select **Detail**.

You can perform the following operations on the this page:

- Switch on **Beat Anno**. For more information, see *15.2.7.4 Viewing Event Details*.
- Select  and set **Speed**, **ECG Gain**, or **Save As Event**.
- Select **Overview** to switch to the compressed waveform view.

15.2.8.5 Printing the Full Disclosure Waveform Report

To print a compressed waveform report, follow this procedure:

1. Enter the full disclosure review page.
2. Select  to enter the **Print Setup** dialog.
3. Select waveform type you want to print:
 - ◆ **Print Waveform Overview**: compressed waveform of selected period will be printed. This option is only available when printing from the Overview or compressed waveform view.
 - ◆ **Print Displayed Waveform Detail**: parameter values and all stored waveforms around the cursor time will be printed. This option is only available when printing from the Detail view.
4. Select **Print**.

NOTE

- When a parameter label is prefixed with the plus sign (+) on a printout, it indicates that the data is from an external device.

15.2.9 OxyCRG Review Page (available when the N1 is used with the independent external display)

You can review up to 48 hours worth of 4 minute trend curves on the OxyCRG review page. The OxyCRG review functionality is available for neonatal monitoring only.

NOTE

- OxyCRG Review Page is available only when Patient Category is set to Neo.

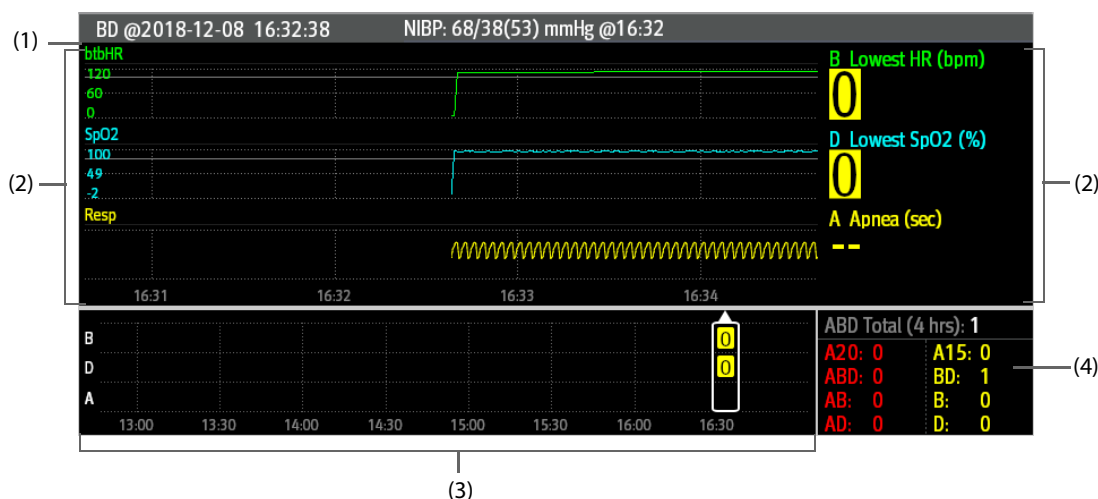
15.2.9.1 Entering the OxyCRG Review Page

Choose one of the following methods to enter the OxyCRG review page:

- From the OxyCRG screen, select the ABD events list area.
- Select the **Main Menu** quick key → from the **Review** column select **OxyCRG**.

15.2.9.2 The Display of the OxyCRG Review Page

The following figure shows the OxyCRG screen:



- Event title area: displays information of the selected event, such as the event type and time.
- Event detail area: displays 4 minutes of parameter trends and compressed waveform, and parameter values of the selected event.
- Event summary area: displays ABD events within the **Zoom** period. The selected event is enclosed in a white frame.
- Event statistics area: displays the total number of ABD events and the numbers of each event within the **Zoom** period.

15.2.9.3 Changing the Resolution of Trend Curves

To set the resolution of trend curves, follow this procedure:


- Enter the OxyCRG review page.
- Set **Zoom**.

NOTE

- If the Zoom is set for a large duration (for example, 8 hrs), the screen may show "No Patient Data" for the first several minutes of data collection (for example, 6 minutes), but data will be shown after enough data has been collected.

15.2.9.4 Printing an OxyCRG Review Report

To print an OxyCRG review report, follow this procedure:

1. Enter the OxyCRG review page.
2. Select  to enter the **Print Setup** dialog.
3. Select **Print**. The report duration corresponds to the duration of data shown on the screen.

15.2.10 12-Lead ECG Review Page

When 12-lead ECG analysis is performed, you can review the most recent 20 events of 12-lead analysis. For more information, see *8 Resting 12-Lead ECG Analysis*.

15.2.10.1 Entering the 12-Lead Review Page

Choose one of the following methods to enter the 12-lead ECG review page:

- Upon completion of 12-lead ECG analysis, select **Review** from the **12-Lead Interpretation** page. For more information, see *8 Resting 12-Lead ECG Analysis*.
- Select the **Main Menu** quick key → from the **Review** column select **12-Lead ECG**.

15.2.10.2 Switching to Median Complex (for Glasgow Algorithm Only)

The median complex template displays 12-lead ECG waveforms on one page in 4 columns, with 3 lines in each column, and one rhythm lead waveform at the bottom. Additionally, a short vertical bar appears above each waveform, marking the start and end positions of the P-wave and the QRS-wave and the end position of T-wave.

To view Median Complex, follow this procedure:

1. Enter the 12-lead review page.
2. Select **Median Complex**.

Selecting **Waveform** can return to the 12-lead ECG waveform page.


15.2.10.3 Setting 12-Lead ECG Waveforms

To set the 12-lead ECG waveforms on the review page, follow this procedure:

1. Enter the 12-lead review page.
2. Set **Speed**, **Gain**, and **Layout**.

15.2.10.4 Printing the 12-Lead ECG Report

To print the 12-Lead ECG report, follow this procedure:

1. Enter the 12-lead review page.
2. Select .
3. Configure the 12-lead ECG report.
4. Select **Print**.

15.3 Reviewing Discharged Patients


For discharged patients, you can review the trend data in the review page. You can also review the events and 12-lead ECG analysis results.

Access the **Discharged Patients** dialog box by selecting the **Main Menu** quick key → from the **Patient Management** column select **Discharged Patients**. If viewing discharged patients is password protected, input the user name and password (the user name and password saved in the MLDAP server).

15.3.1 Checking the Data of a Discharged Patient

1. Access the data of the discharged patient as described in *15.3 Reviewing Discharged Patients*.
2. From the patient list select the desired patient.
3. Select **Detail**.

15.3.2 Checking the Information of a Discharged Patient

1. Access the data of the discharged patient as described in *15.3 Reviewing Discharged Patients*.
2. Select the  icon to enter the **Patient Management** dialog box.
3. Select **Ok** to exit the **Patient Management** dialog box.

16 Clinical Assistive Applications (CAA) (available when the N1 is used with the independent external display)

The Clinical Assistive Applications (CAA) function integrates some commonly used clinical guidelines and tools into the monitor. It puts the currently monitoring parameter measurements together and provides comprehensive analysis results.

CAA can improve the clinician's working efficiency. However, it is not directly used for diagnosis and cannot not replace the clinician's judgement.

16.1 Checking Software Licenses

Licenses are required to run the following CAA functions in the monitor:

- Early Warning Score (EWS)
- SepsisSight
- AF Summary
- ECG 24h Summary
- OxyCRG Expand

To check the licenses, select the **Main Menu** quick key → select **License** → **Local**.

To install the licenses, follow this procedure:

1. Connect the N1 to the Dock.
2. Connect the USB drive to the Dock's USB connector.
3. Select the **Main Menu** quick key → select **License** → select **External**.
4. Select **Install**.

16.2 Early Warning Score (EWS)

The Early Warning Scores (EWS) can help you recognize the early sign of deterioration in patients based on vital signs and clinical observations. It is based on the "Royal College of Physicians (2015) National Early Warning Score (NEWS2): Standardizing the assessment of acute illness severity in the NHS, Report of a Working Party. RCP, London. Depending on the score calculated, appropriate recommendations are displayed.

The monitor supports the following scores:

- MEWS (Modified Early Warning Score)
- NEWS (National Early Warning Score)
- NEWS2 (National Early Warning Score 2)
- Custom Score

A subscore is given for each parameter based on the measured or entered value. When all the required parameters are entered or measured, the subscores are added together to calculate the total early warning score. Each subscore has a color coding to indicate associated level of risk. When the total score is outside of the thresholds, actions are recommended. MEWS, NEWS and NEWS2 can give total scores.

Custom Score is based on user-defined parameters.

MEWS, NEWS and NEWS2 are intended for adult patients only. The patient category applied to the Custom Score is defined by the Mindray Clinical Score Configuration Tool. For more information, see *Mindray Clinical Scoring Config Tool Instruction for Use (P/N: 046-012986-00)*.

WARNING

- The EWS scores and recommended actions are for reference only and cannot be directly used for diagnostic interpretation.
 - EWS cannot be used as an prognosis index. It is not a clinical judgement tool. Clinicians must use their clinical judgement in conjunction with the EWS tool at all times.
 - MEWS, NEWS, and NEWS2 are intended for adult patients only. NEWS is not applicable to pregnant woman and COPD (Chronic Obstructive Pulmonary Disease) patients.
-

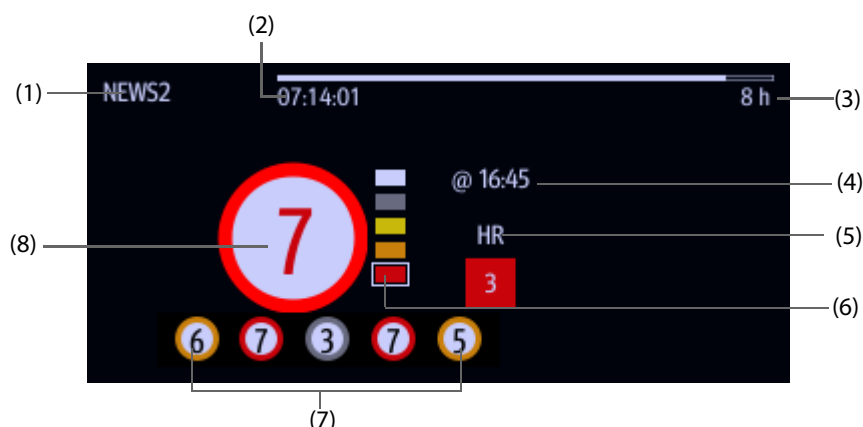
NOTE

- The EWS scores does not trigger any alarms and cannot used for continuous monitoring.
-

16.2.1 Displaying the EWS Numerics Area

To display the EWS numerics area, follow this procedure:

1. Access **Tile Layout** in either of the following ways:
 - ◆ Select the **Screen Setup** quick key → select the **Tile Layout** tab.
 - ◆ Select the **Main Menu** quick key → from the **Display** column select **Tile Layout**.
2. Select the parameter area where you want to display the EWS score, and then from the popup list select **EWS**.





- (1) EWS protocol label
- (2) Scoring countdown: time to the next scoring.
- (3) Scoring interval
- (4) The scoring time
- (5) Single parameter whose score reaches 3
- (6) Risk level indicator. The level of risk increases from top down. The current level is enclosed by a white square frame.
- (7) History total score. The rightmost one is the latest history score.
- (8) Total score. The color of the circle indicates the level of risk.

16.2.2 Accessing the EWS Screen

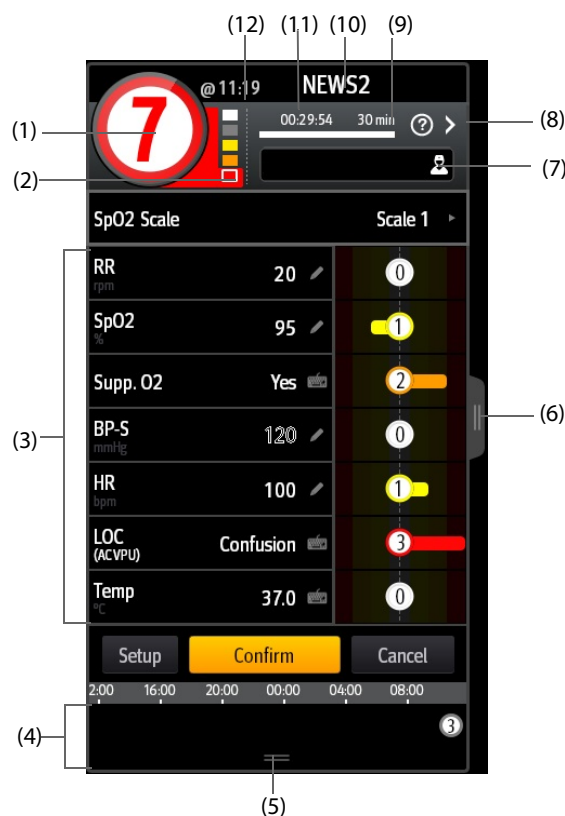
Access the EWS window in any of the following ways:

- Select the EWS parameter area
- Select the **EWS** quick key.
- Select the **Screen Setup** quick key → select the **Choose Screen** tab → select **EWS**.
- Select the **Main Menu** quick key → from the **CAA** column select **EWS**.

When the EWS screen is hidden as , you can also choose one of the following methods to quickly enter the EWS screen.

- Swipe left or right across the touchscreen with two fingers until you switch to the EWS screen.
- Swipe right across the touchscreen with a single finger,
- Select the  button,

Take NEWS2 as an example, the EWS screen is shown as follows. Your screen may be slightly different due to the configuration.



- (1) Total score. The color of the circle indicates the level of risk.
- (2) Risk level indicator. The level of risk increases from top down. The current level is enclosed by a white frame.
- (3) Parameter area: display the subscore and parameter value of each parameter. The keyboard symbol indicates that the parameter value is manually entered.
- (4) History total scores area: selecting this area or swiping up with one finger can review the trends of total score and each subscore
- (5) Selecting this button expands the History Total Scores area where you can review the trends of the total score and each subscore.
- (6) Selecting this button or swiping right across the screen with one finger displays the trends of total score and parameter values for scoring.
- (7) Clinician ID (displays only when the Clinician ID is enabled): allows inputting the Clinician ID to associate with the EWS score. For more information, see 21.4.1 Enabling Inputting the Clinician ID.
- (8) Select this button to see the clinical response to the current score
- (9) Scoring interval
- (10) EWS protocol label
- (11) Scoring countdown: time to the next scoring.
- (12) The scoring time

16.2.3 Performing EWS Scoring


CAUTION

- The decision to use Scale 2 of the SpO2 Scale should be made by a competent clinical decision maker and should be recorded in the patient's clinical notes.
-

NOTE

- Before calculating the score, select **Reset** to clear the previous score.
 - The keyboard symbol at the right of the parameter value indicates that the value is manually entered.
 - You can get the score only when all required parameters have been measured or entered.
 - When a patient is discharged, or the monitor is turned off, the clinician ID is cleared
-

To perform scoring, follow this procedure:

1. Select **Reset** to clear the previous score and update values of currently monitored parameters and relevant subscores.
2. For NEWS2, set the **SpO2 Scale**.
 - ◆ **Scale 1:** for patient without hypercapnic respiratory failure.
 - ◆ **Scale 2:** for patients with a prescribed oxygen saturation requirement of 88–92% (for example, in patients with hypercapnic respiratory failure).
3. Measure or manually enter other required parameters and observations.
4. If the clinician ID is enabled, input the clinician information by selecting , and then manually entering the information, or by scanning the clinician's barcode.
5. Select **Calculate** to get the total score.
6. If **Score Confirmation** is enabled, select **Confirm** to save current scoring, or select **Cancel** to give up current scoring. Refer to section 16.2.4.2 *Setting the Scoring Confirmation Switch* for more information.

16.2.4 Changing EWS Settings

16.2.4.1 Changing the Scoring Protocol

The monitor is configured with a default scoring protocol. To change the scoring protocol, follow this procedure:

1. From the EWS page select **Setup**.
2. Set **Score**.

16.2.4.2 Setting the Scoring Confirmation Switch

To select if confirmation is required before saving score, follow this procedure:

1. From the EWS page select **Setup**.
2. Set **Score Confirmation** switch.
 - ◆ **Off:** the monitor automatically saves the scoring result after the scoring is completed.
 - ◆ **On:** you need to confirm that whether the scoring result is saved or not after the scoring is completed.

16.2.4.3 Setting the Manual Data Timeout

The manually input parameter data can be configured to become invalid after a preset time. To set the timeout period for the input data, follow this procedure:

1. From the EWS screen select **Setup**.
2. From the **Manual Data Timeout** area, select a desired parameter and set its timeout period.

NOTE

- If the data is expired and not updated, the monitor displays the corresponding parameter score in outline font, and gives a timeout alarm.

16.2.4.4 Setting Auto Scoring

The monitor automatically starts scoring at the preset interval. To set auto scoring, follow this procedure:

1. From the EWS page select **Setup**.
2. Set **Auto Scoring**:
 - ◆ **Interval**: the monitor automatically starts scoring at the preset interval.
 - ◆ **NIBP**: the monitor automatically starts scoring at the completion of each NIBP measurement.
 - ◆ **Alarm**: the monitor automatically starts scoring when an alarm occurs to the parameter for scoring.
 - ◆ If no option is selected, the monitor does not initiate auto scoring.


16.2.4.5 Setting Auto Scoring Interval

1. From the EWS page select **Setup**.
2. Set **Interval**:
 - ◆ **By Score**: the monitor automatically starts scoring as per the interval selected for corresponding total score.
 - ◆ **5 min - 24 h**: If **Auto Scoring** is set to **Interval**, the monitor automatically starts scoring as per the selected interval. If **Auto Scoring** is not set to **Interval**, the countdown timer of manual scoring is selected.

16.2.5 Viewing Historical Scores


From the EWS screen, you can view the total score or subscores of the past 24 hours. To do so, choose either of the following ways:

- Select the history total score area.
- From the history total score area, swipe up with a finger.


To return to the EWS screen, select  from the top of the historical score screen. Refer to 16.2.2 *Accessing the EWS Screen* for the position of the history total score area.

16.2.6 Viewing Parameter Trends

From the EWS screen, you can view the 24-hour graphic trends of each parameter used for scoring. To do so, choose either of the following ways:

- Select the  button.
- Swipe right across the EWS screen with a finger.

From the screen of parameter trends, selecting the  button or swiping left across the screen with a finger can return to the EWS screen.

Refer to 16.2.2 *Accessing the EWS Screen* for the position of the  button.

16.3 Glasgow Coma Scale (GCS)

The Glasgow Coma Scale (GCS) function is based on Teasdale's *Assessment of Coma and Impaired Consciousness-A Practical Scale (Lancet, 1974)*. Three aspects of behavior are independently measured: eye opening, verbal response, and motor response. The scores are added together to indicate that patient's level of consciousness.

GCS is intended for adults and pediatric patients.

CAUTION

- GCS is intended as an adjunct in patient assessment and must be used in conjunction with observation of clinical signs and symptoms.

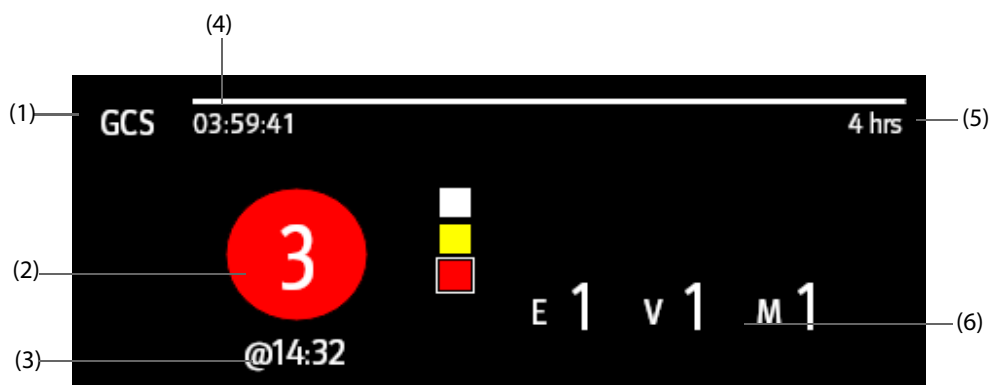
- **GCS is not applied to patients that are sedated, muscularly relaxed, with artificial airway, drunk, hypothermia or in status epilepsies.**
- **Please refer to hospital policy regarding acceptable use of GCS.**
- **When applied to children younger than five years old or to the elderly, the GCS score may not reflect actual function.**

16.3.1 Displaying the GCS Parameter Area

To display the GCS parameter area, follow this procedure:

1. Access **Tile Layout** in either of the following ways:
 - ◆ Select the **Screen Setup** quick key → select the **Tile Layout** tab.
 - ◆ Select the **Main Menu** quick key → from the **Display** column select **Tile Layout**.
2. Select the parameter area where you want to display the GCS score, and then from the popup list select **GCS**.

The following figure shows the GCS parameter area. The display may be configured to look slightly different.



- (1) GCS label
- (2) Total score and level of consciousness. The color of the circle indicates the level of risk.
- (3) Scoring time
- (4) Scoring countdown: time to the next scoring
- (5) Scoring interval
- (6) Subscores
 - ◆ E: eye opening
 - ◆ V: verbal response
 - ◆ M: motor response

16.3.2 Accessing the GCS Dialog

Enter the GCS dialog in any of the following ways:

- Select the GCS parameter area.
- Select the **GCS** quick key.
- Select the **Main Menu** quick key → from the **CAA** column select **GCS**.

GCS		
* Eye Opening	* Verbal Response	* Motor Response
Eyes Opening Spontaneously (4)	Oriented and Converses (5)	Obey Verbal Commands (6) — (1)
Eyes Opening to Verbal Command (3)	Disoriented and Converses (4)	Localize to Pain (5)
Eyes Opening Only with Painful Stimuli (2)	Inappropriate Words (3)	Withdraw from Pain (4)
No Eye Opening (1)	Incomprehensible Sounds (2)	Flexor Response to Painful Stimuli (3)
	No Verbal Response (1)	Extensor Response to Painful Stimuli (2)
		No Motor Response (1)
Total Score 14 — (2)		
Interval 4 hrs Review OK Cancel		

(1) Subscore (2) Total score

16.3.3 Performing GCS Scoring

To perform scoring, follow this procedure:

1. From the **Eye Opening** area, **Verbal Response** area, and **Motor Response** area, respectively select an item that represents the patient's status.
2. Select **Ok** to accept the total score.

The following table lists the default score range and color of relevant consciousness level.

Level	Range	Color
Mild damage	13-15	White
Moderate damage	9 - 12	Yellow
Severe damage	3 - 8	Red

NOTE

- The GCS score range is adjustable. Refer to 21.4.4 *Setting GCS Threshold for Each Consciousness Level* for the method of changing the high limit and low limit of each consciousness level.

16.3.4 Setting GCS Scoring Interval

From the **GCS** dialog, select **Interval** to set GCS scoring interval. When the scoring interval is reached and you do not perform another scoring, the score will be invalidated and displayed as outline fonts.

16.3.5 Reviewing GCS Trend Data

From the **GCS** dialog, select **Review** to enter the **Review** dialog and view the GCS trend data from the **Tabular Trends**.

16.4 SepsisSight™

The SepsisSight™ function is based on Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3) and Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2012 and 2016 (SSC Guideline 2016). It assists you in recognizing the early signs and symptoms of sepsis by comparing the state of the patient to the defined criteria and then guides you through the recommended treatment protocol.

CAUTION

- SepsisSight is not a diagnostic or therapeutic tool and is not intended to replace the competent judgment of a clinician.
 - SepsisSight should not be used with intravenous immunoglobulins in adult patients with severe sepsis or septic shock.
 - SepsisSight should not be used with intravenous selenium for the treatment of severe sepsis.
 - SepsisSight should not be used with sodium bicarbonate therapy for the purpose of improving hemodynamics or reducing vasopressor requirements in patients with hypoperfusion-induced lactic acidemia with pH ≥ 7.15 .
-

NOTE

- SepsisSight is intended to perform routine screening of potentially infected seriously ill patients for severe sepsis to allow earlier implementation of therapy.
 - SepsisSight is intended to be followed by application of hospital-based performance improvement efforts in severe sepsis.
 - The Surviving Sepsis Campaign recommends to discuss goals of care and prognosis with patients and families.
 - The Surviving Sepsis Campaign recommends to incorporate goals of care into treatment and end-of-life care planning, utilizing palliative care principles where appropriate.
 - The SepsisSight goals of care are intended to be applied in a time defined by the SSC guidelines.
 - Due to space limitations on the screen, the recommendations cannot always be reproduced in the full detail available in the printed and on-line guidelines.
 - SepsisSight is intended for adult patients suffering from sepsis or suspicion of sepsis.
-

16.4.1 Accessing the SepsisSight Dialog

Enter the **SepsisSight** dialog in any of the following ways:


- Select the **SepsisSight** quick key.
- Select the **Main Menu** quick key → from the **CAA** column select **SepsisSight**.

16.4.2 Screening

As per Sepsis-3, SepsisSight supports quick Sepsis-Related Organ Failure Assessment (qSOFA, or quick SOFA) and Sepsis-Related Organ Failure Assessment (SOFA). SOFA is the default assessment tool for ICU, while qSOFA is the default for other departments.

16.4.2.1 Performing qSOFA


qSOFA evaluates the patient's respiration rate, systolic blood pressure and altered mental status.

RR and BP-S being monitored are automatically obtained. You can also manually enter these values by selecting the  symbol. Select whether the patient's mental status is altered. Then qSOFA score is calculated. Select **Confirm** to record the calculation time.

If the qSOFA score is greater than or equal to 2, or sepsis is suspected, select **SOFA>>** to perform SOFA.

To clear the score, select **Reset**.

NOTE

- The keyboard symbol  indicates that the parameter value is manually entered.
 - The question mark (?) in the score circle indicates that more parameter values are required before a score can be calculated.
-

16.4.2.2 Performing SOFA

SOFA score is used to identify organ function or the rate of sepsis-related organ failure.

To perform SOFA, enter the value or select a range for each item, SOFA score will be automatically calculated.

To clear the score, select **Reset**.

If Sepsis criteria is met, make a comprehensive judgement on the clinical features.

16.4.2.3 Changing Screening Settings

From the **Screening** page select **Setup**. You can change the following settings:


- In the **Screening** area, set **RR (rpm)** high limit and **BP-S (mmHg)** low limit for qSOFA scoring.
- In the **Unit** area, set the unit of **Bilirubin** and **Creatinine**.

16.4.3 Recommendations


The **SSC Bundles** page lists goals and treatments to be completed in the defined time. Pages **Treatment I** and **Treatment II** list graded recommendations as per the SSC Guidelines 2016,

You can define the time and goals for initial resuscitation, as well as treatments to be completed in one hour, 3 hours, and 6 hours. For more information, see *21.4.5 Changing SepsisSight Settings*.

16.4.3.1 Viewing Detailed Recommendations


On the Pages **Treatment I** and **Treatment II** select the arrow symbol  at the right side of each item to view detailed recommendations of SSC Guideline 2016. The star symbol ★ indicates the grade of recommendation:

- ★ ★ : strong recommendation
- ★ : weak recommendation
- No star symbol: best practice statement

To hide the detailed recommendations, select the arrow symbol .

16.4.3.2 Marking Implemented Items

Check off implemented items. Then the time and date are automatically recorded and displayed.

- You can select the  symbol to change the date and time.
- Select **Reset** to clear the current results.

16.4.4 Reviewing SepsisSight Trend Data

Select the **Graphic Trends** tab to view the trend of parameters of resuscitation.

When a recommended treatment is checked off on pages **Treatment I** and **Treatment II**, relevant event is marked in the tabular trend. Vertical lines of different colors indicate the event type:

- White: inspection performed
- Blue: medication
- Green: goal achieved
- Purple: other treatment

16.5 AF Summary

The AF Summary provides statistics of AF events as well as trends of vital signs.

The AF Summary function is intended for adult patients only.

NOTE

- A License is required for the AF Summary function.
- The AF Summary function is intended for the current patient. It is not intended for discharged patients.
- Data displayed in the AF Summary is not recalculated.

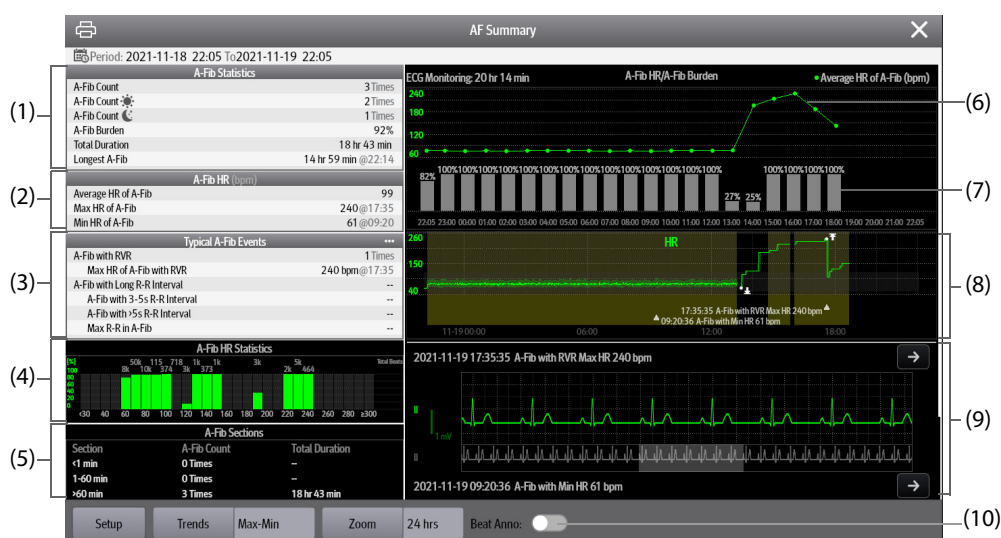
16.5.1 Opening the AF Summary Window

To open the AF Summary window, choose either of the following ways:

- Select the **AF Summary** quick key.
- Select the **Main Menu** quick key → from the **Summary** column select **AF Summary**.

16.5.2 AF Summary Display

The following figure is an example of the AF Summary window:



- (1) A-Fib statistics
- (2) A-Fib HR statistics: shows statistics of heart rates when A-Fib events occur.
- (3) Statistics of typical A-Fib events: selecting this area goes to statistics review.
- (4) A-Fib HR distribution: shows the distribution of A-Fib heart rates over the statistical period.
Horizontal axis: heart rate
Vertical axis: percentage
Total beats: the total beats in corresponding HR range
Green bar: A-Fib HR as a percentage of total beats in corresponding HR range
- (5) Statistics of A-Fib sections: shows A-Fib counts in different A-Fib duration sections.
- (6) Average A-Fib HR: shows hourly average A-Fib HR.
- (7) Hourly AF burden. The AF burden is the cumulative duration of AF events over the statistical period as the percentage of effective monitoring time.
- (8) Graphic trends: shows the trends of mean parameter value or maximum/minimum parameter value. The shaded part indicates that there is an A-Fib event. The triangular symbol ? indicates the occurrence time of the typical AF event or the maximum/minimum AF heart rate.
- (9) A-Fib waveform: shows ECG waveforms corresponding to the typical AF event or the maximum/minimum AF heart rate. Selecting the arrow on the upper right corner can review full disclosure ECG waveforms.
- (10) The Beat Anno: switch. To display beat labels on the first ECG waveform, switch on **Beat Anno**. For more information on Beat Anno, see 15.2.7.4 Viewing Event Details.

16.5.3 Setting A-Fib Statistical Duration

You can view up to 24 hours of A-Fib statistics from the AF Summary window. Select **Zoom** to set statistical duration.

16.5.4 Setting Trend Parameters for the AF Summary

Select **Setup** to set parameters to be displayed in the AF Summary.

16.5.5 Setting the Type of Trend for the AF Summary

Select **Trends** to set whether the trend of maximum/minimum values or the trend of average values is displayed.

16.5.6 Printing the AF Summary Report

Select the printer symbol  to print the AF Summary report.

16.6 ECG 24h Summary

The ECG 24h Summary provides ECG statistics of the current patient over the latest 24 hours. It also displays the patient's typical ECG strips.

NOTE

- **The ECG 24h Summary function is intended for the current patient. It is not intended for discharged patients.**
 - **Pacer statistics is intended for paced patients. Pacer statistics is available only when the Paced setting is Yes.**
 - **ST statistics is available only when ST analysis is switched on.**
 - **QT statistics is available only when QT analysis is switched on.**
 - **Data displayed in the ECG 24h Summary is not recalculated.**
 - **A License is required for the ECG 24h Summary function.**
-

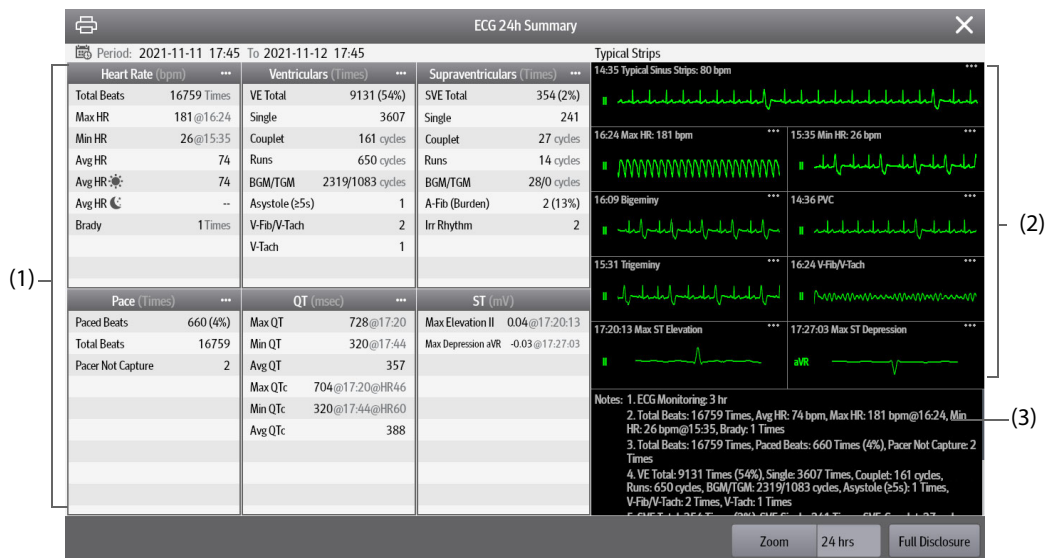
16.6.1 Opening the ECG 24h Summary Window

To open the ECG 24h Summary window, choose either of the following ways:

- Select the **ECG 24h Sum** quick key.
- Select the **Main Menu** quick key → from the **Summary** column select **ECG 24h Summary**.

16.6.2 The Display of ECG 24h Summary

The following figure is an example of the ECG 24h Summary window:



- (1) ECG statistics, including the following items:
 - Statistics of heart rates
 - Statistics of ventricular beats and ventricular events
 - Statistics of supraventricular beats and supraventricular events
 - Statistics of QT/QTc measurements
 - Statistics of maximum ST elevations and depressions
 - Statistics of pace
- (2) Typical ECG strips
- (3) Notes: includes additional information on the ECG 24h Summary

16.6.3 Selecting Typical ECG Strips

Taking V-Tach as an example, to select typical V-Tach waveform, select the currently displayed V-Tach waveform, from the popup list select the desired waveform as typical V-Tach waveform.

If no V-Tach occurs to the patient within 24 hours, an add symbol **+** is displayed in the V-Tach area. You can select the add symbol to display a typical ECG waveform of other event in this area.

16.6.4 Setting the Statistical Duration of the ECG 24h Summary

You can view a maximum of 24 hours of ECG statistics through the ECG 24h Summary. To select the statistical duration, select **Zoom**.

16.6.5 Reviewing the ECG Summary

Selecting any of the statistic area can access corresponding trends and events review. Selecting **Full Disclosure** can review ECG full disclosure waveforms. For more information, see [15.2.8 Full Disclosure Review Page](#).

16.7 OxyCRG Expand Screen

The OxyCRG Expand screen displays the following information:

- Realtime values and waveforms of ECG, Resp, and SpO₂.
- Realtime OxyCRG
- A timer
- SpO₂ statistics

The OxyCRG Expand screen facilitates viewing the result of neonatal monitoring.

NOTE

- **A license is required for the OxyCRG Expand screen.**

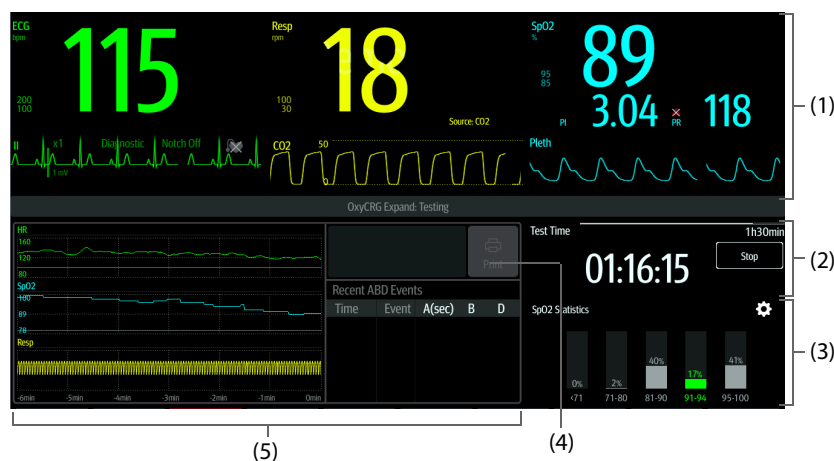
- The OxyCRG Expand screen is not intended for adult and pediatric patients.

16.7.1 Accessing the OxyCRG Expand Screen

Access the OxyCRG Expand screen in any of the following ways:

- Select the OxyCRG Expand quick key.
- Select the **Screen Setup** quick key → select the **Choose Screen** tab → select OxyCRG Expand.
- Select the **Main Menu** quick key → from the **CAA** column select OxyCRG Expand.

The following figure shows the OxyCRG Expand screen. Your screen may be slightly different due to the configuration.



- (1) Parameter numerics and waveforms area
- (2) Timer area
- (3) SpO₂ statistics area: for more information, see 4.4.4 *Setting Parameter Statistics*.
- (4) The printer icon: select it to print the OxyCRG Expand report.
- (5) OxyCRG: for more information, see 4.3 *The OxyCRG Screen*.

16.7.2 Change Parameter Settings

To change parameter settings, select corresponding parameter numerics or waveform area.

16.7.3 Starting the Timer

A timer is used to record the neonatal monitoring time. The monitoring time is 90 minutes by default. For more information on changing the timer settings, see 19.3 *Setting the Timer*.

To start the timer, from the Timer area select **Start**.

16.7.4 Printing the OxyCRG Report

After the neonatal monitoring is finished, select the **Print** icon at the top right corner of the OxyCRG to preview or print the monitoring report.

16.7.5 Reviewing the OxyCRG Events

To review the OxyCRG Expand events, select the ABD events area of the OxyCRG to enter the OxyCRG review page.

For more information on OxyCRG review, see 15.2.9 *OxyCRG Review Page (available when the N1 is used with the independent external display)*.

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17 Calculation (only available when the N1 is used with the independent external display)

17.1 Calculation Overview

The monitor provides calculation functions. The calculated values, which are not directly measured, are computed based on the values you provide. The calculation function is independent of other monitoring functions and can therefore be used for patients being monitored by other monitors. Any operation in a calculation dialog does not affect the patient monitored by the current monitor.

You can perform the following calculations:

- Drug calculations
- Hemodynamic calculations
- Oxygenation calculations
- Ventilation calculations
- Renal calculations

17.2 Calculation Safety Information

WARNING

- **Decisions on the choice and dosage of drugs administered to patients must always be made by the physician in charge. The drug calculations are based on the values input; it does not check the plausibility of the calculation performed.**
 - **Check that the entered values are correct and the calculated values are appropriate. Mindray assumes no responsibility for any consequences caused by wrong entries and improper operations.**
-

17.3 Drug Calculations

17.3.1 Performing Drug Calculations

To perform drug calculations, follow this procedure:

1. Access the drug calculator by either of the following ways:
 - ◆ Select the **Calculations** quick key → select the **Drug** tab.
 - ◆ Select the **Main Menu** quick key → from the **Calculations** column select **Drug**.
2. Set **Drug Name** and **Patient Category**. If the dose of drug is weight dependent, you must input the patient's weight. The dose calculation program has a library of commonly used drugs, while Drug A through Drug E are user defined.
3. Enter the known values, for example **Drug Amount** and **Solution Volume**.
4. Select **Calculate**. The calculated values are indicated by red arrows.

NOTE

- **If available, the patient category and weight from the Patient Demographics dialog are automatically entered when you first access drug calculation. You can change the patient category and weight. This will not change the patient category and weight stored in the patient demographic information.**
-

17.3.2 Checking the Titration Table

The titration table shows information on the currently used drugs. Use the titration table to see what dose of a drug your patient will receive at different infusion rates. To access the titration table, follow this procedure:

1. Access drug calculator by either of the following ways:
 - ◆ Select the **Calculations** quick key.
 - ◆ Select the **Main Menu** quick key → from the **Calculations** column select **Drug**.
2. Select the **Titration Table** tab.
3. Select **Dose Type** to set the type of dose unit in the titration table.
4. Select **Interval** to set the interval between two adjacent titration table items.

You can select how to display the titration table:

- **Dose:** the titration table is listed in the sequence of increased drug dose.
- **Infusion Rate:** the titration table is listed in the sequence of increased infusion rate. By default the resolution of the infusion rate is one (1). By selecting **Exact Rate** the resolution of the infusion rate can reach 0.01 so that you can display the infusion rate more accurately.

17.3.3 Drug Calculation Formula

Description	Unit	Formula
Dose	Dose/hr Dose/min	$\text{Dose} = \text{Infusion Rate} \times \text{Concentration}$
Dose (weight based)	Dose/kg/hr Dose/kg/min	$\text{Dose (weight based)} = \text{Infusion Rate} \times \text{Concentration/Weight}$
Drug Amount	g series: mcg, mg, g unit series: Unit, KU, MU mEq series: mEq	$\text{Drug Amount} = \text{Dose} \times \text{Duration}$
Drug Amount (weight based)	g series: mcg, mg, g unit series: Unit, KU, MU mEq series: mEq	$\text{Drug Amount (weight based)} = \text{Dose} \times \text{Duration} \times \text{Weight}$
Duration	hr	$\text{Duration} = \text{Amount/Dose}$
Duration (weight based)	hr	$\text{Duration (weight based)} = \text{Amount}/(\text{Dose} \times \text{Weight})$
Concentration	mcg/ml, mg/ml, g/ml, Unit/ml, KU/ml, MU/ml, mEq/ml	$\text{Concentration} = \text{Drug Amount/Solution Volume}$
Solution volume	ml	$\text{Volume} = \text{Infusion Rate} \times \text{Duration}$
Infusion rate	ml/hr	$\text{Infusion Rate} = \text{Dose/Concentration}$
Infusion rate (weight based)	g•ml/hr	$\text{Infusion Rate} = \text{Dose} \times \text{Weight/Concentration}$

17.3.4 Titration Table Calculation Formula

Description	Unit	Formula
Infusion Rate	ml/hr	$\text{Infusion Rate} = \text{Dose/Concentration}$
Infusion Rate (weight based)	ml/hr	$\text{Infusion Rate} = \text{Weight} \times \text{Dose/Concentration}$
Dose	Dose/hr Dose/min	$\text{Dose} = \text{Infusion Rate} \times \text{Concentration}$
Dose (weight based)	Dose/kg/hr Dose/kg/min	$\text{Dose (weight based)} = \text{Infusion Rate} \times \text{Concentration/Weight}$

17.4 Hemodynamic Calculations

The monitor provides the hemodynamic calculation function and can save the results of up to 10 calculations, which are displayed in groups.

17.4.1 Performing Hemodynamic Calculations

To perform hemodynamic calculation, follow this procedure:

1. Access hemodynamic calculation by either of the following ways:
 - ◆ Select the **Calculations** quick key → **Hemodynamics** tab.
 - ◆ Select the **Main Menu** quick key → from the **Calculations** column select **Hemodynamics**.
2. Enter the known values. For a patient who is being monitored, the currently measured values are automatically entered.
3. Select **Calculate**.

A calculated value greater than the normal upper limit is indicated by an up arrow “↑”. A calculated value lower than the normal lower limit is indicated by a down arrow “↓”.

You can select **Range** to show the normal range of each parameter.

17.4.2 Input Parameters for Hemodynamic Calculations

Input Parameter	Label	Unit
cardiac output	C.O.	L/min
heart rate	HR	bpm
pulmonary artery wedge pressure	PAWP	mmHg
mean arterial pressure	MAP	mmHg
pulmonary artery mean pressure	PA-M	mmHg
central venous pressure	CVP	mmHg
end-diastolic volume	EDV	ml
height	Height	cm
weight	Weight	kg

NOTE

- If you enable Use PA-D as PAWP, PA-D value will be used to replace PAWP value for hemodynamic calculation. For more information, refer to 13.6.8 Setting the Use PA-D as PAWP Switch (only available when the N1 is used with the independent external display).

17.4.3 Calculated Parameters and Formulas for Hemodynamic Calculations

Calculated Parameters	Label	Unit	Formula
cardiac index	C.I.	L/min/m ²	$C.I. (L/min/m^2) = C.O. (L/min) / BSA (m^2)$
body surface area	BSA	m ²	$BSA (m^2) = Wt^{0.425} (kg) \times Ht^{0.725} (cm) \times 0.007184$
stroke volume	SV	ml	$SV (ml) = 1000 \times C.O. (L/min) / HR (bpm)$
stroke index	SVI	ml/m ²	$SVI (ml/m^2) = SV (ml) / BSA (m^2)$

Calculated Parameters	Label	Unit	Formula
systemic vascular resistance	SVR	DS/cm ⁵	$SVR (DS/cm^5) = 79.96 \times [APMAP (mmHg) - CVP (mmHg)] / C.O. (L/min)$
systemic vascular resistance index	SVRI	DS•m ² /cm ⁵	$SVRI (DS \cdot m^2/cm^5) = SVR (DS/cm^5) \times BSA (m^2)$
pulmonary vascular resistance	PVR	DS/cm ⁵	$PVR (DS/cm^5) = 79.96 \times [PAMAP (mmHg) - PAWP (mmHg)] / C.O. (L/min)$
pulmonary vascular resistance index	PVRI	DS•m ² /cm ⁵	$PVRI (DS \cdot m^2/cm^5) = PVR (DS/cm^5) \times BSA (m^2)$
left cardiac work	LCW	kg•m	$LCW (kg \cdot m) = 0.0136 \times APMAP (mmHg) \times C.O. (L/min)$
left cardiac work index	LCWI	kg•m/m ²	$LCWI (kg \cdot m/m^2) = LCW (kg \cdot m) / BSA (m^2)$
left ventricular stroke work	LVSF	g•m	$LVSF (g \cdot m) = 0.0136 \times APMAP (mmHg) \times SV (ml)$
left ventricular stroke work index	LVSFI	g•m/m ²	$LVSFI (g \cdot m/m^2) = LVSF (g \cdot m) / BSA (m^2)$
right cardiac work	RCW	kg•m	$RCW (kg \cdot m) = 0.0136 \times PAMAP (mmHg) \times C.O. (L/min)$
right cardiac work index	RCWI	kg•m/m ²	$RCWI (kg \cdot m/m^2) = RCW (kg \cdot m) / BSA (m^2)$
right ventricular stroke work	RVSF	g•m	$RVSF (g \cdot m) = 0.0136 \times PAMAP (mmHg) \times SV (ml)$
right ventricular stroke work index	RVSFI	g•m/m ²	$RVSFI (g \cdot m/m^2) = RVSF (g \cdot m) / BSA (m^2)$
ejection fraction	EF	%	$EF (\%) = 100 \times SV (ml) / EDV (ml)$
end-diastolic volume index	EDVI	ml/m ²	$EDVI (ml/m^2) = EDV (ml) / BSA (m^2)$
end-systolic volume	ESV	ml	$ESV (ml) = EDV (ml) - SV (ml)$
end-systolic volume index	ESVI	ml/m ²	$ESVI (ml/m^2) = ESV (ml) / BSA (m^2)$

17.5 Oxygenation Calculations

The monitor provides the oxygenation calculation function and can save the results of up to 10 calculations, which are displayed in groups.

17.5.1 Performing Oxygenation Calculations

To perform oxygenation calculations, follow this procedure:

- Access oxygenation calculation by either of the following ways:
 - ◆ Select the **Calculations** quick key → **Oxygenation** tab.
 - ◆ Select the **Main Menu** quick key → from the **Calculations** column select **Oxygenation**.
- Enter the known values. For a patient who is being monitored, the currently measured values are automatically entered.
- Select **Calculate**.

A calculated value greater than the normal upper limit is indicated by an up arrow “↑”. A calculated value lower than the normal lower limit is indicated by a down arrow “↓”.

In the **Oxygenation** page, you can also perform the following operations:

- Select **OxyCont Unit**, **Hb Unit**, and **Pressure Unit**. Then corresponding parameter values will be automatically converted and updated accordingly.

- Select **Range** to show the normal range of each parameter.

17.5.2 Input Parameters for Oxygenation Calculations

Input Parameter	Label	Unit
cardiac output	C.O.	L/min
percentage fraction of inspired oxygen	FiO ₂	%
partial pressure of oxygen in the arteries	PaO ₂	mmHg, kPa
partial pressure of carbon dioxide in the arteries	PaCO ₂	mmHg, kPa
arterial oxygen saturation	SaO ₂	%
partial pressure of oxygen in venous blood	PvO ₂	mmHg, kPa
venous oxygen saturation	SvO ₂	%
hemoglobin	Hb	g/L, g/dl, mmol/L
respiratory quotient	RQ	None
atmospheric pressure	ATMP	mmHg, kPa
height	Height	cm, inch
weight	Weight	kg, lb

17.5.3 Calculated Parameters and Formulas for Oxygenation Calculations

Calculated Parameters	Label	Unit	Formula
body surface area	BSA	m ²	$BSA (m^2) = Wt^{0.425} (kg) \times Ht^{0.725} (cm) \times 0.007184$
oxygen consumption	VO ₂	ml/min	$VO_2 (ml/min) = C(a-v)O_2 (ml/L) \times C.O. (L/min)$
arterial oxygen content	CaO ₂	ml/L, ml/dL	$CaO_2 (ml/L) = 10 \times (0.0134 \times Hb (g/dl) \times SaO_2 (\%)) + 0.031 \times PaO_2 (mmHg)$
venous oxygen content	CvO ₂	ml/L, ml/dL	$CvO_2 (ml/L) = 10 \times (0.0134 \times Hb (g/dl) \times SvO_2 (\%)) + 0.031 \times PvO_2 (mmHg)$
arteriovenous oxygen content difference	C(a-v)O ₂	ml/L, ml/dl	$C(a-v)O_2 (ml/L) = CaO_2 (ml/L) - CvO_2 (ml/L)$
oxygen extraction ratio	O ₂ ER	%	$O_2ER (\%) = 100 \times C(a-v)O_2 (ml/L) / CaO_2 (ml/L)$
oxygen transport	DO ₂	ml/min	$DO_2 (ml/min) = C.O. (L/min) \times CaO_2 (ml/L)$
partial pressure of oxygen in the alveoli	PAO ₂	mmHg, kPa	$PAO_2 (mmHg) = [ATMP (mmHg) - 47 mmHg] \times FiO_2 (\%)/100 - PaCO_2 (mmHg) \times [FiO_2 (\%)/100 + (1 - FiO_2 (\%)/100)/RQ]$
alveolar-arterial oxygen difference	AaDO ₂	mmHg, kPa	$AaDO_2 (mmHg) = PAO_2 (mmHg) - PaO_2 (mmHg)$
capillary oxygen content	CcO ₂	ml/L, ml/dl	$CcO_2 (ml/L) = Hb (g/L) \times 1.34 + 0.031 \times PAO_2 (mmHg)$
venous admixture	QS/QT	%	$QS/QT (\%) = 100 \times [1.34 \times Hb (g/L) \times (1 - SaO_2 (\%)/100) + 0.031 \times (PAO_2 (mmHg) - PaO_2 (mmHg))] / [1.34 \times Hb (g/L) \times (1 - SvO_2 (\%)/100) + 0.031 \times (PAO_2 (mmHg) - PvO_2 (mmHg))]$
oxygen transport index	DO ₂ I	ml/min/m ²	$DO_2I (ml/min/m^2) = CaO_2 (ml/L) \times (C.O. (L/min) / BSA (m^2))$

Calculated Parameters	Label	Unit	Formula
oxygen consumption	VO ₂ I	ml/min/m ²	VO ₂ I (ml/min/m ²) = C (a-v) O ₂ (ml/L) × (C.O. (L/min)/BSA (m ²))

17.6 Ventilation Calculations

The monitor provides the ventilation calculation function and can save the results of up to 10 calculations, which are displayed in groups.

17.6.1 Performing Ventilation Calculations

To perform ventilation calculations, follow this procedure:

- Access ventilation calculation by either of the following ways:
 - ◆ Select the **Calculations** quick key → **Ventilation** tab.
 - ◆ Select the **Main Menu** quick key → from the **Calculations** column select **Ventilation**.
- Enter the known values. For a patient who is being monitored, the currently measured values are automatically taken. If the anesthesia machine or ventilator is connected, measured values for ventilation calculation are also automatically entered.
- Select **Calculate**.

A calculated value greater than the normal upper limit is indicated by an up arrow "↑". A calculated value lower than the normal lower limit is indicated by a down arrow "↓".

On the **Ventilation** page, you can also perform the following operations:

- Select **Pressure Unit**. Then corresponding parameter values will be automatically converted and updated accordingly.
- Select **Range** to show the normal range of each parameter.

17.6.2 Input Parameters for Ventilation Calculations

Input Parameter	Label	Unit
percentage fraction of inspired oxygen	FiO ₂	%
respiration rate	RR	rpm
partial pressure of mixed expiratory CO ₂	PeCO ₂	mmHg, kPa
partial pressure of carbon dioxide in the arteries	PaCO ₂	mmHg, kPa
partial pressure of oxygen in the arteries	PaO ₂	mmHg, kPa
tidal volume	TV	ml
respiratory quotient	RQ	None
atmospheric pressure	ATMP	mmHg, kPa

17.6.3 Calculated Parameters and Formulas for Ventilation Calculations

Calculated Parameters	Label	Unit	Formula
partial pressure of oxygen in the alveoli	PAO ₂	mmHg, kPa	PAO ₂ (mmHg) = [ATMP (mmHg) - 47 mmHg] × FiO ₂ (%) / 100 - PaCO ₂ (mmHg) × [FiO ₂ (%) / 100 + (1 - FiO ₂ (%) / 100) / RQ]
alveolar-arterial oxygen difference	AaDO ₂	mmHg, kPa	AaDO ₂ (mmHg) = PAO ₂ (mmHg) - PaO ₂ (mmHg)

Calculated Parameters	Label	Unit	Formula
oxygenation ratio	Pa/FiO ₂	mmHg, kPa	$\text{Pa/FiO}_2(\text{mmHg}) = 100 \times \text{PaO}_2(\text{mmHg})/\text{FiO}_2(\%)$
arterial to alveolar oxygen ratio	a/AO ₂	%	$\text{a/AO}_2(\%) = 100 \times \text{PaO}_2(\text{mmHg})/\text{PAO}_2(\text{mmHg})$
minute volume	MV	L/min	$\text{MV (L/min)} = [\text{TV (ml)} \times \text{RR (rpm)}]/1000$
volume of physiological dead space	Vd	ml	$\text{Vd (ml)} = \text{TV (ml)} \times [1 - \text{PeCO}_2(\text{mmHg})/\text{PaCO}_2(\text{mmHg})]$
physiologic dead space in percent of tidal volume	Vd/Vt	%	$\text{Vd/Vt}(\%) = 100 \times \text{Vd (ml)}/\text{TV (ml)}$
alveolar volume	VA	L/min	$\text{VA (L/min)} = [\text{TV (ml)} - \text{Vd (ml)}] \times \text{RR (rpm)}/1000$

17.7 Renal Calculations

The monitor provides the renal calculation function and can save the results of up to 10 calculations, which are displayed in groups.

17.7.1 Performing Renal Calculations

To perform renal calculations, follow this procedure:

- Access renal calculation by either of the following ways:
 - ◆ Select the **Calculations** quick key → select the **Renal** tab.
 - ◆ Select the **Main Menu** quick key → from the **Calculations** column select **Renal**.
- Enter the known values.
- Select **Calculate**.

A calculated value greater than the normal upper limit is indicated by an up arrow “↑”. A calculated value lower than the normal lower limit is indicated by a down arrow “↓”.

You can select **Range** to show the normal range of each parameter.

17.7.2 Calculated Parameters and Formulas for Renal Calculations

Input Parameter	Label	Unit
urine potassium	URK	mmol/L
urinary sodium	URNa	mmol/L
urine	Urine	ml/24 hrs
plasm osmolality	Posm	mOsm/kgH ₂ O
urine osmolality	Uosm	mOsm/kgH ₂ O
serum sodium	SerNa	mmol/L
creatinine	Cr	μmol/L
urine creatinine	UCr	μmol/L
blood urea nitrogen	BUN	mmol/L
height	Height	cm
weight	Weight	kg

17.7.3 Calculated Parameters and Formulas for Renal Calculations

Calculated Parameters	Label	Unit	Formula
urine sodium excretion	URNaEx	mmol/24 hrs	$\text{URNaEx (mmol/24 hrs)} = \text{Urine (ml/24 hrs)} \times \text{URNa (mmol/L)} / 1000$
urine potassium excretion	URKEx	mmol/24 hrs	$\text{URKEx (mmol/24 hrs)} = \text{Urine (ml/24 hrs)} \times \text{URK (mmol/L)} / 1000$
sodium potassium ratio	Na/K	%	$\text{Na/K (\%)} = 100 \times \text{URNa (mmol/L)} / \text{URK (mmol/L)}$
clearance of sodium	CNa	ml/24 hrs	$\text{CNa (ml/24 hrs)} = \text{URNa (mmol/L)} \times \text{Urine (ml/24 hrs)} / \text{SerNa (mmol/L)}$
creatinine clearance rate	Clcr	ml/min	$\text{Clcr (ml/min)} = \text{Ucr (\mu mol/L)} \times \text{Urine (ml/24 hrs)} / [\text{Cr (\mu mol/L)} \times (\text{BSA (m}^2\text{)} / 1.73) \times 1440]$
fractional excretion of sodium	FENa	%	$\text{FENa (\%)} = 100 \times \text{URNa (mmol/L)} \times \text{Cr (\mu mol/L)} / [\text{SerNa (mmol/L)} \times \text{Ucr (\mu mol/L)}]$
osmolar clearance	Cosm	ml/min	$\text{Cosm (ml/min)} = \text{Uosm (mOsm/kgH}_2\text{O)} \times \text{Urine (ml/24 hrs)} / (\text{Posm (mOsm/kgH}_2\text{O)} \times 1440)$
free water clearance	CH ₂ O	ml/hr	$\text{CH}_2\text{O (ml/hr)} = \text{Urine (ml/24 hrs)} \times [1 - \text{Uosm (mOsm/kgH}_2\text{O)} / \text{Posm (mOsm/kgH}_2\text{O)}] / 24$
urine to plasma osmolality ratio	U/P osm	None	$\text{U/P osm} = \text{Uosm (mOsm/kgH}_2\text{O)} / \text{Posm (mOsm/kgH}_2\text{O)}$
blood urea nitrogen creatinine ratio	BUN/Cr*	Mmol/L	$\text{BUN/Cr} = 1000 \times \text{BUN (mmol/L)} / \text{Cr (\mu mol/L)}$
urine-serum creatinine ratio	U/Cr	None	$\text{U/Cr (mmol/L)} = \text{Ucr (\mu mol/L)} / \text{Cr (\mu mol/L)}$

*: BUN/Cr is a ratio under the unit of mol.

18 Printing

18.1 Supported Printer

The N1 monitor can output patient reports with a printer connected to the N1 via the wired network or Wi-Fi network.

- HP LaserJet Pro M202dw
- HP LaserJet Pro 400 M401n
- HP LaserJet P4015n
- HP LaserJet 600 M602
- HP LaserJet Enterprise M605
- HP LaserJet Enterprise M608n

NOTE

- **For more details about the printer, refer to the document accompanying the printer. With product upgrades, the monitor may support additional printers without prior notice. If you have any doubts about the compatibility of the printer used with this monitor, contact Mindray.**
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18.2 End Case Reports

18.2.1 Printing the End Case Report

To print the end case report, choose one of the following ways:

- Select **Print** from the **End Case Report** menu.
- Select **Print End Case Report** when you discharge a patient.
- Select the **End Case Report** quick key (only available when the N1 is used with the independent external display).

18.2.2 Setting a Report as An End Case Report

The following reports can be set as end case reports:

- Tabular Trends Report
- Graphic Trends Report
- Event Report
- 12-lead Interpretation
- Alarm Limits Report
- Realtime Report
- ECG Report

To set a report as an end case report, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **End Case Report**.
2. From the **Select Reports** page, select the desired report tab, for example **ECG Report**.

18.2.3 Configuring the End Case Reports

To configure the end case reports, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **End Case Report**.

2. From the **Report Setup** page, set the following end case reports:
 - ◆ Select the **Tabular Trends Report**, **Graphic Trends Report**, **Realtime Report**, and **ECG Report** tab, and set these end case report by referring to section *18.6 Configuring Reports*.
 - ◆ Select the **Event Report** tab, and select the event that needs to be printed.
 - ◆ Select the **12-Lead Interpretation** tab, and set the switch of **Median Complex**, **Measurements**, **Interpretation**, or **Interpretation Summary**. For other settings, refer to section *18.6.1 Configuring ECG Reports*.

18.2.4 Setting the End Case Report Period

To set the end case report print period, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **End Case Report**.
2. From the **Select Reports** page, set the **Period**.


NOTE

- **End case report print period is calculated from the patient discharged time to the configured period.**
- **Period setting is applicable to all of the end case reports.**

18.3 Manually Starting a Printing Task

This section describes different methods for manually printing a report.

18.3.1 Printing from the Screen

The  button will be shown at the top of dialogs that have associated reports. If the button is gray, then there is not enough information to begin the report, or the printer has not been set up.

When the icon is white, pressing it opens a **Print Setup** dialog or starts printing a report. If the **Print Setup** dialog is entered, configure the report and press **Print** to start printing.

18.3.2 Printing Realtime Reports

Select the **Print** quick key to print a realtime report. You can also print a realtime report from the **Report Setup** dialog. For more information, see *18.3.3 Printing Most Common Reports*.

18.3.3 Printing Most Common Reports

The following most common reports can be printed:

- ECG Report
- Realtime Report
- Tabular Trends Report
- Graphic Trend Report.

To print these reports, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **Report Setup**.
2. Select the desired report tab.
3. Check the settings.
4. Select **Print**.

18.4 Automatically Printing Reports

When a parameter alarm switch is set to on and an alarm is triggered for this parameter, you can set the monitor to automatically print a Print on Alarm Report.

To do so, follow this procedure:

1. Access alarm related tabs such as the **Alarm** tab for a parameter in one of the following ways:
 - ◆ Select the parameter or waveform area of the desired parameter → select the **Alarm** tab.
 - ◆ Select the **Main Menu** quick key → from the **Parameters** column select **Setup** → select the desired parameter → select the **Alarm** tab.
2. Switch on **Alarm Outputs** for desired parameters.

18.5 Stopping a Printing Task

To stop a printing task, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **Print Queue**.
2. Select desired printing tasks and then select **Delete**. Alternately, select **Delete All** to stop all the printing tasks.

18.6 Configuring Reports

This section focuses on how to configure ECG reports, realtime reports, tabular trends reports, and graphic trends reports.

18.6.1 Configuring ECG Reports

To configure ECG reports, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **Report Setup**.
2. Select the **ECG Report** tab.
3. Set the desired options. The following table explains some of the less familiar options.

Menu item	Function	Description
Speed	Set the print speed of ECG waveforms	25 mm/sec: prints 25 mm of ECG waveform per second. 50 mm/sec: prints 50 mm of ECG waveform per second.
Auto Interval	Defines the spacing between the ECG waveforms on a printout	On: automatically adjusts the space between waveforms to avoid overlapping. Off: each waveform area has the same size on a printout.
	Note: Auto Interval is only enabled when 12x1 is selected for 12-Lead Format .	
12-Lead Format	Select the format of 12-lead ECG waveforms on a printout.	12x1: displays 12-lead ECG waveforms on one page in one column. 6x2: displays 12-lead ECG waveforms on one page in two columns, with 6 lines in each column. 6x2+1: displays 12-lead ECG waveforms on one page in two columns, with 6 lines in each column, and one rhythm lead waveform at the bottom. 3x4+1: displays 12-lead ECG waveforms on one page in 4 columns, with 3 lines in each column, and one rhythm lead waveform at the bottom. 3x4+3: displays 12-lead ECG waveforms on one page in 4 columns, with 3 lines in each column, and three rhythm lead waveforms at the bottom.
Rhythm Lead 1 Rhythm Lead 2 Rhythm Lead 3	Select the lead that will be used as Rhythm Lead 1, 2, or 3.	I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6
	Note: Rhythm Lead setting is only enabled when 6x2+1 , 3x4+1 , or 3x4+3 is selected for 12-Lead Format .	
Format Sequence	Select the recording method of ECG report generated by auto measurement	Sequential: 12-lead ECG data are recorded sequentially and displayed in 3 lines and 4 columns with 2.5 seconds of ECG data for each column. Simultaneous: Record simultaneous 12-lead ECG data.

NOTE

- When ECG Lead Set is set to 3-Lead, the ECG report cannot be printed.

18.6.2 Configuring Realtime Reports

To configure tabular realtime reports, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **Report Setup**.
1. Select the **Realtime Report** tab.
2. Set the desired options. The following table explains some of the options.

Menu item	Function	Description
Select Waveform	Select the desired waveform to print	Current Waveforms: prints the realtime report for the currently displayed waveforms and all the currently measured parameter values. Selected Waveforms: prints the realtime report for the waveforms configured in the Select Waveform dialog, accessed by clicking the Select Waveform button.

18.6.3 Configuring Tabular Trends Reports

To configure tabular trends reports, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **Report Setup**.
2. Select the **Tabular Trends Report** tab.
3. Set the desired options.

The following table explains some of the options.

Menu Item	Function	Description
Time	Select the time before which a tabular trends report will be printed	/
Period	Select the period during which a tabular trends report will be printed.	Auto: one page of a tabular trends before the current time will be printed at the selected Interval . All: all stored tabular trends will be printed at the selected Interval . 30 min to 96 hrs: 30 min to 96 hrs of tabular trends before the selected Time will be printed at the selected Interval .
Interval	Select the resolution of the tabular trends printed on a report.	NIBP, EWS, GCS: at an interval of acquiring the values of selected parameter (EWS and GCS are only available when the N1 is used with the independent external display). Auto: using the Interval setting of the Tabular Trends review page. 5 sec to 3 hrs: the tabular trends will be printed at the interval of 5 sec to 3 hrs .
Report Format	Select the printing principle.	Parameter Oriented: print one page span of report with parameters listed by row and time listed by column when Interval is set to Auto . Time Oriented: print one page span of report with time listed by row and parameter listed by column when Interval is set to Auto . Note that Interval on Auto only limits the number of rows or columns for Time. The report may have multiple pages to accommodate the number of parameters. To limit the parameters, change the Trend Group .

18.6.4 Configuring Graphic Trends Reports

To set graphic trends reports, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **Report Setup**.
2. Select the **Graphic Trends Report** tab.
3. Set the desired options.

Menu Item	Function	Description
Period	Select the period during which a graphic trends report will be printed.	Auto: one page of a graphic trends before the current time will be printed. All: all stored graphic trends will be printed.. 30 min to 96 hrs: 30 min to 96 hrs of graphic trends before the selected Time will be printed.

18.7 Viewing Printer Status

You can view the status of the most recent ten printing tasks in the **Print Queue** dialog. To view the status of printing tasks, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **Print Queue**.
2. View the status of printing tasks in the **Print Queue** dialog.

Each printing task includes the following information:

- Print time
- Report title
- Printer name (when using the printer server) or IP address (when using the network printer)
- Printing status, for example, printing, failed, retrying, and waiting.

18.8 Printer Out of Paper

When the printer runs out of paper, the print request will remain incomplete. If there are too many print jobs that remain incomplete, then a printer error may occur. To resolve the error, install paper. Some print requests may be lost if the incomplete tasks overflow the printer buffer. Missing or lost reports must be recreated and printed.

To reduce risks of printer errors, maintain enough paper in the printer.

18.9 List of Reports

The monitor can output the following reports to the printer:

- Realtime reports
 - ◆ Realtime Report
 - ◆ Freeze Report
 - ◆ ECG Report (5-lead, 6-lead, 12-lead)
 - ◆ 12-Lead Interpretation Report (realtime)
 - ◆ Print on Alarm Report
 - ◆ Alarm Limits Report
 - ◆ Titration Table Report (only available when the N1 is used with the independent external display)
 - ◆ Hemodynamic Calculation Report (only available when the N1 is used with the independent external display)
 - ◆ Oxygenation Calculation Report (only available when the N1 is used with the independent external display)
 - ◆ Ventilation Calculation Report (only available when the N1 is used with the independent external display)
 - ◆ Renal Calculation Report (only available when the N1 is used with the independent external display)
 - ◆ ST Report (Realtime)

- ◆ QT Report (Realtime)
- ◆ OxyCRG Report (only available when the N1 is used with the independent external display)
- ◆ PAWP Report (only available when the N1 is used with the independent external display)
- History reports
 - ◆ Tabular Trends Report
 - ◆ Graphic Trends Report
 - ◆ Event List Report
 - ◆ Event Detail Report
 - ◆ Full Disclosure Overview Report
 - ◆ Full Disclosure Detail Report
 - ◆ 12-Lead Review Interpretation Report (review)
 - ◆ OxyCRG Report (review, only available when the N1 is used with the independent external display)
 - ◆ OxyCRG review Report (review)
- End Case Report
 - ◆ End Case Report - Realtime Report
 - ◆ End Case Report -ECG Report
 - ◆ End Case Report - Tabular Trends Report
 - ◆ End Case Report - Graphic Trends Report

19 Using the On-Screen Timers

The monitor has a Timer function to notify you when a preset time period is expired or how much time has elapsed. You can simultaneously display up to four timers.

19.1 Displaying Timers

To display a timer, follow this procedure:

1. Access **Tile Layout** in either of the following ways:
 - ◆ Select the **Screen Setup** quick key → select the **Tile Layout** tab.
 - ◆ Select the **Main Menu** quick key → from the **Display** column select **Tile Layout**.
2. Click the numeric tile area where the timer is to be displayed, and then select a timer from the popup list.

19.2 Controlling the Timer

The timer provides the following controls, depending on the state and settings of the timer:

- **Start:** starts the timer.
- **Pause:** pauses the timer.
- **Resume:** continues timing after the timer is paused.
- **Reset:** clears the timer and end this timing episode.

19.3 Setting the Timer

You can set each timer independently. To set the timer, follow this procedure:

1. Select the timer area to enter the **Timer Setup** dialog.
2. Set **Timer Type**:
 - ◆ **Normal:** The timer has a single and defined run time, and stops with a notification beep when the run time is reached.
 - ◆ **Advanced:** The timer has a single and defined run time. When the run time is reached, the timer makes a notification beep and continuously displays the time beyond the end of run time.
 - ◆ **Cycled:** The timer has a single and defined run time. When the run time is reached, the timer makes a notification beep and restarts automatically. The number of elapsed cycles is also displayed on the left of the Timer tile.
 - ◆ **Unlimited:** The timer displays the time elapsed since the timer was started.
 - ◆ **Clock:** The timer displays the system time.
3. Set **Direction**.
 - ◆ **Up:** the timer counts up, from zero to Run Time.
 - ◆ **Down:** the timer counts down, from Run Time to zero.
4. Set **Run Time**.
5. Set **Reminder Volume**.

A progress bar is shown with the run time. When the remaining time is 10 seconds, the monitor issues a reminder tone and the timer flashes in red, prompting you that the run time is about to expire.

NOTE

- You cannot change timer settings, other than Reminder Volume when a timer is running.
- You can set Direct, Run Time, and Reminder Volume only for normal, advanced, and cycled timers.

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20 Managing Configurations

20.1 Configuration Introduction

When performing continuous monitoring on a patient, the clinical professional often needs to adjust the monitor's settings according to the patient's condition. The collection of all these settings is called a configuration. The system configuration items can be classified as: parameter configuration items, conventional configuration items, and user maintenance items. Allowing you to configure the monitor more efficiently, the monitor provides different sets of configurations to accommodate the varying patient categories and departments. You can change some settings from a certain set of configuration and then save the changed configuration as a user configuration.

The default configurations provided for your monitor are department-oriented. You can choose either from:

- General
- OR
- ICU
- Neonatology
- CCU


Each department has three different sets of configurations tailored for adult, pediatric and neonatal patients respectively.

WARNING

- **The configuration management function is password protected. The configuration management tasks must be performed by clinical professionals.**
-

20.2 Changing the Department

If the current department configuration is not the one you want to view, you can change the department by following this procedure:

1. Select the **Main Menu** quick key → from the **Configuration** column select **Manage** → input the required password → select .
2. Select **Change Department**.
3. Select a department.
4. Select **Ok**.

CAUTION

- **Changing the department will delete all current user configurations.**
-

NOTE

- **Some settings may be available for one specific department but removed for others. Changing departments would mean change in these settings. For example, Adult and pediatric patient types and related settings are removed if the department is changed to Neonatology.**
-

20.3 Setting Default Patient Category

To set the default patient category when admitting a new patient, follow this procedure:

1. Select the **Main Menu** quick key → from the **Configuration** column select **Manage** → input the required password → select .


2. Set **Default Patient Category**.

20.4 Setting Default Configuration

The monitor will load the pre-set default configuration in the following cases:



- A patient is admitted.
- A patient is discharged.
- Patient category is changed.

To set the default configuration, follow this procedure:

1. Select the **Main Menu** quick key → from the **Configuration** column select **Manage** → input the required password → Select .
2. Select **Select Default Config**.
3. Select **Load the Latest Config** or **Load Specified Config**.
 - ◆ When you select **Load the Latest Config**, the latest configuration is loaded when the monitor is started or a patient is admitted.
 - ◆ When you select **Load Specified Config**, the selected configuration of **Default Adult Config**, **Default Ped Config**, or **Default Neo Config** is loaded when the monitor is started or a patient is admitted. The specified configuration can be the factory default configuration, the age segments configuration, or a saved user defined configuration. As an example, select **Default Neo Config** and then select **Factory Default, Neo GA Segments**, or a user configuration. For more information on defining age segments, see *20.5 Defining Age Segments*.

20.5 Defining Age Segments


You must define age segments for any patient category you want to load configurations based on the patient's age. To do so, follow this procedure:

1. Select the **Main Menu** quick key → from the **Configuration** column select **Manage** → input the required password → Select .
2. Select **Select Default Config**.
3. Respectively select the edit icons  followed **Customize Configurations for Adult Age Segments**, **Customize Configurations for Ped Age Segments**, **Customize Configurations for Neo Gestational Age Segments** to define the age segments for each patient category. The age segment of the neonatal patient is based on the baby's gestational age.

20.6 Saving Current Settings


Current settings can be saved as a user configuration. Up to 25 user configurations can be saved.

To save current settings, follow this procedure:

1. Select the **Main Menu** quick key → from the **Configuration** column select **Manage** → input the required password → Select .
2. Select **Save Current Settings**.
3. Input the configuration name.
4. Select **Ok** to save current settings as a user configuration.

20.7 Deleting a Configuration

To delete a configuration, follow this procedure:

1. Select the **Main Menu** quick key → from the **Configuration** column select **Manage** → input the required password → Select .
2. Select **Delete Configuration**.
3. Select the configuration you want to delete:


- ◆ In the **Delete Configuration** dialog, selecting **Local** tab shows the existing user configurations on the monitor.
 - ◆ In the **Delete Configuration** dialog, selecting **USB Drive** tab shows the existing user configurations on the USB drive.
4. Select **Delete**.
 5. Select **Ok**.

20.8 Transferring a Configuration

When installing several monitors with identical user configurations, it is not necessary to set each unit separately. Use a USB drive to transfer the configuration from monitor to monitor.


20.8.1 Exporting a Configuration

To export the current monitor's configuration, follow this procedure:

1. Connect the N1 to the Dock.
2. Connect the USB drive to the Dock's USB port.
3. Select the **Main Menu** quick key → from the **Configuration** column select **Manage** → input the required password → Select .
4. Select **Export Configuration**.
5. Select the configurations and **User Maintenance Settings** to export.
6. Select **Export**.

20.8.2 Importing a Configuration

To import the configuration from the USB drive to the monitor, follow this procedure:

1. Connect the N1 to the Dock.
2. Connect the USB drive to the Dock's USB port.
3. Select the **Main Menu** quick key → from the **Configuration** column select **Manage** → input the required password → Select .
4. Select **Import Configuration**.
5. Select the configurations and **User Maintenance Settings** to import.
6. Select **Import**.

20.8.3 Loading a Configuration

You may make changes to some settings during operation. However, these changes or the pre-selected configuration may not be appropriate for the newly admitted patient. Therefore, the monitor allows you to load a desired configuration to ensure that all the settings are appropriate for your patient.

To load a configuration, follow this procedure:


1. Select the **Main Menu** quick key → from the **Configuration** column select **Load**.
2. Select the desired configuration.
 - ◆ Select the configuration on this monitor in the **Local** page.
 - ◆ Select the configuration on the USB drive in the **USB Drive** page.
3. Select **Load**.

NOTE

- **The monitor may configure some settings by default when you load a configuration of different software version with the current configuration.**


20.9 Printing Configurations

To print both factory configurations and user configurations, follow this procedure:

1. Select the **Main Menu** quick key → from the **Configuration** column select **Manage** → input the required password → select .
2. Select **Print Configuration**.
3. Select desired configurations.
4. Select **Print**.

20.10 Modifying Configuration Password

To modify the configuration password, follow this procedure:

1. Select the **Main Menu** quick key → from the **Configuration** column select **Manage** → input the required password → Select .
2. Select **Modify Password**.
3. Respectively input the old password and new password.
4. Select **OK**.


21 Password-protected User Settings

This chapter describes the password-protected functions accessed in the **Maintenance** dialog.

21.1 Setting the Device Location


21.1.1 Setting Monitor Information

To set monitor information, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Device Location** tab.
3. Input monitor name, facility name and department name.

21.1.2 Setting Monitor Location

If your monitor is installed at a fixed position, or you do not need clinicians to change the room number and bed number, you can set **Monitor Location** to **Fixed**. To set the monitor location, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Device Location** tab.
3. Set **Location**.
 - ◆ **Fixed**: the **Patient Management** dialog displays **Bed No.** and **Room No.**, but you cannot change them.
 - ◆ **Unfixed**: you can change **Bed No.** and **Room No.** from the **Patient Management** dialog.
4. Input the room number and bed number.


NOTE

- If **Location** is set to **Unfixed**, **Bed No.** and **Room No.** are cleared from the **Device Location** tab each time you discharge a patient.
-

21.1.3 Enabling the Auto Obtain Bed Number Function

If the monitor is connected to the wired network, the monitor can automatically set the patient's bed number according to the bed number information bonded to the bedside network connector.

To enable this function, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Device Location** tab.
3. Select **Unfixed**.
4. Switch on **Auto Obtain Bed No.**


NOTE

- The **Auto Obtain Bed Number** function is available only when the switch connected to the monitor supports the LLDP or CDP protocol, and the corresponding protocol is enabled.
-

21.2 Changing Patient Management Settings

21.2.1 Selecting Displayed Patient Information

You can define which items can be displayed and edited from the **Patient Management** tab. To do so, follow this procedure:


1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Patient Management** tab.
3. Select the fields you want to display in the **Patient Management** dialog.
4. If necessary, select the customized fields and input names for these fields.

NOTE

- If the monitor is connected with the CMS, the patient information items and customized fields are loaded from the CMS.

21.2.2 Setting the Range of Finding Patient


You can configure which patient can be found in the CMS or the ADT server. To do so, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Patient Management** tab.
3. Select **Find Patient**:
 - ◆ **All Patients**: search from all patients in the CMS or ADT server.
 - ◆ **Current Department Patients**: only searches from the current department in the CMS or ADT server.

21.2.3 Auto Discharging a Patient after Monitor Power Off


You can let the monitor automatically discharge after the monitor has been switched off for a period of time.

To set the time period of discharging a patient, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Patient Management** tab → select the **Discharge** tab.
3. Select a time for **Auto Discharge When Power Off**. The monitor will automatically discharge the patient when it is turned off for the designated period of time. The default is **Never**. That is to say the monitor will not automatically discharge a patient, regardless of how long the monitor has been switched off.


21.2.4 Configuring Alarms for Auto Deleting Discharged Patients

The monitor automatically delete earlier discharged patients when the memory is limited. You can select whether an alarm is issued when discharged patients are automatically deleted and the monitor memory is very low.

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Patient Management** tab → **Discharge** tab.
3. Configure the alarms as needed:
 - ◆ **Prompt on patient auto deleted**: an alarm is issued when the monitor automatically deletes earlier discharged patients.
 - ◆ **Prompt Alarm When Storage Is Nearly Full**: selects whether an alarm is issued when the monitor memory is very low and the priority of this alarm.


21.2.5 Configuring Discharged Patients Data

To configure discharged patient data, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Patient Management** tab → **Discharge** tab.
3. Switch on **Include Patient Demographics When Exporting Patient Data** if you want to include patient demographics when exporting the patient data.
4. Select **Auto Delete Patient Data If Discharged** to specify whether patient data is deleted when the patient is discharged.
 - ◆ **Auto:** patient data is not deleted when the patient is discharged. The oldest discharged patient data will be deleted when the storage space of the monitor is full.
 - ◆ **Right Now:** deletes patient data as soon as the patient is discharged.
 - ◆ **7 days:** deletes discharged patient data seven days after the patient was discharged.
 - ◆ **1 Month:** deletes discharged patient data one month after the patient was discharged.

21.2.6 Clearing All Patient Data

You can delete all patient information and data in the monitor. To do so, follow this procedure:


1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Patient Management** tab → select the **Discharge** tab.
3. Select **Clear All Patient Data**.
4. Select **OK**. Select **OK** again for confirmation until a message indicating you that all data is cleared.

CAUTION

- **Clearing patient data will discharge the current patient. Make sure there is no patient is being monitored before you clear all data.**
-


21.2.7 Selecting Query Criteria for Searching Patients in ADT Server

You can define which criteria can be used to search patients in the ADT server. To do so, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Patient Management** tab → **ADT Query** tab.
3. Select the query criteria as desired.


21.2.8 Setting Patient Location Options for the Discharge Screen

To set options for patient location, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Patient Management** tab → select the **Location** tab.
3. Input or edit patient location options.

21.2.9 Hiding Patient Name

To hide patient name on specific screens, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Patient Management** tab → select the **Display** tab.
3. Set the following switches as desired:


- ◆ Switch off **Primary Screen Display Full Name**: does not display patient name in the patient information area on the primary display.
- ◆ Switch off **Secondary Screen Display Full Name**: does not display patient name in the patient information area on the secondary display, if configured.
- ◆ Switch off **Remote View Display Full Name**: does not display patient name in the patient information area on the remote monitors when this monitor is viewed by other monitors.
- ◆ Switch off **Remote View Bedlist Display Full Name**: does not display patient name in bed list on the remote monitors when this monitor is viewed by other monitors.

21.3 Changing the Alarm Settings

21.3.1 Setting Alarm Tone Properties

21.3.1.1 Setting the Minimum Alarm Volume


To set the minimum alarm volume, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → **Audio** tab.
3. Set **Minimum Alarm Volume**.

21.3.1.2 Setting the Audible Alarm Tone Pattern

You can make a distinction between the heart beat tone, pulse tone, and keystroke tone by frequency. For more information, see **6.5 Alarm Indicators**.

To set the alarm tone pattern, follow this procedure:


1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → **Audio** tab.
3. Set **Alarm Sound**.

NOTE

- When ISO2 is selected, the monitor can be configured to generate a special alarm sound.

21.3.1.3 Setting the Interval between Alarm Sounds

If you choose the ISO or ISO2 tone pattern, you can change the interval between alarm tones. To change the interval between alarm tones, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → **Audio** tab.
3. Set **High Alarm Interval**, **Med Alarm Interval**, and **Low Alarm Interval**.

21.3.1.4 Setting Alarm Volume Escalation

The monitor provides the function of automatically escalating the alarm tone volume. When this function is enabled, if an alarm is not reset within the designated delay time after the alarm occurs, the volume of the alarm tone increases automatically.

To set the alarm volume escalation, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .


2. Select the **Alarm** tab → **Audio** tab.
3. Set **Auto Increase Volume**.
 - ◆ **2 Steps:** if an alarm is not reset within the designated delay time after the alarm occurs, the alarm volume automatically increases by two levels.
 - ◆ **1 Step:** if an alarm is not reset within the designated delay time after the alarm occurs, the alarm volume automatically increases by one level.
 - ◆ **Off:** if an alarm is not reset within the designated delay time after the alarm occurs, the volume of the alarm tone does not change.
4. Select **Increase Volume Delay** to set the delay time of alarm volume escalation.

NOTE

- **The alarm volume escalation function is not applied to the latched alarms.**

21.3.1.5 Enabling Special Alarm Sound

To enable the special alarm sound, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab.
3. From the **Special Advanced Alarm Sound** area, select desired alarms. The monitor generates a special alarm tone when any of selected alarms is triggered.


NOTE

- **The special alarm sound is available only when Alarm Sound is set to ISO2. See 21.3.1.2 Setting the Audible Alarm Tone Pattern for setting alarm sound.**

21.3.2 Setting Alarm Pausing and Resetting Properties

21.3.2.1 Defining the Pause Function


You can either pause alarms or pause alarm tones. This depends on the pause setting. To set the pause function, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → **Pause/Reset** tab.
3. Set **Pause** to **Alarm Pause** or **Audio Pause**.

21.3.2.2 Setting the Alarm Pause Time/Alarm Tone Pause Time


The alarm pause time or alarm tone pause time can be set to **1 min**, **2 min**, **3 min**, or **Permanent**. The default audio pause time is two minutes.

To set the alarm tone pause time, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → **Pause/Reset** tab.
3. Set **Pause Time**.


21.3.2.3 Setting the Priority of Audio Paused Alarms

To select alarm of what priority can be paused or alarm sound of what priority can be paused, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → **Pause/Reset** tab.
3. Set **Pause Priority**.
 - ◆ **All**: pressing the **Alarm Pause** quick key pauses all alarms.
 - ◆ **Med & Low**: pressing the **Alarm Pause** quick key pauses alarms of medium and low priority. The high priority alarms will not be paused.
 - ◆ **Disable**: the **Alarm Pause** quick key is disabled.


21.3.2.4 Disabling the Options of Prolonging Alarm Pause Time/Alarm Tone Pause Time

To disable specific options for the clinician when prolonging alarm pause time or the alarm tone pause time, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → **Pause/Reset** tab.
3. Switch off **Pause 5 min**, **Pause 10 min**, or **Pause 15 min**.

21.3.2.5 Setting Alarm Light Status on Alarm Reset


When the alarm system is reset, the monitor presents the alarm light by default, but you can switch off the alarm light. To change the alarm light setting, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → **Pause/Reset** tab.
3. Set **Alarm Light**.
 - ◆ **On When Reset**: when the alarm system is reset, the alarm tones of the current alarms are switched off, but the alarm lamp remains flashing.
 - ◆ **Off When Reset**: when the alarm system is reset, both the alarm tone and alarm lamp of the current alarms are switched off.

21.3.2.6 Setting the Reminder Tones


When the alarm volume is set to zero, or the alarm is reset or switched off, the monitor issues a periodical reminder tone. The reminder tone is enabled by default.

To set the reminder tone, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → **Pause/Reset** tab.
3. Set **Alarm Reset Reminder** and **Alarm Off Reminder**.
 - ◆ **On**: the monitor issues reminder tones at a designated interval.
 - ◆ **Re-alarm**: if the alarm condition persists the alarms marked with “√” will be re-generated after the designated reminder tone interval.
 - ◆ **Off**: the monitor does not issue reminder tones at a designated interval. The alarms marked with “√” will be silenced.
4. Set **Reminder Interval** to **10 min**, **5 min**, **3 min**, **2 min**, or **1 min**.

21.3.3 Latching Physiological Alarms

To latch physiological alarms, follow this procedure:


1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → **Latching** tab.
3. Select how you want to latch the alarms.

Alarm latching rules are as follows:

- You can separately latch visible alarm signals and audible alarm signals.
- Latching audible alarm signals simultaneously latches the corresponding visible signals.
- Selecting alarms of lower priority simultaneously latches higher priority alarms.
- Switching **V-Tach Latching Lock** off allows you to switch on or off **V-Tach Latching**.
- When **V-Tach Latching Lock** is switched on, V-Tach latching follows the setting of **Lethal** alarm latching and you cannot control **V-Tach Latching**.

21.3.4 Setting Guard Limits

To set guard limits, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → **Guard Limits** tab.
3. Set **Patient Category**.
4. Set guard limits for the selected patient category:
 - ◆ **Disable Off**: if this switch is on, corresponding alarm cannot be switched off.
 - ◆ **Highest**: the high alarm limit cannot be higher than this setting.
 - ◆ **Lowest**: the low alarm limit cannot be lower than this setting.
 - ◆ **Priority**: the alarm priority cannot be lower than this setting.

Selecting **Clear** restores default guard limits.

WARNING

- **For Lethal Arrhy, SpO2 Desat, and Apnea alarms, the default setting of the Disable Off switch is on. If you set the Disabled Off switch to Off, lethal arrhythmia alarms, SpO2 Desat alarm, and apnea alarm can be switched off. Thus, the monitor does not present the corresponding alarm when an alarm condition occurs. This may result in a hazard to the patient. Keep the patient under close surveillance.**

21.3.5 Setting Combined Alarms

The monitor predefines the following combined alarms. Certain settings (for example, name, limits, priority, etc.) for these alarms are configurable. References for the predefined combined alarms are as follows:

Combined alarms	Reference
HR>100 with IBP-S<90 and RR>22 over 1 min	Levi D. Procter , MD, Virginia Commonwealth University "Shock" Last full review/revision Sep 2019, Content last modified Sep 2019
qSOFA score ≥2 over 1 min	Napolitano LM. Sepsis 2018: Definitions and Guideline Changes. Surg Infect (Larchmt). 2018 Feb/Mar;19(2):117-125. doi: 10.1089/sur.2017.278. PMID: 29447109.
ICP-M > 20 over 5 min	Brain Trauma Foundation; American Association of Neurological Surgeons; Congress of Neurological Surgeons; Joint Section on Neurotrauma and Critical Care, AANS/CNS, Bratton SL, Chestnut RM, Ghajar J, McConnell Hammond FF, Harris OA, Hartl R, Manley GT, Nemecek A, Newell DW, Rosenthal G, Schouten J, Shutter L, Timmons SD, Ullman JS, Videtta W, Wilberger JE, Wright DW. Guidelines for the management of severe traumatic brain injury. VI. Indications for intracranial pressure monitoring. J Neurotrauma. 2007;24 Suppl 1:S37-44. doi: 10.1089/neu.2007.9990. Erratum in: J Neurotrauma. 2008 Mar;25(3):276-8. multiple author names added. PMID: 17511544


Combined alarms	Reference
CPP > 95 over 5 min	Neurocritical Care Collaborative Group, Chinese Society of Neurology under Chinese Medical Association; Neurocritical Care Professional Committee of Chinese Society of Neurology Physicians under Chinese Medical Doctor Association; Chinese Expert Consensus on Monitoring and Treatment of Refractory Increased Intracranial Pressure; Natl Med J China, December 4, 2018, Vol. 98, No. 45
CPP < 60 over 5 min	
EtCO ₂ ≤ 15 over 3 min, or EtCO ₂ ≥ 60 over 3 min, or RR ≤ 5 over 3 min, or SpO ₂ ≤ 85 over 3 min	Ashish Khanna, Wolfgang Buhre, Leif Saager, Paola Di Stefano, Toby Weingarten, Albert Dahan, Luca Brazzi, Frank Overdyk Derivation and Validation of a Novel Opioid-induced Respiratory Depression Risk Prediction Tool Critical Care Medicine • Volume 47 • Number 1 (Supplement)
IBP-S ↓ 20% within 30 min, or IBP-S ↑ 20% within 30 min	General Office of National Health Commission Office of State Administration of Traditional Chinese Medicine; COVID-19 Diagnosis and Treatment Protocol (trial version 7) Office of State Administration of Traditional Chinese Medicine March 03, 2020
HR/PR ↓ 20% within 30 min, or HR/PR ↑ 20% within 30 min	
A-Fib with RVR over 1 min	Members of the Expert Working Committee (in alphabetical order by last name) includes Cao Kejiang, Chen Ke Ping, Chen Ming Long, Gao Lianjun, Hua Wei Huang He, Huang Congxin, Huang Dejie Jiang Hong, Jiang Chenyang, Liu Xu Liu Yu, Liu Shaowen, Liu Xingpeng, Ma Changsheng, Meng Xu, Niu Guodong, Su Xi, Tang Yanhong, Wang Jingfeng, Wang Zulu, Wu Liqun, Xia Yunlong, Xu Yawei, Yang Bing, Yang Jiefu, Yang Xinchun, Yang Yanzong, Yang Yanmin, Yao Yan, Zhang Shu, Zhang Jinlin, Zheng Liangrong, and Zhong Jingquan. Atrial fibrillation: Current Understanding and Treatment Recommendations – 2018 Chinese Journal of Cardiac Pacing and Electrophysiology Vol. 32, No. 4, 2018
A-Fib with Long R-R Interval	
R on T with QT Prolonged	Yu Xia, Ye Shenfeng, He Fangtian, Xie Wei, Li Zhongjie; reviewers: Xu Geng, Xiang Meixiang Zhejiang ECG Critical Value Standard (trial) Journal of Electrocardiography and Circulation
Freq. PVCs with QT Prolonged	Bi Chunxiao, Zhang Lin, Li Shifeng, Li Zhongjian (Department of Electrocardiogram, the Second Affiliated Hospital of Zhengzhou University), Identification of ECG Critical Values (2) 2015-01-07 Source: Journal of Chinese General Practice

NOTE

- Copies of the references can be provided upon request. To request a copy, contact Mindray at service@mindray.com.

21.3.5.1 Configuring Predefined Combined Alarms

To configure combined alarms, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → select the **Combined Alarm** tab.
3. Select the alarms you want to display and configure from the Combined Alarm page of the **Alarm** menu. Only selected alarms are displayed in the Combined Alarm page of the **Alarm** menu.
4. To change the default label of a combined alarm, select its name and input desired name.
5. Set **Notification**:
 - ◆ **Only Alarm**: when a combined alarm occurs, the alarm message is displayed in the physiological alarm area.
 - ◆ **Only Popup**: when a combined alarm occurs, the Patient Status window pops up.
 - ◆ **Alarm+Popup**: when a combined alarm occurs, the alarm message is displayed in the physiological alarm area and the Patient Status window pops up.
6. Set the default alarm delay.


NOTE


- You can only change the default alarm priority of custom combined alarms.

- You can only select the icon type of the custom combined alarms. In the *iStatus* window, the selected icon type is used to indicate the alarmed system or organ
-

21.3.5.2 Adding Custom Combined Alarms

You can add a maximum of 10 custom combined alarms. To add a custom combined alarm, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → select the **Combined Alarm** tab.
3. select **Add**.
4. Edit the name of the custom combined alarm and set all alarm properties. Note that all alarm properties, including icon type and delay time, are required.
5. Select parameter, alarm condition, and duration.
6. Select **Save**.

To delete a custom combined alarm, select the edit symbol  at the rightmost of the alarm to enter the **Custom Combined Alarm** dialog. Select **Delete**.


NOTE

- You can only delete custom combined alarms.
-

21.3.5.3 Setting the Refractory Period of Combined Alarms

The monitor generally issues an alarm once an alarm condition occurs. However, combined alarms can be configured with a refractory period. After the alarm condition is cleared, the alarm will not be announced during the refractory period, even if the alarm condition occurs again.

To set the refractory period, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → select the **Combined Alarm** tab.
3. Set **Combined Alarm Refractory Period**.


NOTE

- The refractory period applies to all combined alarms, both pre-configured and custom.
-

21.3.6 Changing Remote Alarm Settings

21.3.6.1 Resetting Alarms for Remote Devices

You can reset the alarms occurring on the remote devices that are viewed on the **Remote View** screen of the monitor. To enable this function, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → **Remote View** tab.
3. Switch on **Reset Remote Bed Alarms**. Then the **Alarm Reset** button appears on the bottom left of the **Remote View** screen.


To reset any remote device alarms, the clinician may now select the **Alarm Reset** button at the bottom of the **Remote View** screen.

NOTE

- You can reset remote device alarms only if the **Alarm Reset By Other Bed** switch is on at the remote devices and alarms are occurring on the remote device.
-


21.3.6.2 Authorizing the Alarm Reset to Other Devices

Alarms on your monitor can be reset by remote devices if you enable this function. To do so, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → **Remote View** tab.
3. Switch on **Alarm Reset By Other Bed**.


21.3.6.3 Selecting the Alarm Reminder for Remote Devices

You can configure what alarm indicators are necessary for the remote devices. To do so, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → **Remote View** tab.
3. Select **Alarm Reminder**:
 - ◆ **Visible + Audible**: the monitor provides visual alarm indication, and continuous audible alarm indication if the alarm persists at the remote device.
 - ◆ **Visible + Single Tone**: the monitor provides visual alarm indication, and a single tone when the alarm occurs at the remote device.
 - ◆ **Visible Only**: the monitor only provides visual alarm indication.

21.3.6.4 Presenting Alarm Sound for Remote Devices as per Alarm Priority


You can configure what priority of remote device alarms are presented for audible notification. To do so, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → **Remote View** tab.
3. Select **Alarm Priority**:
 - ◆ **All**: the monitor sounds if an alarm occurs.
 - ◆ **High & Med**: the monitor sounds if a high or medium priority alarm occurs.
 - ◆ **High Only**: the monitor sounds only if a high priority alarm occurs.

21.3.6.5 Setting the Tone Pattern for Alarms from Remote Devices


The monitor provides the same alarm sound options for the remote device alarms as those for your monitor alarms. For more information on alarm tone pattern, see 6.5 *Alarm Indicators*.

To set the alarm tone pattern for the remote device alarms, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → select the **Remote View** tab.
3. Set **Alarm Sound**.

21.3.6.6 Switching Off the Remote Device Disconnection Alarm

The monitor can provide an alarm if remote devices, for example, a bedside monitor or a telemetry, are disconnected. By default, the function is enabled. To disable the alarm, follow this procedure:


1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → **Remote View** tab.

Switch off **Remote Disconnected Alarm**.

21.3.7 Changing Alarm Priority Settings


21.3.7.1 Setting the Priority of the ECG Lead Off Alarm

To set the priority of the ECG lead off alarm, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → select the **Other** tab.
3. Set the priority of **ECG Lead Off**.


21.3.7.2 Setting the Priority of the SpO₂ Sensor Off Alarm

To set the priority of the SpO₂ sensor off alarm, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → select the **Other** tab.
3. Set the priority of **SpO2 Sensor Off**.


21.3.7.3 Setting the Priority of the IBP No Sensor Alarm

To set the priority of the IBP no sensor alarm, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → select the **Other** tab.
3. Set the priority of **IBP No Sensor**.


21.3.7.4 Setting the Switch of the CMS and eGateway Disconnection Alarm

You can choose whether to issue an alarm when the monitor is not connected or disconnected from the CMS/eGateway. To do so, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → **Other** tab.
3. In the Other block, switch on or off **CMS/eGW Disconnected Alarm**. If **CMS/eGW Disconnected Alarm** is switched off, the "Offline" alarm is not presented when the monitor is not connected or disconnected from the CMS/eGateway.

21.3.7.5 Setting the Priority of the CMS and eGateway Disconnection Alarm

To set the priority of the CMS and eGateway disconnection alarm, follow this procedure:


1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → **Other** tab.
3. Set **CMS/eGW Disconnected**.

21.3.8 Changing Alarm Delay Settings

21.3.8.1 Setting the Alarm Delay Time

For continuously measured parameters, you can set the alarm delay time. If the alarm condition is resolved within the delay time, the monitor does not present the alarm.

To set the alarm delay time, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → **Other** tab.
3. Set **Alarm Delay**.
 - ◆ **Off**: an alarm is presented as soon as the alarm condition occurs.
 - ◆ **1 sec ~ 8sec**: for continuously measured parameters, an alarm is not presented if the alarm condition is resolved within the designated delay time.

The setting of **Alarm Delay** is not applied to the following alarms:

- Apnea alarms
- ST alarms
- SpO₂ alarms
- SpO₂ Desat alarms

You can set these alarms separately.


WARNING

- **The alarm delay time can be set to a maximum of 8 seconds. Changing this setting to an inappropriate level could result in a hazard to the patient.**
-

21.3.8.2 Setting the ST Alarm Delay Time

The delay time of the ST alarms is not controlled by the setting of **Alarm Delay**. The ST alarm delay time can be set to a maximum of 3 minutes.


To set the ST alarm delay time, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → **Other** tab.
3. Set **ST Alarm Delay**.

21.3.8.3 Setting the SpO₂ Alarm Delay Time

The delay time of the SpO₂ alarms is not controlled by the setting of **Alarm Delay**. The SpO₂ alarm delay time can be set to a maximum of 30 seconds.


To set the SpO₂ alarm delay time, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → **Other** tab.
3. Set **SpO₂ Alarm Delay**.

21.3.8.4 Setting the SpO₂ Desat Alarm Delay Time


The delay time of the SpO₂ Desat alarms is not controlled by the setting of **Alarm Delay**. The SpO₂ Desat alarm delay time can be set to a maximum of 30 seconds.

To set the SpO₂ Desat alarm delay time, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → **Other** tab.
3. Set **SpO₂ Desat Alarm Delay**.

21.3.9 Adjusting the Alarm Light Brightness


To adjust the alarm light brightness, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → **Other** tab.
3. From the **Alarm Light Brightness** area, set **Primary Screen** (note that you may have to scroll up the dialog to see this option). If you set alarm light brightness to **Auto**, the monitor automatically adjusts the alarm light brightness according to the ambient light. The stronger the ambient light is, the brighter the alarm light is.

21.3.10 Changing Other Alarm Settings

21.3.10.1 Setting the Intubation Time


The default intubation time is 2 minutes. To change the intubation time, following this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → **Other** tab.
3. Set the **Intubation Mode Period**.

21.3.10.2 Setting Arrhythmia Alarm Timeout Period

The arrhythmia algorithm can disable alarm light and alarm tone for designated period of time when certain arrhythmia alarms are detected.

To set the arrhythmia alarm timeout period, follow this procedure:


1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → select the **Other** tab.
3. From the **Other** block, set **Arrhy Shield Time**.

NOTE

- For the following alarms, alarm light and alarm tone cannot be disabled: HR high, HR low, Tachycardia, Bradycardia, Afib End, Irr Rhythm End.
- The arrhythmia alarm timeout period is only applied to the medium priority chains and atrial fibrillation chain. For the alarms in the high priority chain, alarm tone and alarm light are presented as soon as the alarm condition is detected. Refer to 7.6.5.1 Arrhythmia Alarm Chains for more information on the arrhythmia alarm chain.
- Alarm indication rules for alarms in the atrial fibrillation chain are the same with those for the medium priority chains.


21.3.10.3 Setting the Night Mode Switch

You can enable or disable the night mode function. To do so, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → select the **Other** tab.
3. From the **Other** block, set **Disable Night Mode**.
 - ◆ **On**: the night mode function is not available.
 - ◆ **Off**: the night mode function is available.

21.3.10.4 Setting the Notify Alarm Setting Change Switch

The monitor can give an prompt when alarm settings, including alarm limits, alarm priorities, and alarm switches, are changed from the CMS. This function is disabled by default. To enable this function, follow this procedure:


1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Alarm** tab → select the **Other** tab.
3. From the **Other** block, switch on **Notify Alarm Setting Change**.

When this switch is turned on, the monitor gives the prompt "Alarm Limits/Level/Switch is changed by CMS" if alarm settings are changed from the CMS.

21.4 Changing CAA Settings (only available when the N1 is used with the independent external display)

21.4.1 Enabling Inputting the Clinician ID

To display the clinician ID on the EWS screen, follow this procedure:


1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **CAA** tab → select the **EWS** tab.
3. Switch on **Clinician ID**.
4. Select **Clinician ID Timeout** to set how long the clinician ID will remain valid.

NOTE

- The EWS tab is only available if a license for EWS is installed in the monitor.


21.4.2 Selecting the Default Scoring Tool

To set the default scoring tool for different patient category, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **CAA** tab → select **EWS** tab.
3. From the **Select Default Score** area, set **Default Adult Score**, **Default Ped Score**, and **Default Neo Score**.

21.4.3 Managing the Scoring Tools

To manage the scoring tool, follow this procedure:


1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **CAA** tab → select **EWS** tab.
3. Select the **Manage Score** button.
 - ◆ Delete local scoring tools: from the **Local** page, delete any unnecessary scoring tools.
 - ◆ Import the desired scoring tools to the monitor: from the USB drive page, select the scoring tools on the USB drive, and then select **Import**.

NOTE

- The monitor provides MEWS and NEWS by default. You cannot delete them.


21.4.4 Setting GCS Threshold for Each Consciousness Level

You can configure the threshold and color of each consciousness level. To do so, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **CAA** tab → select the **GCS** tab.
3. Set high limit, low limit for each level.

21.4.5 Changing SepsisSight Settings


To change SepsisSight settings, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **CAA** tab → select the **SepsisSight** tab.
3. Select **The first of resuscitation** to define the desired period of initial resuscitation. Select and edit the goals for initial resuscitation.
4. In the Bundles area, select and edit treatments to be completed in 1 hour, 3 hour, and 6 hours.

21.5 Changing Module Settings


21.5.1 Selecting the ECG Standard

Select the ECG standard according to the leadwires you are using. To select the ECG standard, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Module** tab → **ECG** tab.
3. Set **ECG Standard** to **AHA** or **IEC**.

21.5.2 Changing the QTc Formula

The monitor uses the Hodges correction formula by default to correct the QT interval for heart rate. To select the QTc formula, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Module** tab → **ECG** tab.
3. Set **QTc Formula**.

◆ Hodges: $QTc = QT + 1.75 \times (HeartRate - 60)$


◆ Bazett: $QTc = QT \times \left(\frac{HeartRate}{60} \right)^{\frac{1}{2}}$

◆ Fridericia: $QTc = QT \times \left(\frac{HeartRate}{60} \right)^{\frac{1}{3}}$

◆ Framingham: $QTc = QT + 154 \times \left(1 - \frac{60}{HeartRate} \right)$


21.5.3 Setting the 12-Lead Order Switch

To set whether to send the order number of 12-lead interpretation report to the hospital information system while saving the report, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Module** tab.
3. Select the **ECG** tab.
4. Set **12-Lead Order**.

21.5.4 Calibrating ECG


The ECG signal may be inaccurate due to hardware or software problems. As a result, the ECG waveform amplitude becomes greater or smaller. In that case, you need to calibrate the ECG module. To do so, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Module** tab → **ECG** tab.
3. From the bottom left corner of the dialog select **Calibrate**.

21.5.5 Setting the Refractory Period of IBP Alarms


IBP alarms can be blocked for a period of time (refractory period) if interference occurs to the arterial pressure (except for PA) from a certain IBP channel. During the refractory period, the monitor only displays the mean pressure value of this arterial pressure. Physiological alarms related to this IBP channel and technical alarms including “XX No Pulse” and “XX Searching Pulse” are blocked, where XX represents corresponding IBP label.

To set the refractory period of the IBP alarms, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Module** tab → **Other** tab.
3. Set **IBP Interference Refractory Period**.

21.5.6 Manually Zeroing the CO₂ Module


To zero the CO₂ module, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Module** tab → **CO2** tab.
3. From the bottom left corner of the dialog select **Zero**.

21.5.7 Hiding the Invalid Display after Zeroing the CO₂ Module

After the zero calibration is completed, the CO₂ module reacquires the CO₂ readings. During the reacquisition period, “**Zero Recovering**” is displayed in the CO₂ numeric area. Valid data will reappear 30 seconds after the zero calibration is started.


To hide the display of the “**Zero Recovering**” message, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Module** tab → **CO2** tab.
3. Switch off **Zero Recovery for 30s**.

Selecting **Defaults** from the bottom of the dialog can restore this setting to the factory default.


21.5.8 Setting Parameter Measurement Timeout

NIBP measurements become outline fonts after a preset time. This feature prevents older values being misinterpreted as current measurements. To adjust the timeout period for PAWP, C.O., and NIBP, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Module** tab → select the **Other** tab.
3. Set the timeout period for PAWP and NIBP.


21.5.9 Setting Flow Rate (For Sidestream CO₂ Module Without O₂)

When you are using the sidestream CO₂ module without the O₂ monitoring function to monitor a neonatal patient, you can select flow rate. To do so, follow this procedure:

1. Ensure that the sidestream module without O₂ is inserted in the monitor.
2. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
3. Select the **Module** tab → **Other** tab.
4. Set **CO2 Flow Rate For Neo**.

21.5.10 Setting Custom IBP Labels (P1, P2, P3, and P4)


You can set a custom name for P1, P2, P3, and P4 labels. Follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Module** tab → select the **Other** tab.
3. Select **P1 Custom Label**, **P2 Custom Label**, **P3 Custom Label**, or **P4 Custom Label**, and input a name of up to five characters for this label.

21.6 Changing the Review Settings


21.6.1 Hiding Undesired Review Tabs

If you do not need to review some items, you can hide them. To do so, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Review** tab.
3. From the **Tabs** page, **Event** page or **Arrh Mark** page deselect those that do not need to be available to clinicians during review.


21.6.2 Renaming Events

You can rename manual events and arrhythmia events. To do so, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Review** tab.
3. Switch on **Rename Event**.

21.6.3 Exporting Patient Data

To export data of the current and discharged patients, follow this procedure:

1. Connect the N1 to the Dock.
2. Connect the USB drive to the Dock's USB connector.
3. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
4. Select the **Review** tab → **Export** tab.
5. Select **Export Patient Data**.
6. From the patient list select desired patients.
7. Select **Export Patient Data**.





NOTE

- **Patient data cannot be uploaded to an N Series patient monitor via the USB drive.**

21.7 Setting the Printer

21.7.1 Setting the Printer Properties


To set a network printer, follow this procedure:

1. Select the **Main Menu** quick key → from the **System column** select **Maintenance** → input the required password → select .
2. Select the **Print** tab.
3. In the **Printer** tab, select **Connection Type** to choose whether you want to output patient reports via the print server or a network printer.
4. If you set **Connection Type** to **Print Server**, perform the following settings:
 - ◆ **Print Server Address**: select  to input the print server name or IP address.
 - ◆ **Port**: selects  to input the print server port. If the CMS is used as the print server, set **Port** to **6603**.
 - ◆ Set the report type in the **Report Type** area. For more information, see section 21.7.2 *Setting the Report Type*.
5. If you set **Connection Type** to **Printer**, perform the following settings:
 - ◆ Select **Printer IP Address**. Select  to input the IP address of the desired network printer.
 - ◆ Select **Paper Size**.
 - ◆ Select **Resolution**.

After finishing configurations, you can select the **Print Test Page** button to verify that the printer works properly.

21.7.2 Setting the Report Type

If the **Connection Type** is set to **Print Server**, you need to set the report type:


1. Select the **Main Menu** quick key → from the **System column** select **Maintenance** → input the required password → select .
2. Select the **Print** tab.
3. Set **Connection Type** to **Print Server**.
4. Select the report you intend to set, for example, **General Report**.
5. Set the **Print Action**:
 - ◆ **Paper**: outputs paper report.
 - ◆ **PDF**: outputs the electronic report in PDF format.
 - ◆ **Paper And PDF**: outputs both the paper report and the PDF report.
6. For paper report, respectively select **Printer** and **Printer Resolution** to set the default printer and the resolution for the default printer.
7. For PDF report, select the **PDF Resolution** to set the resolution.

NOTE

-
- **General reports refer to the reports other than the end case report and realtime alarm report.**
-


21.7.3 Setting the Report Layout

To set the patient information you want to display on general reports, follow this procedure:

1. Select the **Main Menu** quick key → from the **System column** select **Maintenance** → input the required password → select .
2. Select the **Print** tab.
3. Select the **Report Layout** tab.
4. Select the desired items under **Report Name**. **N/A** indicates that this item is not displayed on a report.

21.7.4 Setting Patient Information on 12-lead ECG Reports

To set the patient information you want to display on 12-lead ECG reports, follow this procedure:


1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Print** tab.
3. select the **ECG Report** tab.
4. On the right of the **ECG Report** page, select the desired patient information items. Patient ID, Patient Name, Age, and Gender are displayed on an ECG report by default.

NOTE

- You can only set the patient information to display on the ECG report from the ECG Report page. Patient information configured in the Report Layout page is not applied to ECG reports.


21.7.5 Configuring the Name of PDF Files

If you use the print server to output patient reports, you can use the PDF printer to output PDF format reports. To configure the name of PDF files, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Print** tab → **PDF File Name** tab.
3. Select the desired items and their sequence under **PDF File Name**. **N/A** refers to no information.


21.7.6 Showing the Second Mark

To set whether you want to show second marks on the report output by the printer, follow this procedure.

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Print** tab → **Other** tab.
3. Enable or disable **Second Mark (Printer)**.

21.7.7 Setting Parameter Unit

To set parameter unit, follow this procedure:


1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Set the **Unit** tab.
3. Set unit for each parameter.

21.8 Setting the Time

21.8.1 Enabling NTP Time Synchronization


If the NTP Time Synchronization function is enabled, the monitor can automatically synchronize its time with a time server on which NTP (Network Time Protocol) is implemented. If there are many monitors connected within one network, you can enable the time synchronization to synchronize the time, so that you do not need to manually set the time for individual monitors.

To enable the NTP Time Synchronization function, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Time** tab → **Time Synchronization** tab.
3. Switch on **Start NTP Time Sync**.

21.8.2 Setting the Time Server Address


To set the DNS name of the time server address, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Time** tab → **Time Synchronization** tab.
3. Input the name or IP address of the time server.

After configuring the NTP time server, select **Network Test** to verify that the NTP server is properly connected.


21.8.3 Setting the Time Synchronization Interval

To set the time synchronization interval, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Time** tab → **Time Synchronization** tab.
3. Set **Interval**.


21.8.4 Defining the Night Time Period

To define the nighttime, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Time** tab → **Time Synchronization** tab.
3. Select **From** and **To** to define the beginning and end of night time.

21.8.5 Enabling Auto Daylight Savings Time

By default, daylight savings time is disabled. If this function is needed, you need to manually enable the daylight savings time. To auto start the daylight savings time, follow this procedure:


1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Time** tab → **Daylight Savings Time** tab..
3. Switch on **Auto Daylight Savings Time**.
4. Adjust daylight savings time settings as necessary.

NOTE

- If you enable Auto Daylight Savings Time you cannot manually switch it on or off from the System Time dialog. For more information, see 3.8.1 Setting the Date and Time.

21.9 Viewing Version Information


To view the system software version, module hardware and software version, and firmware version , follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Version** tab.

You can also view the system software version by selecting the **Main Menu** quick key → from the **System** column select **Version**.

21.10 Checking Battery Information

To check the battery information, follow this procedure:


1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Battery Information** tab.

21.11 Changing Scanner Settings

For the 2D barcode reader, you can change the scanner settings.


21.11.1 Establish the Relationship between Patient Demographics and 2D Barcode Fields (for the Mindray Custom 2D Barcode Reader)

To configure 2D barcode reader, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Scanner** tab → **2D Barcode** tab.
3. Establish the relationship between the monitor data and hospital's barcode data for selectable patient demographics. For example, the monitor has an option of **Ped** for patient category. In your hospital barcode, the text may read as **Pediatric**. So input **Pediatric** for the field **Ped** to establish their relationship.

21.11.2 Setting the Barcode Reader Information

To set the barcode reader information, follow this procedure:


1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Scanner** tab → **Scanner Info.** tab.
3. Set **Scanner Type**:
 - ◆ **1D Scanner**: select this option when using a 1D scanner or a 2D scanner other than the Mindray custom 2D scanner.
 - ◆ **2D Scanner**: select this option when using the Mindray custom scanner.

NOTE

- When you set Scanner Type to 2D Scanner, default settings are applied to Data Encoding Type and Data Parse Mode. You do not need to change these setting.


21.11.3 Identifying the Barcode Reader (for the non-Mindray Custom 2D Barcode Reader)

When you are using barcode readers other than the JADAK Flexpoint HS-1R or HS-1M, you should select the barcode reader from the USB device list, so that the monitor can identify the barcode reader. To do so, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Scanner** tab → **Identify Scanner** tab.
3. From the USB device list, select the barcode reader you are using.

21.11.4 Selecting Patient Information to be Read (for the Mindray Custom 2D Barcode Reader)

To select desired patient information that will be read by the barcode reader, follow this procedure:

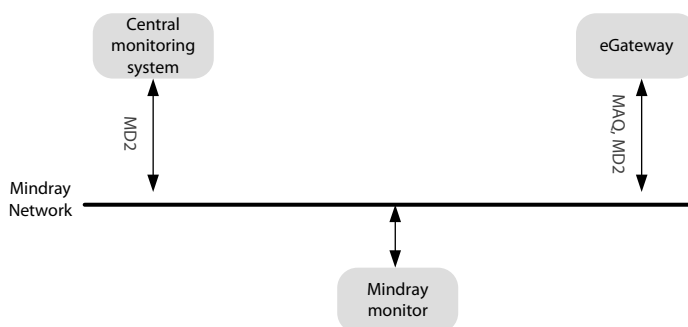
1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Scanner** tab → **Field** tab.
3. Select the patient information. The selected information can be read by the barcode reader.

NOTE

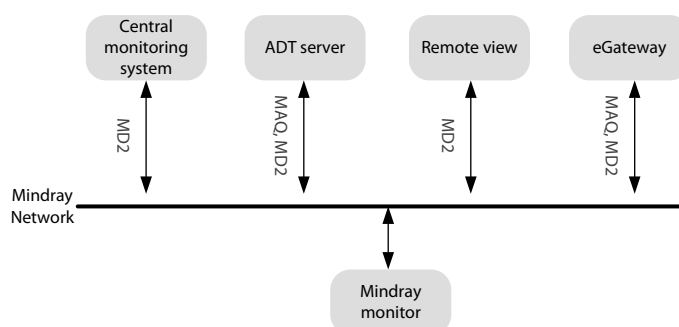
- The patient information read by the barcode reader is dependent on the patient information encoded in the hospital's barcodes.

21.12 Configuring the Network

You can connect the monitor to the central monitoring system (CMS), eGateway, and other monitors through wired LAN or wireless LAN.



When using the WMTS network



When using wired network or Wi-Fi

21.12.1 Network Safety Information


CAUTION

- Wireless network designing, deploying, debugging, and maintenance should be executed by Mindray service personnel or authorized technicians.
- Always set the wireless network according to local wireless regulations.
- Using 5 GHz frequency band is recommended whenever possible. There are more interference sources in 2.4 GHz frequency band.
- Private APs and wireless routers are not allowed. These devices may cause radio interference and result in monitor and CMS data loss.
- Data communication must be performed within a closed network or within a virtually isolated network provided by a hospital for all network functions. The hospital is responsible for ensuring the security of the virtually isolated network.
- WPA2-PSK and WPA2-Enterprise verification and encryption should be used if possible. Otherwise, the equipment may not be able to work or patient information may be divulged. WPA2-Enterprise and a long password are recommended.
- Keep network authentication information, for example passwords, safe, to protect the network from being accessed by unauthorized users.
- Do not connect non-medical devices to the monitor network.
- If wireless network signal is poor, there may be a risk of CMS-destined data loss.



- **Maximum number of monitors connected to a single AP is 16. Too many monitors connected to the same AP may result in network disconnection.**
 - **RF interference may result in wireless network disconnection.**
 - **Disconnecting from the network may result in CMS-destined data loss and function failure. Check the patient in case of network disconnection and solve the network problem as soon as possible.**
 - **Ensure that the monitor IP address setting is correct. Changing the network settings may result in network disconnection. Contact your service personnel if there are any problems with the IP address.**
 - **If the device remains in service following the end of support, the cybersecurity risks for end-users can be expected to increase over time.**
 - **Network disconnection does not have an impact on local monitoring functions.**
 - **Contact Mindray service personnel if cybersecurity problems occur.**
-

21.12.2 Setting the Wireless Network (for N1 Supporting Wi-Fi)

To add and set the wireless network, follow this procedure:


1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Network Setup** tab → **WLAN** tab.
3. Select **Add WLAN**. In the popup dialog, input network name, SSID, and password. Set **Security**.
4. Select the **WLAN IP** tab and select how to get the IP address and DNS address.
 - ◆ **Obtain IP Address Automatically:** the monitor automatically gets the IP address.
 - ◆ **Use the Following Address:** you need to input the **IP address**, **Subnet Mask**, and **Gateway**.
 - ◆ **Obtain DNS Address Automatically:** the monitor automatically gets the DNS address.
 - ◆ **Use the following DNS Address:** you need to input the IP address of **Preferred DNS server** and **Alternate DNS server**.
5. Select the **WLAN Setup** tab and set WLAN band and channels. The default is **Auto**, which means the monitor can automatically identify the WLAN band.

After configuring the wireless network, select **Network Test** to verify that the wireless network can be properly connected.

If you need to change network settings, select  beside the desired wireless network. Selecting  deletes the wireless network.

21.12.3 Setting the Wireless Network (for N1 Supporting WMTS)

To set the wireless network of the N1, follow this procedure:


1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Network Setup** tab → **WMTS Setting** Tab.
3. From the **WMTS Setting** block, set **SSID** and **WMTS Band**.

NOTE

- **Prior to changing the WMTS SSID or Band settings, contact Mindray service to ensure that the new settings are consistent with the settings for the installed WMST network.**
-

21.12.4 Managing Certifications (for N1 Supporting Wi-Fi)


You can delete certifications from the monitor, or import certifications from the USB memory device. To do so, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Network Setup** tab → **WLAN** tab.

3. Select the **Certificate Management** button from the bottom left corner of the dialog.
 - ◆ From the **Local** tab, select certifications you want to delete from the monitor, and then select **Delete**.
 - ◆ From the **USB Drive** tab, select certifications you want to import from the USB memory device, and then select **Import**.


21.12.5 Enabling Selecting a CMS

To enable selecting a CMS, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Network Setup** tab → **Central Station Setup** tab.
3. Switch on **Select CMS**.

21.12.6 Adding CMSs


You can add up to 30 central monitoring systems (CMS) for your monitor. To add CMSs, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Network Setup** tab → **Central Station Setup** tab.
3. Select **Add Central Station**, and then input the CMS name and IP address of this department.

21.12.7 Setting Multicast Parameters


Multicast helps device discovery between monitors and other devices on the network. Devices in the same multicast group can be mutually discovered.

To set multicast parameters, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Network Setup** tab → **Device Discover** tab.
3. Set **Multicast TTL**.
4. Set **Multicast Address**.


21.12.8 Setting the Master Server Address

To set the DNS name of the master server, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Network Setup** tab → **Device Discover** tab.
3. Select **Master Server Address** to input the DNS name or IP address of the master server.

21.12.9 Setting the Network Service Quality Level


To set the quality of service (QoS), follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Network Setup** tab → **QoS** tab.
3. Select **QoS Level For Realtime Monitoring** to set the service quality of network connection for realtime monitoring, for example parameter measurements and waveforms, alarms, etc.
4. Select **QoS Level For Others** to set the service quality of network connection for non-realtime monitoring, for example history data, printing, etc.

21.12.10 Using the ADT Gateway

The ADT (admit-discharge-transfer) gateway is normally deployed in the eGateway. You can obtain patient information from the hospital ADT server through the ADT gateway.

To configure the ADT gateway, follow this procedure:


1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Network Setup** tab → **ADT** tab.
3. Select **Server Address** to input the host name or IP address of the ADT gateway.
4. Select **Port** to input the port of the ADT gateway.

ADT Query is switched off by default. You can load patient information to the monitor from the ADT server only when this function is enabled.

After configuring the ADT gateway, select **Network Test** to verify that the ADT server is properly connected.

21.12.11 Sending Realtime Data, Waveforms and Alarms via HL7 Protocol (for N1 Supporting Wi-Fi)

You can send the realtime data, waveforms, and alarms from the monitor to the hospital servers via HL7 protocol. To do so, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Network Setup** tab → **HL7 Configuration** tab.
3. Select **Network Mode** under both **Data + Waveforms** and **Alarms** to set the network mode for sending realtime data, waveforms, and alarms.
 - ◆ **Client Mode:** the monitor is connected to the hospital information system and works as a client. You need to set **Server Address** by inputting the name or IP address of the hospital server for receiving realtime data, waveform, and alarm data. Set **Port** as well.
 - ◆ **Listening Mode:** in this mode, the monitor works as a server. The hospital information system can connect the monitor to receive realtime data, waveform, and alarm data.
4. Switch on **Send Data**, **Send Waveform**, and **Send Alarms** as needed.
5. Set **Data Interval**.
6. From the **Compatibility** area, set **HL7 Protocol Version**.


This page also displays the server connection status.

NOTE

- Licenses are required for sending realtime data, waveforms, and alarms via HL7.


21.12.12 Selecting Data Encryption Type

To set data encryption type, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Network Setup** tab → **Information Security** tab.
3. Select **Encryption Connection Type** to set data encryption type when connecting devices:
 - ◆ **Only Private Encryption:** Mindray private encryption is used to encrypt the transmitted data. You cannot connect devices supporting SSL (secure sockets layer) encryption.
 - ◆ **SSL Encryption Priority:** for devices supporting SSL encryption, SSL encryption is used when connecting the devices. For devices not supporting SSL encryption, private encryption is used when connecting the devices.

21.12.13 Disabling the Broadcasting Patient Demographics Function

When viewing other patients, device location and patient information of remote devices are displayed in the remote device list by default. To protect patient privacy, you can disable the broadcasting of patient demographics function to prevent the monitor from sending patient information via broadcast. To do so, follow this procedure:


1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select **Network Setup** tab → **Information Security** tab.
3. Switch off **Broadcast Patient Demographics**.

Thus, patient information will not display in the remote device list.

21.12.14 Managing TLS Certificates

You can delete local certificates or import certificates from a USB drive.

To delete local CA certificates or user certificates, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select **Network Setup** tab → **Information Security** tab.
3. Select **Certificate Type**.
4. Select certificates you want to delete.
5. Select **Delete**. To delete all certificate type, select **Delete All**.

To import certificates from a USB drive, follow this procedure:

1. Select the **Import Certificate** tab.
2. Select **Certificate Type**.
3. Select **Certificate Name**, **Private Key Name**, and input private key password.
4. Select **Confirm** to start import.

21.13 MLDAP (for N1 Supporting Wi-Fi)


MLDAP refers to Mindray LDAP (Lightweight Directory Access Protocol). It is an independent process which can be installed on the eGateway or other application server (Windows). MLDAP provides user identity and authentication.

The MLDAP server is connected with the hospital LDAP server. All monitoring devices are connected to the MLDAP server to implement identity and authentication for the following operations:

- Changing alarm settings
- Changing arrhythmia settings
- Accessing the **Maintenance** dialog

21.13.1 Setting MLDAP

To access the MLDAP server, you should set your monitor as follows:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Network Setup** tab → **MLDAP** tab.
3. Set Server address and port of the MLDAP server.

21.13.2 Testing MLDAP Server Connection


To test whether the monitor is properly connected with the MLDAP server, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .

2. Select the **Network Setup** tab→ **MLDAP** tab.
3. Select **Network Test**.

21.13.3 Selecting Password for User Authentication

You can select what password is used when changing alarm settings, arrhythmia settings, viewing current or discharged patient data, and accessing the **Maintenance** dialog. To do so, follow this procedure:


1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Authorization Setup** tab.
3. From the **Maintenance** area, set **User Maintenance** to select the password for accessing the monitor's **Maintenance** dialog.
 - ◆ **Local Password:** the monitor's password for accessing the **Maintenance** dialog is required.
 - ◆ **User Password:** the user name and password saved in the MLDAP server are required.
4. From the **Clinical Setting** area, set passwords for **Alarm Setup**, **Arrhythmia**, **View Discharged Patients**, and **Viewing Patient Review Data**.
 - ◆ **No Password:** changing alarm settings and arrhythmia settings, reviewing data of the current patient and discharged patients are not password protected.
 - ◆ **Local Password:** changing alarm settings, arrhythmia settings, and reviewing data of the current patient are password protected. The clinical password is required.
 - ◆ **User Password:** changing alarm settings, arrhythmia settings, and reviewing data of discharged patients are password protected. The user name and password saved in the MLDAP server are required.

From the **Maintenance** area, selecting **Modify Local Password** can change the monitor's password for accessing the **Maintenance** dialog.

From the **Clinical Setting** area, selecting **Modify Local Password** can change the monitor's password for accessing alarm settings, arrhythmia settings, and reviewing data of the current patient and discharged patients.

21.13.4 Setting the Password Timeout Period

If you use the password saved in the MLDAP server to access the **Maintenance** dialog, alarm settings and arrhythmia settings, you can set the password timeout period. Once the timeout period is reached, you will need to re-enter the password. To do so, follow this procedure:


1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Authorization Setup** tab.
3. Set **Automatic Logout Time**.

21.14 Setting the Dock

After the N1 is transferred to the target location, connecting the N1 to a Dock enables N1 to use the settings of the Dock. All the settings in this section are stored in the Dock. When the N1 is disconnected from the Dock, the N1 uses its own settings and network.

21.14.1 Setting the Dock Work Mode


To set the work mode of the Dock, follow this procedure:

1. Connect the N1 to the Dock.
2. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
3. Select the **Dock Setup** tab→ select the **Setup** tab.
4. Set the **Work Mode**. The default work mode is **Dock Mode**.

- ◆ **Dock Mode:** the patient location settings (facility, department, room number, and bed number), printer settings, and authorization settings are from the N1. You can change these settings on **Device Location**, **Print**, or **Authorization Setup** page from the **Maintenance** menu.
- ◆ **Host Mode:** the patient location settings (facility, department, room number, and bed number), printer settings, and authorization settings are from the Dock. You can change these settings on **Location**, **Printer**, or **Authorization Setup** tab from the **Dock Setup** page.


21.14.2 Setting the Net Setting Type for the Dock (for N1 Supporting Wi-Fi)

To set the network setting type of the Dock, follow this procedure:

1. Connect the N1 to the Dock.
2. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
3. Select the **Dock Setup** tab → select the **Setup** tab.
4. Set the **Net Setting Type**. The default work mode is **Use current N1 net setting**.
 - ◆ **Use current N1 net setting:** the IP and WLAN settings are from the N1. You can change these settings on **Network Setup** page from the **Maintenance** menu.
 - ◆ **Use current Dock net setting:** the IP and WLAN settings are from the Dock. You can change these settings on **IP**, or **WLAN** tab from the **Dock Setup** page.


21.14.3 Selecting a Network Type for the Dock (for N1 Supporting Wi-Fi)

To select network type, follow this procedure:

1. Connect the N1 to the Dock.
2. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
3. Select the **Dock Setup** tab → select the **Setup** tab.
4. Set the **Work Mode** to **Host Mode**.
5. Select the **IP** tab.
6. Set **Network Type** to **LAN1 IP**, or **WLAN** according to your network type.


21.14.4 Setting the Wired Network for the Dock

Wired networking is available as long as N1 is connected to the Dock. To set the wired network, follow this procedure:

1. Connect the N1 to the Dock.
2. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
3. Select the **Dock Setup** tab → select the **Setup** tab.
4. Set the **Work Mode** to **Host Mode**.
5. Select the **IP** tab.
6. Set **Network Type** to **LAN1 IP**.
7. Select how to get the IP address of wired network.
 - ◆ **Obtain IP Address Automatically:** the monitor automatically gets the IP address.
 - ◆ **Use the Following Address:** you need to input the **IP address**, **Subnet mask**, and **Gateway**.
8. Select how to get the DNS address:
 - ◆ **Obtain DNS Address Automatically:** the monitor automatically gets the DNS address.
 - ◆ **Use the following DNS Address:** you need to input the IP address of **Preferred DNS server** and **Alternate DNS server**.

21.14.5 Setting the Wireless Network (for N1 Supporting Wi-Fi)


To set the wireless network of the Dock, follow this procedure:

1. Connect the N1 to the Dock.
2. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
3. Select the **Dock Setup** tab → select the **Setup** tab.
4. Set the **Work Mode** to **Host Mode**.
5. Select the **IP** tab, and set **Network Type** to **WLAN**.
6. Select how to get the IP address of wireless network.
 - ◆ **Obtain IP Address Automatically:** the monitor automatically gets the IP address.
 - ◆ **Use the Following Address:** you need to input the **IP address**, **Subnet Mask**, and **Gateway**.
7. Select how to get the DNS address:
 - ◆ **Obtain DNS Address Automatically:** the monitor automatically gets the DNS address.
 - ◆ **Use the following DNS Address:** you need to input the IP address of **Preferred DNS server** and **Alternate DNS server**.
8. Select the **WLAN** tab and set **SSID**, **Security**, and **Password**.

After configuring the wireless network, select **Network Test** to verify that the wireless network can be properly connected.

21.14.6 Setting the External Display

To set the external display, follow this procedure:

1. Connect the N1 to the Dock.
2. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
3. Select the **Dock Setup** tab → select the **Setup** tab.
4. Set the **External Screen Contents**.
 - ◆ **Mirrored:** the contents of the external display is exactly the same with the monitor.
 - ◆ **Independent:** separately configure the contents and layout of the monitor and external display.


NOTE

- The N1's screen and the independent external display's screen cannot be viewed simultaneously. To switch the viewing location between the N1's screen and the independent external display, gently press the power switch of the N1, or double click on the screen to be viewed.
- In the situation that the External Screen Content is set to Independent and the viewing location is switched to the N1, if there is no operation on the monitor within one minute, the viewing location will automatically switch back to the external display.

21.15 Defining Other Functions


21.15.1 Setting Notch Filter Frequency

Set notch filter frequency according to the power line frequency of your country. To set notch filter frequency, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Other** tab.
3. Set **Notch Frequency** to **50 Hz** or **60 Hz** according to the power line frequency.


21.15.2 Setting Mouse Sensitivity

The mouse sensitivity is adjustable. To do so, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Other** tab.
3. Set **Mouse Sensitivity**.


21.15.3 Setting the Manual Event Edit Switch

You can set whether selecting and editing the name of a manual event is allowed. To do so, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Other** tab.
3. Switch on or off **Manual Event Edit**.


21.15.4 Setting the Screenshot Switch (only available when the N1 is used with the independent external display)

To enable the screenshot feature, switch on the screenshot switch. To do so, follow this procedure:

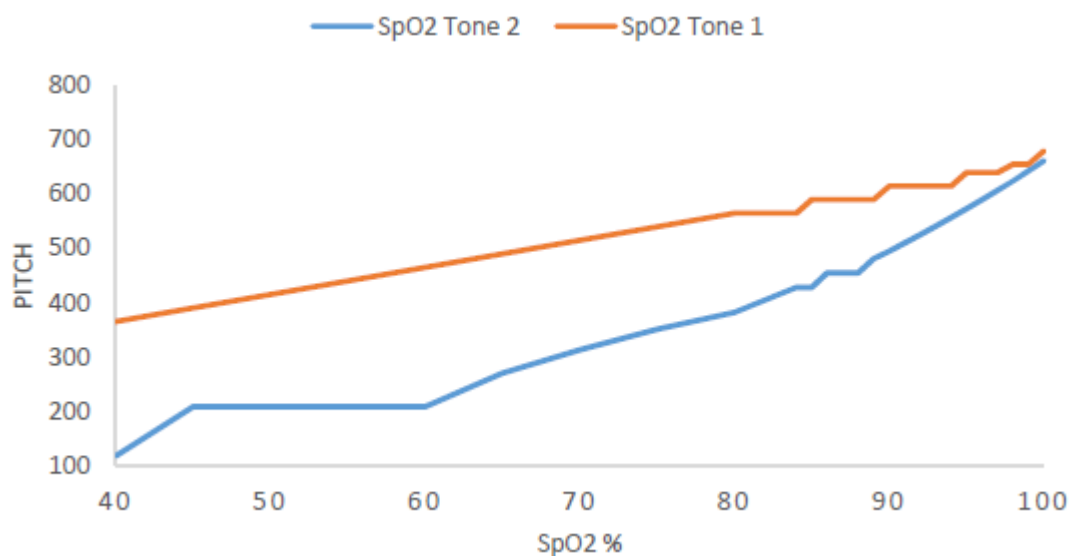
1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Other** tab.
3. Switch on or off **Screenshot**.

21.15.5 Setting the SpO₂ Tone Mode

The monitor adjusts the QRS tone (pitch tone) according to the SpO₂ values. To set the SpO₂ tone mode, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Other** tab.
3. Set **SpO₂ Tone** to **Mode 1** or **Mode 2**. The pitch changes more rapidly in Mode 2 than in Mode 1, as saturation levels change.

The SpO₂ tone mode chart for SpO₂ between 40% to 100% is as follows:




CAUTION

- It is highly recommended to use the same SpO₂ tone mode for the same monitors in a single area to prevent issues arising from inconsistent operation.
-


21.15.6 Selecting the Language

To set the user interface (UI) language, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Other** tab
3. Set **Language**.

21.15.7 Switching On or Off a Parameter

If there is no **Parameters On/Off** tab in the **Screen Setup** dialog then setting parameter switches is password protected. Follow this procedure to set parameter switches:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Other** tab.
3. Select **Parameters On/Off**.
4. Enable or disable desired parameters.


When a parameter is switched off, the monitor stops data acquisition and alarming for this measurement.

NOTE

- When a parameter is manually switched off and the corresponding parameter module is plugged in, you cannot monitor this parameter.
-


21.15.8 Setting If Setting Parameter Switches is Protected

You can set whether setting parameter switches is password protected. To do so, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Other** tab.
3. Switch on or off **Parameters On/Off Protected**.


21.15.9 Setting If Parameter Switch is Influenced by Configuration

You can set if the settings of parameter switches are influenced by loading a configuration. To do so, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Other** tab.
3. Switch on or off **Parameters On/Off Config Influenced**.

21.15.10 Browsing System Log


To browse the system log, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Other** tab.
3. Select **Browse System Log** to enter the **System Log** page.

4. Select the log classifications you want to view, and then select **Search**. To view logs of certain date and time, select **Jump To** and define the date and time.


21.15.11 Exporting System Log

To export the system log, follow this procedure:

1. Connect the N1 to the Dock.
2. Connect the USB drive to the Dock's USB connector.
3. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
4. Select the **Other** tab.
5. Select **Export System Log**.

21.15.12 Setting the Outdoor Mode

To set the way of entering the outdoor mode, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Other** tab.
3. Set **Enter Outdoor Mode** to **Manual** or **Auto**.
 - ◆ **Manual:** The monitor enters the outdoor mode by manually selecting the **Main Menu** quick key → from the **Display** column select **Enter Outdoor Mode**.
 - ◆ **Auto:** The monitor enters the outdoor mode automatically if the strength of ambient light is greater than the threshold.

22 Battery

22.1 Battery Introduction

This monitor is designed to run on rechargeable Lithium-ion battery power when the external power is not available. The monitor can switch between battery power and the external power without interrupting patient monitoring. If both the external power and the battery power are available, the monitor uses the external power in preference to the battery power.

This monitor is designed to operate on battery power when the mains power is not available. The monitor uses mains power as primary power source. In case of mains power failure, the monitor automatically runs on the battery power.

22.2 Battery Safety Information

WARNING

- **Keep batteries out of the reach of children.**
 - **Use only Mindray specified batteries. Use of a different battery may present a risk of fire or explosion.**
 - **Keep the batteries in their original package until you are ready to use them.**
 - **Do not expose batteries to liquid.**
 - **Do not crush, drop or puncture the battery. Mechanical abuse can lead to internal damage and internal short circuits. If a battery has been dropped or banged against a hard surface, whether damage is externally visible or not, remove the battery from use and dispose of it properly.**
 - **If the battery shows signs of damage or signs of leakage, replace it immediately. Use caution in removing the battery. Avoid contacting the leakage.**
 - **Batteries should be charged only in this monitor.**
 - **Extremely high ambient temperature may cause battery overheat protection, resulting in monitor shutdown.**
 - **The lithium-ion battery has a service life. Replace the battery when it reaches the end of its service life. Failure to replace the battery may cause serious damage to the equipment from battery overheating.**
 - **Do not open batteries, heat batteries above 60 °C, incinerate batteries, or short battery terminals. They may ignite, explode, leak or heat up, causing personal injury.**
-

CAUTION

- **Remove the battery if it will not be used for an extended period of time.**
-

22.3 Installing the Battery

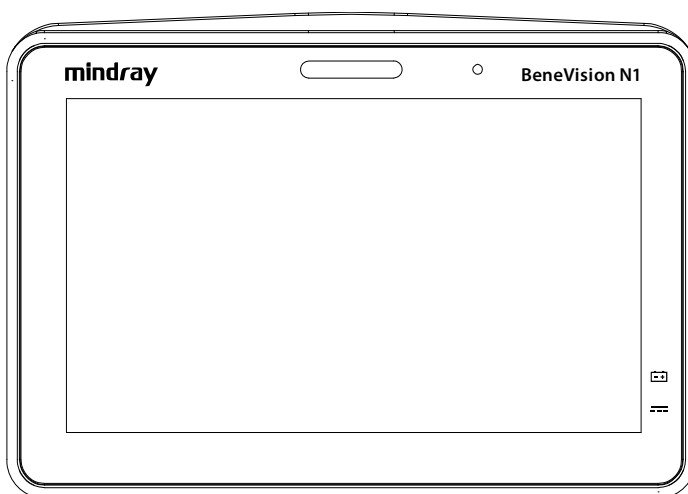
The battery must only be installed by service personnel trained and authorized by Mindray. To install the battery, contact your service personnel. The battery is installed when the monitor leaves the factory.

22.4 Battery Indications

The battery LED, on-screen battery symbol, battery power indicator, and related alarm messages indicate the battery status.

22.4.1 Battery LED

The battery LED lies on the lower right corner of the monitor front panel.









The battery LED indications are as follows:

- Green: the battery is fully charged.
- Yellow: the battery is being charged.
- Flashing green: the monitor is running on battery power.
- Flashing yellow: the battery is malfunctioning.
- Off: no battery is installed, or the monitor is powered off and no external power is connected.

22.4.2 Battery symbols

The on-screen battery symbols indicate the battery status as follows:

-  indicates that the battery is working correctly. The green portion represents the remaining charge.
-  indicates that the battery power is low and needs to be charged.
-  indicates that the battery is almost depleted and needs to be charged immediately. Otherwise, the monitor will automatically shut down soon.
-  indicates that the battery is being charged.
-  indicates that no battery is installed.
-  indicates a battery fault, battery communication fault, or battery charging fault. Contact service personnel for help.

22.4.3 Battery Power Indicator

Battery power indicator displays the remaining battery power.



22.4.4 Battery-related Alarms

The capacity of the battery is limited. When the battery level is low, the monitor presents the **Low Battery** alarm, the alarm lamp flashes, and the monitor produces an alarm sound.

If the battery is almost depleted, the monitor presents the **Critically Low Battery** alarm. In this case, immediately connect the external power to the monitor and charge the battery. Otherwise, the monitor will automatically shut down soon.

If the battery has been used for a prolonged period of time, the battery will be aged and its runtime may be significantly less than the specification. If the battery is aged, the "Battery aged, replace the battery." alarm is presented each time the monitor is turned on, indicating that the battery has reached its end of life.

For more information on battery-related alarms, see Appendix **D Alarm Messages**.

22.5 Charging the Battery

To optimize performance, a fully (or nearly fully) discharged battery should be charged as soon as possible. The battery can be charged in any of the following methods:

- Method 1: the monitor is connected to the AC adapter or Dock.
- Method 2: the monitor is in use with a host monitor.
- Method 3: the monitor is in use with the Transport Dock.

For method 1 and method 3, the battery is charged regardless of whether or not the monitor is currently turned on. For method 2, the host monitor must be powered on for the N1 monitor's battery to charge.

22.6 Maintaining the Battery

22.6.1 Conditioning the Battery

The performance of the battery deteriorates over time. You should condition the battery every three months. If the battery is not conditioned for a prolonged time, its charge indication may not be accurate and you may wrongly evaluate the remaining battery runtime.

To condition a battery, follow this procedure:

1. Disconnect the monitor from the patient and stop all monitoring and measuring procedures.
2. Turn off the monitor, and connect the monitor to the external power source.
3. Allow the battery to be charged uninterruptedly until it is fully charged.
4. Disconnect the monitor from the external power source, and turn on the monitor.
5. Allow the monitor to run on the battery until the battery is completely depleted and the monitor automatically shuts down.
6. Fully charge the battery again for use or charge it to 40 - 60% for storage.

NOTE

- **Do not use the monitor to monitor a patient during battery conditioning.**
- **Do not interrupt battery conditioning. Interrupting battery conditioning to use the monitor will prevent completion of the conditioning cycle and require repeating the conditioning process completely to properly condition the battery.**

22.6.2 Checking Battery Performance

Life expectancy of a battery depends on how frequent and how long it is used. When properly used, the lithium-ion battery has a useful life of approximately two years. If improperly used, its life expectancy can be shorter. We recommend replacing the lithium-ion battery every two years.

The performance of a rechargeable battery deteriorates over time. You should check the battery performance every two months or if you question it is meeting the product specifications.

See steps 1 to 5 of 22.6.1 *Conditioning the Battery* to check battery performance. The operating time of the batteries reflects their performance directly. If the operating time of a battery is noticeably shorter than that stated in the specifications, the battery may have reached its service life or be malfunctioning. If the battery performance meets the requirement, fully charge the battery again for use or charge it to 40 - 60% for storage.

NOTE

- **Battery operating time depends on equipment configuration and operation. For example, high display brightness or measuring NIBP repeatedly will shorten the battery operating time.**

22.7 Storing Batteries

When storing batteries, make sure that the battery terminals do not come into contact with metallic objects. If batteries are stored for an extended period of time, place the batteries in a cool place with a partial charge of 40% to 60% capacity.

Condition the stored batteries every three months. For more information, see *22.6.1 Conditioning the Battery*.

NOTE

- **Remove the battery from the equipment if the equipment is not used for a prolonged time (for example, several weeks). Otherwise the battery may overdischarge.**
 - **Storing batteries at high temperature for an extended period of time will significantly shorten their life expectancy.**
 - **Storing batteries in a cool place can slow the aging process. Ideally the batteries should be stored at 15 °C.**
-

22.8 Recycling Batteries

Discard a battery in the following situations:

- The battery has visual signs of damage.
- The battery fails.
- The battery is aged and its runtime significantly less than the specification.
- The battery has been used for more than its service time.

Properly dispose of batteries according to local regulations.

WARNING

- **Do not open batteries, heat batteries above 60 °C, incinerate batteries, or short the battery terminals. They may ignite, explode, leak or heat up, causing personal injury.**
-
-

23 Care and Cleaning

23.1 Care and Cleaning Introduction

In this chapter we only describe cleaning and disinfection of the main unit, parameter modules, mounting kits, and certain parameter accessories. For the cleaning and disinfection of the Transport Dock and other reusable accessories, refer to their instructions for use of the corresponding accessories.

Keep your equipment and accessories clean. To avoid damage to the equipment, follow these guidelines:

- Always follow the manufacturer's instructions for each cleaning/disinfecting agent.
- Do not immerse any part of the equipment or accessories into liquid.
- Do not pour liquid onto the equipment or accessories.
- Do not allow liquid to enter the case.
- Never use abrasive materials (such as steel wool or silver polish), or erosive cleaners (such as acetone or acetone-based cleaners).

23.2 Care and Cleaning Safety Information

WARNING

- **Be sure to turn off the system and disconnect all power cables from the outlets before cleaning the equipment.**
-

CAUTION

- **If you spill liquid on the equipment or accessories, contact Mindray or your service personnel.**
 - **Avoid wetting the pins and metal parts of the equipment, mounting kits or accessories during cleaning and disinfection.**
 - **Use only Mindray approved cleaners and disinfectants and methods listed in this chapter to clean or disinfect your equipment. Warranty does not cover damage caused by unapproved substances or methods.**
 - **We make no claims regarding the efficacy of the listed chemicals or methods as a means for controlling infection. For the method to control infection, consult your hospital's Infection Control Officer or Epidemiologist.**
 - **The responsible hospital or institution shall carry out all cleaning and disinfection procedures specified in this chapter.**
 - **Refer to the respective instructions for use of the cleaning agents and disinfectants.**
 - **Do not mix disinfecting solutions (such as bleach and ammonia) as hazardous gases may result.**
-

NOTE

- **To clean or disinfect reusable accessories, refer to the instructions delivered with the accessories.**
-

23.3 Cleaning and Disinfecting the Equipment and Mounting Kits

Use approved cleaning and disinfecting agents for cleaning or disinfecting the main unit, parameter modules, Modular Rack, Dock, folding hook, monitor handle, and bedrail hook.

23.3.1 Approved Cleaning and Disinfecting Agents for the Main Unit and Mounting Kits

The following table lists approved cleaning and disinfecting agents for the main unit and mounting kits:

Product Name	Product Type	Active Ingredients
Sodium hypochlorite bleach	Liquid	Sodium hypochlorite bleach 0.5%
Hydrogen peroxide	Liquid	Hydrogen peroxide 3%
Isopropanol	Liquid	Isopropanol 70%
1-Propanol	Liquid	1-Propanol 50%
Metrex CaviCide1™	Liquid	Diisobutylphenoxyethoxyethyl dimethyl benzyl ammonium chloride 0.28%, Isopropanol 17.2%
Virex® II 256 (1:256)	Liquid	Didecyl dimethyl ammonium chloride 8.704%, n-Alkydimethyl benzyl ammonium chloride 8.190%
Virex® TB	Liquid	n-Alkyl dimethyl benzyl ammonium chlorides 0.105%, n-Alkyl dimethyl ethylbenzyl ammonium chlorides 0.105%
Rely+On™ Virkon® High Level Surface Disinfectant	Powder	Used as 1% solution Biocidal active: Pentapotassium bis (peroxymonosulphate) bis (sulphate)(500g/kg), Contains dipotassium peroxodisulphate.
Alpet® D2 Surface Sanitizing Wipes	Wipes	Isopropyl Alcohol 58.6000%, Octyl Decyl Dimethyl Ammonium chloride 0.0075%, Dioctyl Dimethyl Ammonium Chloride 0.0030%
Clorox Dispatch® Hospital Cleaner Disinfectant Towels with Bleach	Wipes	Sodium Hypochlorite 0.65%
Clorox Healthcare® Bleach Germicidal Wipes	Wipes	Sodium Hypochlorite 0.55%
Clorox Healthcare® Hydrogen Peroxide Cleaner Disinfectant Wipes	Wipes	Hydrogen Peroxide 1.4%
Diversey Oxivir® TB Wipes	Wipes	Hydrogen Peroxide 0.5%
Metrex CaviWipes™	Wipes	Diisobutylphenoxyethoxyethyl dimethyl benzyl ammonium chloride 0.28%, Isopropanol 17.2%
PDI Sani-Cloth® AF3 Germicidal Disposable Wipe	Wipes	n-Alkyl dimethyl ethylbenzyl ammonium chlorides 0.14%, n-Alkyl dimethyl benzyl ammonium chlorides 0.14%
PDI Sani-Cloth® Bleach Germicidal Disposable Wipe	Wipes	Sodium Hypochlorite 0.63%, other ingredients 99.37%
PDI Sani-Cloth® HB Germicidal Disposable Wipe	Wipes	n-Alkyl dimethyl ethylbenzyl ammonium chlorides 0.07%, n-Alkyl dimethyl benzyl ammonium chlorides 0.07%
PDI Sani-Cloth® Plus Germicidal Disposable Cloth	Wipes	n-Alkyl dimethyl ethylbenzyl ammonium chlorides 0.125%, n-Alky dimethyl benzyl ammonium chlorides 0.125%

Product Name	Product Type	Active Ingredients
PDI Super Sani-Cloth® Germicidal Disposable Wipe	Wipes	n-Alkyl dimethyl ethylbenzyl ammonium chlorides 0.25%, n-Alkyl dimethyl benzyl ammonium chlorides 0.25%, Isopropyl Alcohol 55.0%
VIRAGUARD Hospital Surface Disinfectant Towelette	Wipes	Isopropanol 70%, Other ingredients 30%

NOTE

- For equipment with the symbol , all the listed cleaning and disinfecting agents are available for use.

23.3.2 Cleaning the Equipment and Mounting Kits

The main unit, parameter modules, Modular Rack, Dock, folding hooks, monitor handle, and bedrail hooks should be cleaned on a regular basis. Before cleaning the equipment and mounting kits, consult your hospital's regulations for cleaning the equipment.

To clean your equipment, follow this procedure:

- Shut down the monitor and disconnect it from the AC power.
- Clean the display screen with wipes or a soft cloth moistened with one of the cleaning agents listed in 23.3.1 *Approved Cleaning and Disinfecting Agents for the Main Unit and Mounting Kits* only.
- Clean the exterior surface of the equipment and mounting kits with wipes or a soft cloth moistened with one of the cleaning agents listed in 23.3.1 *Approved Cleaning and Disinfecting Agents for the Main Unit and Mounting Kits* only.
- Wipe off all the cleaning agent residue with a dry cloth.
- Dry your equipment in a ventilated, cool place.

23.3.3 Disinfecting the Equipment and Mounting Kits

Disinfect the main unit, parameter modules, Modular Rack, Dock, folding hook, monitor handle, and bedrail hook as required in your hospital's servicing schedule using the disinfecting agents listed in the table above. Cleaning equipment and mounting kits before disinfecting is recommended.

CAUTION

- Never use EtO or formaldehyde for disinfection.

23.4 Cleaning and Disinfecting the Accessories

To clean and disinfect the following accessories, using cleansers, disinfectants, and methods described in this manual:

- NIBP air hose
- Masimo SpO₂ cable
- Nellcor SpO₂ cable
-

For other accessories, consult the instructions delivered with the accessories.

CAUTION

- Fluids entering the NIBP air hose can damage the equipment. When cleaning and/or disinfecting the NIBP air hose, prevent liquid from entering the hose.
- Periodically inspect the NIBP air hose and connector for signs of wear or deterioration. Replace the NIBP air hose if you detect a leak. Dispose of damaged NIBP air hose according to local laws for disposal of hospital waste.

- **Never immerse or soak the accessories in any liquid.**
- **Never clean or disinfect the metallic connectors at either end of the accessories.**
- **Use only Mindray approved cleaners and disinfectants and methods listed in this section to clean or disinfect the accessories. Warranty does not cover damage caused by unapproved substances or methods.**
- **To avoid long term damage, the accessories should be disinfected only when necessary as determined by your hospital's policy.**

23.4.1 Approved Cleaning and Disinfecting Agents for NIBP Air Hose

The following table lists approved cleaning and disinfecting agents for NIBP air hose:

Product Name	Product Type	Active Ingredients
Isopropanol	Liquid	Isopropanol 70%
1-Propanol	Liquid	1-Propanol 50%
Metrex CaviCide1™	Liquid	Diisobutylphenoxyethoxyethyl dimethyl benzyl ammonium chloride 0.28%, Isopropanol 17.2%
Virex® TB	Liquid	n-Alkyl dimethyl benzyl ammonium chlorides 0.105%, n-Alkyl dimethyl ethylbenzyl ammonium chlorides 0.105%
Rely+On™ Virkon® High Level Surface Disinfectant	Powder	Used as 1% solution Biocidal active: Pentapotassium bis (peroxymonosulphate) bis (sulphate)(500g/kg), Contains dipotassium peroxodisulphate.
Alpet® D2 Surface Sanitizing Wipes	Wipes	Isopropyl Alcohol 58.6000%, Octyl Decyl Dimethyl Ammonium chloride 0.0075%, Dioctyl Dimethyl Ammonium Chloride 0.0030%
Clorox Dispatch® Hospital Cleaner Disinfectant Towels with Bleach	Wipes	Sodium Hypochlorite 0.65%
Metrex CaviWipes™	Wipes	Diisobutylphenoxyethoxyethyl dimethyl benzyl ammonium chloride 0.28%, Isopropanol 17.2%
PDI Sani-Cloth® AF3 Germicidal Disposable Wipe	Wipes	n-Alkyl dimethyl ethylbenzyl ammonium chlorides 0.14%, n-Alkyl dimethyl benzyl ammonium chlorides 0.14%
PDI Sani-Cloth® Plus Germicidal Disposable Cloth	Wipes	n-Alkyl dimethyl ethylbenzyl ammonium chlorides 0.125%, n-Alky dimethyl benzyl ammonium chlorides 0.125%
PDI Super Sani-Cloth® Germicidal Disposable Wipe	Wipes	n-Alkyl dimethyl ethylbenzyl ammonium chlorides 0.25%, n-Alkyl dimethyl benzyl ammonium chlorides 0.25%, Isopropyl Alcohol 55.0%
VIRAGUARD Hospital Surface Disinfectant Towelette	Wipes	Isopropanol 70%, Other ingredients 30%

23.4.2 Approved Cleaning and Disinfecting Agents for Masimo SpO₂ cable

The following table lists approved cleaning and disinfecting agents for Masimo SpO₂ cable:

Product Name	Product Type	Active Ingredients
Isopropanol	Liquid	Isopropanol 70%
Sodium hypochlorite bleach	Liquid	Sodium hypochlorite bleach, 0.5%

Product Name	Product Type	Active Ingredients
PDI Super Sani-Cloth® Germicidal Disposable Wipe	Wipe	n-Alkyl dimethyl ethylbenzyl ammonium chlorides 0.25%, n-Alkyl dimethyl benzyl ammonium chlorides 0.25%, Isopropyl Alcohol 55.0%
Glutaraldehyde	Liquid	Glutaraldehyde, 2%

23.4.3 Approved Cleaning and Disinfecting Agents for Nellcor SpO₂ cable

The following table lists approved cleaning and disinfecting agents for Nellcor SpO₂ cable:

Product Name	Product Type	Active Ingredients
Sodium hypochlorite bleach	Liquid	Sodium hypochlorite bleach 0.5%
Isopropanol	Liquid	Isopropanol 70%
1-Propanol	Liquid	1-Propanol 50%
Virex® TB	Liquid	n-Alkyl dimethyl benzyl ammonium chlorides 0.105%, n-Alkyl dimethyl ethylbenzyl ammonium chlorides 0.105%
Rely+On™ Virkon® High Level Surface Disinfectant	Powder	Used as 1% solution Biocidal active: Pentapotassium bis (peroxymonosulphate) bis (sulphate)(500g/kg), Contains dipotassium peroxodisulphate.
Clorox Dispatch® Hospital Cleaner Disinfectant Towels with Bleach	Wipes	Sodium Hypochlorite 0.65%
Clorox Healthcare® Bleach Germicidal Wipes	Wipes	Sodium Hypochlorite 0.55%
Clorox Healthcare® Hydrogen Peroxide Cleaner Disinfectant Wipes	Wipes	Hydrogen Peroxide 1.4%
Diversey Oxivir® TB Wipes	Wipes	Hydrogen Peroxide 0.5%
PDI Super Sani-Cloth® Germicidal Disposable Wipe	Wipes	n-Alkyl dimethyl ethylbenzyl ammonium chlorides 0.25%, n-Alkyl dimethyl benzyl ammonium chlorides 0.25%, Isopropyl Alcohol 55.0%
VIRAGUARD Hospital Surface Disinfectant Towelette	Wipes	Isopropanol 70%, Other ingredients 30%

The FloTrac cable can be cleaned and disinfected with agents that are based on the following chemical content:

- Isopropanol 70%
- Glutaraldehyde 2%
- Bleach solution 10%
- Quaternary ammonium solution

23.4.4 Cleaning the Accessories

You should clean the accessories on a regular basis. Before cleaning the accessories, consult your hospital's regulations for cleaning the accessories.

To clean the accessories, follow this procedure:

1. Clean the accessories with wipes or a soft cloth moistened with one of the approved cleaning agents.
2. Wipe off all the cleaning agent residue with a dry cloth.

3. Allow the accessories to air dry.

23.4.5 Disinfecting the Accessories

We recommend that the accessories should be disinfected only when necessary as determined by your hospital's policy, to avoid long term damage to the accessories. Use only approved disinfectants. Cleaning the accessories before disinfecting is recommended.

23.5 Sterilization

Sterilization is not recommended for this equipment, related products, accessories, or supplies unless otherwise indicated in the Instructions for Use that accompany the products, accessories or supplies.

24 Maintenance

24.1 Maintenance Introduction

Regular maintenance is essential to ensure that the equipment continues to function properly. This chapter contains information on periodic testing and maintenance.

24.2 Maintenance Safety Information

WARNING

- To avoid electric shock, stop using the equipment if you find the housing is damaged, and contact the service personnel.
 - Failure on the part of the responsible individual hospital or institution using this equipment to implement a recommended maintenance schedule may cause undue equipment failure and possible health hazards.
 - No modification of this equipment is allowed.
 - This equipment contains no user serviceable parts.
 - Software upgrades to the monitor can only be done by Mindray service engineers with Mindray upgrading tools.
 - The safety checks or maintenance involving any disassembly of the equipment should be performed by professional service personnel. Otherwise, undue equipment failure and possible health hazards could result.
 - Do not open batteries, heat batteries to above 60 °C, incinerate batteries, or short the battery terminals. Batteries may ignite, explode, leak or heat up, causing personal injury.
 - The service personnel must be properly qualified and thoroughly familiar with the operation of the equipment.
-

CAUTION

- The equipment and accessories shall not be serviced or maintained while in use on a patient.
 - If you discover a problem with any of the equipment, contact your service personnel or Mindray.
 - Use and store the equipment within the specified temperature, humidity, and altitude ranges.
 - When disposing of the packaging material, be sure to observe the applicable waste control regulations and keep it out of the reach of children.
 - At the end of its service life, the equipment, as well as its accessories, must be disposed of in compliance with the guidelines regulating the disposal of such products. If you have any questions concerning disposal of the equipment, please contact Mindray.
-

24.3 Maintenance and Testing Schedule

Follow the maintenance and testing schedule or local regulations to perform testing and maintenance such as defined in section 24.5 *Testing Methods and Procedures*. Follow your hospital policy on cleaning and disinfecting the equipment before testing and maintenance.

The following table lists the maintenance and testing schedule:

Test/Maintenance Item		Recommended Frequency
Performance Tests		
Visual inspection		Every day, before first use.
Measurement module performance test and calibration		1. If you suspect that the measurement values are incorrect. 2. Follow any repairs or replacement of relevant module. 3. Once a year for CO ₂ tests. 4. Once every two years for other parameter module performance tests.
Analog output test		If you suspect that the analog output function does not work properly.
Defibrillation synchronization test		If you suspect that the defibrillation synchronization function does not work properly.
Electrical Safety Tests		
Electrical safety tests		Once every two years.
Other Tests		
Power-on test		Before use
Network printer tests		1. When first installed. 2. Follow any repair or replacement of the printer.
Battery check	Functionality test	1. When first installed. 2. When battery is replaced.
	Performance test	Every three months or if the battery runtime is reduced significantly.

24.4 Checking System Software Version

To view system software version information, select the **Main Menu** quick key → from the **System** column select **Version**.

You can check the detailed system software version, module hardware and software version, and firmware version only from the **Maintenance** dialog.

24.5 Testing Methods and Procedures

Except for the following maintenance tasks, all other test and maintenance tasks should be performed by Mindray-qualified service personnel only.

- Regular checks, including visual inspection and power-on test
- Printer tests
- Battery check

If your monitor needs a safety test and performance test, contact the service personnel.

24.5.1 Performing Visual Inspection

Visually inspect the equipment before its first use every day. If you find any signs of damage, remove the monitor from use and contact the service personnel.

Verify that the equipment meets the following requirements:

- Environment and power supply specifications are met.
- The monitor housing and display screen are free from cracks or other damage.
- The power cord is not damaged and the insulation is in good condition.
- Connectors, plugs, and cables are not damaged or kinked.
- Power cord and patient cables are securely connected to the equipment and modules.

24.5.2 Performing Power-on Test

The monitor automatically performs a power-on test at startup. Verify the following items for the power-on test:

- The equipment powers on properly.
- The alarm system works properly, denoted by alarm sounds and display of all 3 alarm light colors.
- The monitor displays properly.

24.5.3 Testing the Network Printer

To check the printer, follow this procedure:

1. Start a printing task to print waveforms and reports.
2. Check that the printer is properly connected and functions correctly.
3. Check that the printout is clear with no missing information.

24.5.4 Checking the Battery

For information on battery check, see 22.6.2 *Checking Battery Performance*.

24.6 NIBP Maintenance

24.6.1 NIBP Leakage Test

The NIBP leakage test checks the integrity of the system and of the valve. The NIBP leakage test should be performed once every two years or when you doubt the NIBP measurements. The NIBP leakage test should be performed by Mindray-qualified service personnel only.

24.6.2 NIBP Accuracy Test

The NIBP accuracy test should be performed once every two years or when you doubt the NIBP measurements. The NIBP accuracy test should be performed by Mindray-qualified service personnel only.

24.7 Disposing of the Monitor

Dispose of the monitor and its accessories when its service life is reached. Follow local regulations regarding the disposal of such product.

WARNING

- **For disposal of parts and accessories, where not otherwise specified, follow local regulations regarding disposal of hospital waste.**
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25 Accessories

The accessories listed in this chapter comply with the requirements of IEC 60601-1-2 when in use with the patient monitor. The accessory material that contacts the patients has undertaken the bio-compatibility test and is verified to be in compliance with ISO 10993-1. For details about the accessories, refer to the instructions for use provided with the accessory.

WARNING

- **Use accessories specified in this chapter. Using other accessories may cause damage to the patient monitor or not meet the claimed specifications.**
- **Single-use accessories are not designed to be reused. Reuse may cause a risk of contamination and affect the measurement accuracy.**

CAUTION

- **The accessories may not meet the performance specifications if stored or used outside the specified temperature and humidity ranges. If accessory performance is degraded due to aging or environmental conditions, contact your service personnel.**
- **Verify the compatibility between the monitor and accessories before use. Using incompatible accessories can result in equipment damage and patient injury.**
- **Check the accessories and their packages for any sign of damage. Do not use them if any damage is detected.**
- **Use the accessories before the expiration date if an expiration date is indicated.**
- **Discard disposable accessories according to hospital regulations.**

NOTE

- **This manual describes all the accessories that are validated for use. Not all accessories are available in every market.**

25.1 ECG Accessories

25.1.1 ECG Electrodes Available for Purchase

Model	Part No.	Description	Usage	Applicable patient
31499224	0010-10-12304	Electrode, Kendall, pkg of 10	Disposable	Adult
1050NPSMKittycat	0681-00-0098-01	NEO pre-wired electrode radio Opaque, pkg of 100	Disposable	Neonate
1051NPSMKittycat	0681-00-0098-02	NEO pre-wired electrode radio Translucent, pkg of 100	Disposable	Neonate

25.1.2 ECG Electrodes Also Compatible

Model	Part No.	Description	Usage	Applicable patient
2245-50	9000-10-07469	ECG electrode, 3M, pkg of 50	Disposable	Pediatric

25.1.3 12-Pin Trunk Cables Available for Purchase

Model	Part No.	Description	Usage	Applicable patient
EV6206	009-005266-00	ECG cable, 10' (3.1 m), defibrillation-proof, for N/T	Reusable	Adult/Pediatric
EV6207	009-005267-00	ECG cable, 20' (6.2 m), defibrillation-proof, for N/T	Reusable	Adult/Pediatric
EV6216	009-005268-00	ECG cable, 10' (3.1 m), ESU-proof, for N/T	Reusable	Adult/Pediatric
EV6217	009-005269-00	ECG cable, 20' (6.2 m), ESU-Proof, for N/T	Reusable	Adult/Pediatric
EV6208	040-003528-00	ECG cable, 10' (3.1 m), 12-lead, defibrillation-proof, for N/T 5-lead leadwires	Reusable	Adult/Pediatric
EV6202	0010-30-42720	12Pin 3-Lead ECG trunk cable, defibrillation-proof	Reusable	Pediatric/Neonate
EV6212	0010-30-42724	12Pin 3-Lead ECG trunk cable, ESU-proof	Reusable	Pediatric/Neonate
EV6222	040-000754-00	12Pin 3-Lead trunk cable, defibrillation-proof, DIN Conn	Reusable	Pediatric/Neonate

Note: 040-003528-00 uses 5-Lead N/T leadwires for the limb leads.

25.1.4 12-Pin Trunk Cables Also Compatible

Model	Part No.	Description	Usage	Applicable patient
EV6201	0010-30-42719	12Pin 3/5-Lead ECG trunk cable, defibrillation-proof	Reusable	Adult/Pediatric
EV6203	0010-30-42721	12Pin 12-Lead trunk cable, defibrillation-proof	Reusable	Adult/Pediatric
EV6211	0010-30-42723	12Pin 3/5-Lead ECG trunk cable, ESU-proof	Reusable	Adult/Pediatric
/	040-001416-00	12Pin 3/5-Lead ECG trunk cable, defibrillation-proof	Reusable	Adult/Pediatric
/	009-003652-00	12Pin 3/5-Lead ECG trunk cable, ESU-proof	Reusable	Adult/Pediatric

25.1.5 3-lead ECG Leadwires Available for Purchase

Model	Part No.	Description	Usage	Applicable patient
EY6316B	009-004765-00	3-Lead, N/T, AHA, snap, 24"	Reusable	Adult/Pediatric
EY6305B	009-004766-00	3-Lead, N/T, AHA, snap, 36"	Reusable	Adult/Pediatric
EY6316A	009-004771-00	3-Lead, N/T, AHA, clip, 24"	Reusable	Adult/Pediatric
EY6305A	009-004772-00	3-Lead, N/T, AHA, clip, 36"	Reusable	Adult/Pediatric
EY6310B	009-004777-00	3-Lead, N/T, AHA, snap, 24"	Disposable	Adult/Pediatric
EY6310B	115-032954-00	3-Lead, N/T, AHA, snap, 24", pkg of 20	Disposable	Adult/Pediatric
EL6305A	0010-30-42896	3-Lead leadset, AHA, clip	Reusable	Neonate
EL6311B	040-000146-00	3-Lead leadset, AHA, snap	Disposable	Pediatric/Neonate
EL6311A	040-000148-00	3-Lead leadset, AHA, clip	Disposable	Pediatric/Neonate

25.1.6 3-lead ECG Leadwires Also Compatible

Model	Part No.	Description	Usage	Applicable patient
EL6303A	0010-30-42731	3-Lead leadset, AHA, clip, Long	Reusable	Adult/Pediatric
EL6301B	0010-30-42734	3-Lead leadset, AHA, snap	Reusable	Adult/Pediatric
/	0012-00-1503-05	3-Lead leadset, snap, 24" (61.0 cm), AAMI	Reusable	Adult/Pediatric
/	0012-00-1503-06	3-Lead leadset, snap, 36" (101.6 cm), AAMI	Reusable	Adult/Pediatric
/	0012-00-1514-05	3-Lead leadset, clip, 24" (61.0 cm), AAMI	Reusable	Adult/Pediatric
/	0012-00-1514-06	3-Lead leadset, clip, 36" (101.6 cm), AAMI	Reusable	Adult/Pediatric

25.1.7 5-lead ECG Leadwires Available for Purchase

Model	Part No.	Description	Usage	Applicable patient
EY6511B	009-004782-00	5-Lead, N/T, AHA, snap, 24"	Reusable	Adult/Pediatric
EY6512B	009-004783-00	5-Lead, N/T, AHA, snap, 36"	Reusable	Adult/Pediatric
EY6511A	009-004786-00	5-Lead, N/T, AHA, pinch, 24"	Reusable	Adult/Pediatric
EY6512A	009-004787-00	5-Lead, N/T, AHA, pinch, 36"	Reusable	Adult/Pediatric
EY6507B	009-004790-00	5-Lead, N/T, AHA, snap, 24"	Disposable	Adult/Pediatric
EY6507B	115-032955-00	5-Lead, N/T, AHA, snap, 24", pkg of 20	Disposable	Adult/Pediatric

25.1.8 5-lead ECG Leadwires Also Compatible

Model	Part No.	Description	Usage	Applicable patient
EL6503A	0010-30-42729	5-Lead leadset, AHA, clip, Long	Reusable	Adult/Pediatric
EL6501B	0010-30-42735	5-Lead leadset, AHA, snap	Reusable	Adult/Pediatric
EL6501A	0010-30-42727	5-Lead leadset, AHA, clip	Reusable	Adult/Pediatric
/	0012-00-1503-02	5-Lead leadset, snap, 24" (61.0 cm), AAMI	Reusable	Adult/Pediatric
/	0012-00-1503-03	5-Lead leadset, snap, 36" (101.6 cm), AAMI	Reusable	Adult/Pediatric
/	0012-00-1514-02	5-Lead leadset, clip, 24" (61.0 cm), AAMI	Reusable	Adult/Pediatric
/	0012-00-1514-03	5-Lead leadset, clip, 36" (101.6 cm), AAMI	Reusable	Adult/Pediatric

25.1.9 6-lead ECG Leadwires Available for Purchase

Model	Part No.	Description	Usage	Applicable patient
EY6601B	009-004794-00	6-Lead, N/T, AHA, snap, 24"	Reusable	Adult/Pediatric
EY6602B	009-004795-00	6-Lead, N/T, AHA, snap, 36"	Reusable	Adult/Pediatric
EY6601A	009-004798-00	6-Lead, N/T, AHA, pinch, 24"	Reusable	Adult/Pediatric
EY6602A	009-004799-00	6-Lead, N/T, AHA, pinch, 36"	Reusable	Adult/Pediatric

25.1.10 12-lead ECG Chest Leadwires Available for Purchase

Model	Part No.	Description	Usage	Applicable patient
EL6803A	0010-30-42904	12-Lead leadset, chest, AHA, clip	Reusable	Adult/Pediatric
EL6803B	0010-30-42908	12-Lead leadset, chest, AHA, snap	Reusable	Adult/Pediatric

25.1.11 12-lead ECG Leadwires Also Compatible

Model	Part No.	Description	Usage	Applicable patient
EL6801A	0010-30-42902	12-Lead leadset, limb, AHA, clip	Reusable	Adult/Pediatric
EL6801B	0010-30-42906	12-Lead leadset, limb, AHA, snap	Reusable	Adult/Pediatric

25.2 SpO₂ Accessories

Wavelength emitted by the sensors is between 600 nm and 1000 nm. The maximum photic output consumption of the sensor is less than 18 mW.

The information about the wavelength range and maximum photic output consumption can be especially useful to clinicians, for example, when photodynamic therapy is performed.

25.2.1 Extension Cables and Adapter Cables Available for Purchase

Model	Part No.	Description	Usage	Applicable patient
572A	0010-20-42712	8-pin SpO ₂ extension cable, Nellcor	Reusable	/
583A	040-003310-00	8-pin, RD SET, Masimo	Reusable	/
4089	040-003381-00	RD to LNCS adapter cable, Masimo	Reusable	/
4092	040-003426-00	LNCS to RD adapter, Masimo	Reusable	/

25.2.2 Extension Cables and Adapter Cables Also Compatible

Model	Part No.	Description	Usage	Applicable patient
582A	115-020768-00	8-pin SpO ₂ extension cable, Masimo	Reusable	/

25.2.3 Masimo SpO₂ RD Set Sensors Available for Purchase

Model	Part No.	Description	Usage	Applicable patient
4050	040-003376-00	SpO ₂ sensor, RD SET DCI	Reusable	Adult (> 30 kg)
4051	040-003377-00	SpO ₂ sensor, RD SET DCI	Reusable	Pediatric (10-50 kg)
4053	040-003380-00	SpO ₂ sensor, RD Set TC-I, tip-clip ear sensor, 3ft	Reusable	Adult (> 30 kg)
4000	040-003382-00	SpO ₂ sensor, RD SET Adt, adhesive, pkg of 20	Disposable	Adult (> 30 kg)
4001	040-003383-00	SpO ₂ sensor, RD SET PDT, adhesive, pkg of 20	Disposable	Pediatric (10 to 50 kg)
4002	040-003384-00	SpO ₂ sensor, RD Set Inf, adhesive, pkg of 20	Disposable	Infant (3 to 20 kg)
4003	040-003385-00	SpO ₂ sensor, RD Set Neo, adhesive, pkg of 20	Disposable	Neonatal /Adult (<3Kg or >40Kg)

Model	Part No.	Description	Usage	Applicable patient
4004	040-003386-00	SpO2 sensor, RD Set NeoPt, adhesive, pkg of 20	Disposable	Neonate (<1 kg)
4005	040-003387-00	SpO2 sensor, RD Set NeoPt-500, non-adhesive, pkg of 20	Disposable	Neonate (<1 kg)

25.2.4 Masimo SpO₂ LNCS Sensors Also Compatible

Model	Part No.	Description	Usage	Applicable patient
LNCS Adtx	0600-00-0121	SpO2 sensor, finger-clip, 20 pcs/box	Disposable	Adult (>30 kg)
LNCS Pdtx	0600-00-0122	SpO2 sensor, finger-clip, 20 pcs/box	Disposable	Pediatric (10-50 kg)
LNCS DCI	0600-00-0126	SpO2 sensor, finger-clip	Reusable	Adult (>30 kg)
LNCS DCIP	0600-00-0127	SpO2 sensor, finger-clip	Reusable	Pediatric (10-50 kg)
LNCS NeoPt	0600-00-0156	SpO2 sensor, finger-clip	Disposable	Neonate (<1Kg)
LNCS Neo-L	0600-00-0157	SpO2 sensor, 20 pcs/box	Disposable	Neonate /Adult (<3 kg or > 40 kg)
LNCS Inf	0600-00-0158	SpO2 sensor, 20 pcs/box	Disposable	Infant (3-20 kg)

25.2.5 Nellcor SpO₂ Sensors Also Compatible

Model	Part No.	Description	Usage	Applicable patient
DS100A	9000-10-05161	SpO2 sensor, finger-clip	Reusable	Adult
D-YS	0010-10-12476	SpO2 sensor, with wraps	Reusable	/
OXI-P/I	9000-10-07308	SpO2 sensor, finger, band	Reusable	Pediatric/Infant
OXI-A/N	9000-10-07336	SpO2 sensor, finger/foot, band	Reusable	Adult/Neonate
MAXAI	0010-10-12202	SpO2 sensor, 24 pcs/box	Disposable	Adult (>30 kg)
MAXPI	0010-10-12203	SpO2 sensor, 24 pcs/box	Disposable	Pediatric (10-50 Kg)
MAXII	0010-10-12204	SpO2 sensor, 24 pcs/box	Disposable	Infant (3-20 kg)
MAXNI	0010-10-12205	SpO2 sensor, 24 pcs/box	Disposable	Adult/Neonate (<3 kg or >40 kg)

25.3 Temp Accessories

25.3.1 Temp Cable Available for Purchase

Model	Part No.	Description	Usage	Applicable patient
MR420B	040-001235-00	2-pin Temperature adapter cable	Reusable	/

25.3.2 Temp Cable Also Compatible

Model	Part No.	Description	Usage	Applicable patient
MR420B	0011-30-37391	2-pin, extension cable	Reusable	/

25.3.3 Temp Probes Available for Purchase

Model	Part No.	Description	Usage	Applicable patient
MR401B	0011-30-37392	Temperature probe, endocavity	Reusable	Adult
MR402B	0011-30-37394	Temperature probe, endocavity	Reusable	Pediatric/Infant
MR403B	0011-30-37393	Temperature probe, skin surface	Reusable	Adult
MR404B	0011-30-37395	Temperature probe, skin surface	Reusable	Pediatric/Infant
MR411	040-003292-00	Temperature probe, esophageal/ rectal, 9FR	Disposable	All
MR411	040-003294-00	Temperature probe, esophageal/ rectal, 9FR, pkg of 20	Disposable	All
MR412	040-003293-00	Temp probe, skin surface	Disposable	All
MR412	040-003295-00	Temp probe, skin surface, pkg of 20	Disposable	All
ES400-12	0206-03-0112-02	PROBE,D TEMP,ES400-12 (box of 20)	Disposable	Adult
ES400-18	0206-03-0118-02	PROBE,D TEMP,ES400-18 (box of 20)	Disposable	Adult
ER400-9	0206-03-0209-02	PROBE,D TEMP,ER 400-9 (box of 20)	Disposable	Adult
ER400-12	0206-03-0212-02	PROBE,D TEMP,ER400-12 (box of 20)	Disposable	Adult
STS-400	0206-03-0300-02	PROBE,D TEMP,STS-400 (box of 20)	Disposable	Adult

25.3.4 Temp Probes Also Compatible

Model	Part No.	Description	Usage	Applicable patient
MR411	0011-30-90446	Disposable temperature probe, esophageal	Disposable	All
MR412	0011-30-90447	Disposable temperature probe, skin	Disposable	All

25.4 NIBP Accessories

25.4.1 NIBP Hoses Available for Purchase

Model	Part No.	Description	Usage	Applicable patient
CM1903	6200-30-09688	NIBP hose, inbuilt connector, 3m	Reusable	Adult/Pediatric/ Neonate

25.4.2 Cuffs Available for Purchase

Model	Part No.	Description	Usage	Applicable patient
CM1301	115-027713-00	Cuff, 10-19 cm, bladderless	Reusable	Infant
CM1302	115-027714-00	Cuff, 18-26 cm, bladderless	Reusable	Small Adult
CM1303	115-027715-00	Cuff, 25-35 cm, bladderless	Reusable	Adult
CM1304	115-027716-00	Cuff, 33-47 cm, bladderless	Reusable	Adult
CM1305	115-027717-00	Cuff, 46-66 cm, bladderless	Reusable	Adult thigh
CM1306	115-027718-00	Cuff, 24-35 cm, bladderless	Reusable	Adult
CM1307	115-027719-00	Cuff, 33-47 cm, bladderless	Reusable	Adult

Model	Part No.	Description	Usage	Applicable patient
CM1501	115-027563-00	Cuff, 10-19 cm, bladderless, pkg of 10	Disposable	Child
CM1502	115-027564-00	Cuff, 18-26 cm, bladderless, pkg of 10	Disposable	Small adult
CM1503	115-027565-00	Cuff, 25-35 cm, bladderless, pkg of 10	Disposable	Adult
CM1504	115-027566-00	Cuff, 33-47 cm, bladderless, pkg of 10	Disposable	Large adult
CM1505	115-027567-00	Cuff, 46-66 cm, bladderless, pkg of 5	Disposable	Adult thigh
CM1506	115-027568-00	Cuff, 25-35 cm, bladderless, pkg of 10, long	Disposable	Adult
CM1507	115-027569-00	Cuff, 33-47 cm, bladderless, pkg of 10, long	Disposable	Large adult
CM1500A	125-000051-00	Cuff, 3.1-5.7 cm, pkg of 20	Disposable	Neonate
CM1500B	125-000052-00	Cuff, 4.3-8.0 cm, pkg of 20	Disposable	Neonate
CM1500C	125-000053-00	Cuff, 5.8-10.9 cm, pkg of 20	Disposable	Neonate
CM1500D	125-000054-00	Cuff, 7.1-13.1 cm, pkg of 20	Disposable	Neonate
/	115-031807-00	Cuff starter kit, bladderless	Reusable	Child/Small adult/ Adult/Adult thigh

25.4.3 Cuffs Also Compatible

Model	Part No.	Description	Usage	Applicable patient
CM1500A	001B-30-70692	Cuff, 3.1-5.7 cm, pkg of 20	Disposable	Neonate
CM1500B	001B-30-70693	Cuff, 4.3-8.0 cm, pkg of 20	Disposable	Neonate
CM1500C	001B-30-70694	Cuff, 5.8-10.9 cm, pkg of 20	Disposable	Neonate
CM1500D	001B-30-70695	Cuff, 7.1-13.1 cm, pkg of 20	Disposable	Neonate

25.5 IBP Accessories

25.5.1 IBP Accessories Available for Purchase

Model	Part No.	Description	Usage	Applicable patient
IM2202	001C-30-70757	12 Pin IBP cable, Argon	Reusable	/
IM2201	001C-30-70759	12 Pin IBP cable, ICU Medical	Reusable	/
IM2204	040-001029-00	IBP extended cable with dual-receptacle	Reusable	/
IM2211	125-000123-00	12 Pin IBP cable, Edwards (not for transportation)	Reusable	/

25.5.2 ICP Accessories Available for Purchase

Model	Part No.	Description	Usage	Applicable patient
82-6653	040-002336-00	Codman ICP sensor kit, Johnson & Johnson, pkg of 1	Disposable	/

Model	Part No.	Description	Usage	Applicable patient
CP12601	009-005460-00	12-pin ICP cable	Reusable	/

25.5.3 ICP Accessories Also Compatible

626631US	/	Codman microsensor basic kit for subdural/intraparenchyma1 procedure	Disposable	/
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25.6 CO₂ Accessories

25.6.1 Sidestream CO₂ Accessories Available for Purchase

Model	Part No.	Description	Usage	Applicable patient
4000	115-043001-00	CO2 Nasal sample cannula, 7' line, pkg of 25	Disposable	Adult
4100	115-043002-00	CO2 Nasal sample cannula, 7' line, pkg of 25	Disposable	Pediatric
4200	115-043003-00	CO2 Nasal sample cannula, 7' line, pkg of 25	Disposable	Neonatal
60-15200-00	115-043017-00	Sampling line, 2.5 m, pkg of 25	Disposable	Adult/Pediatric
60-15300-00	115-043018-00	Sampling line, 2.5 m, pkg of 25	Disposable	Neonatal
60-14100-00	115-043020-00	Dryline airway adapter, straight, pkg of 10	Disposable	Adu/Ped
040-001187-00	115-043019-00	Airway Adapter pkg of 10	Disposable	Neonatal
60-14200-00	115-043021-00	Dryline airway adapter, elbow pkg of 10	Disposable	/
100-000080-00	115-058733-00	DRYLINE II water trap, pkg of 10	Reusable	Adult/Pediatric
100-000081-00	115-058734-00	DRYLINE II water trap, pkg of 10	Reusable	Neonatal
4707	125-000365-00	CO2 Nasal cannula,with O ₂ , pkg of 25	Disposable	Adult
4703	125-000366-00	CO2 Nasal cannula,with O ₂ , pkg of 25	Disposable	Pediatric
4700	125-000367-00	CO2 Nasal cannula,with O ₂ , pkg of 25	Disposable	Neonatal

25.6.2 Microstream™ CO₂ Accessories Intended for Sale

Model	Part No.	Description	Usage
/	045-003134-00	CO2 adapter	Reusable

25.6.3 Microstream™ CO₂ Accessories Also Compatible

Model	Part No.	Description	Usage	Applicable patient
MVAI	0010-10-42560	Adult-Pediatric Intubated CO2 FilterLine	Disposable	Adult, pediatric
MVAIH	0010-10-42561	Adult-Pediatric Intubated CO2 FilterLine	Disposable	Adult, pediatric
MVIIH	0010-10-42562	Neonatal-Infant Intubated CO2 FilterLine	Disposable	Neonate
MVAIL	0010-10-42563	Adult-Pediatric Intubated CO2 FilterLine	Disposable	Adult, pediatric
MVAIHL	0010-10-42564	Adult-Pediatric Intubated CO2 FilterLine	Disposable	Adult, pediatric

Model	Part No.	Description	Usage	Applicable patient
MVIIIHL	0010-10-42565	Neonatal-Infant Intubated CO2 FilterLine	Disposable	Neonate
MVA	0010-10-42566	Adt Oral-Nasal CO2 FilterLine	Disposable	Adult
MVP	0010-10-42567	Ped Oral-Nasal CO2 FilterLine	Disposable	Pediatric
MVAO	0010-10-42568	Adt Oral-Nasal CO2 FilterLine w/O2	Disposable	Adult
MVPO	0010-10-42569	Ped Oral-Nasal CO2 FilterLine w/O2	Disposable	Pediatric
MVAOL	0010-10-42570	Adt Oral-Nasal CO2 FilterLine w/O2 L	Disposable	Adult
MVPOL	0010-10-42571	Ped Oral-Nasal CO2 FilterLine w/O2 L	Disposable	Pediatric
MVANH	0010-10-42572	Adult Nasal CO2 FilterLine	Disposable	Adult
MVINH	0010-10-42574	Neo-Inf Nasal CO2 FilterLine H	Disposable	Neonate
MVANO	0010-10-42575	Adt Nasal CO2 FilterLine w/O2 H	Disposable	Adult
MVPNOH	0010-10-42576	Ped Nasal CO2 FilterLine w/O2 H	Disposable	Pediatric
MVAN	0010-10-42577	Adult Nasal CO2 FilterLine	Disposable	Adult
MVPN	0010-10-42578	Pediatric Nasal CO2 FilterLine	Disposable	Pediatric

25.7 External Modules

Part No.	Description
115-053711-00	Sidestream CO2 module, with neonatal accessories
115-049134-00	Sidestream CO2 module, with adult and pediatric accessories
120-023072-00	Microstream™ CO2 module, with accessories
115-047286-00	IBP module

25.8 Mount and Mounting Accessories

Part No.	Description
115-028320-00	Monitor handle
115-048378-00	Modular Rack kit
115-054849-00	Dock and pole mount kit
115-054851-00	Modular Rack and folding hook kit
115-048990-00	Bedrail hook kit
045-001229-00	LCD wall-mount bracket
045-001230-00	Pole mounting kit
045-002198-00	Dock wall mount bracket
045-003427-00	GCX M series wall mount with quick release
045-001228-00	N1/T1 docking station wall-mount (for LCD)
034-000454-00	GCX M series arm, 16", with 6" riser
034-000457-00	GCX M series 12" pivot arm
034-000782-00 034-000456-00	GCX VHM variable height arm

Part No.	Description
045-000934-00	Keyboard wall-mount bracket
045-004267-00	Rolling stand with quick release mount
115-050757-00	Hook kit

25.9 Miscellaneous Accessories

Part No.	Description
009-009766-00	N Series to N1/T1 docking station cable, 20 m
009-006594-00	N Series to N1/T1 docking station cable, 10 m
009-005123-00	N Series to N1/T1 docking station cable, 4 m
009-006593-00	N Series to N1/T1 docking station cable, 2 m
115-048379-00	Dock, with power cord
115-048384-00	Transport Dock
009-005391-00	MPM analog output and defib sync cable
023-001788-00	External display, 21.5"
023-001566-00	HP LaserJet Enterprise M608n, black and white
115-048139-00	AC adapter kit
115-049427-00	Lithium battery kit
0012-25-0001	Power cord
115-048417-00	N1 Accessories Storage Box
023-000524-00	Wireless keyboard and mouse set
023-000525-00	Wired keyboard and mouse set
023-000247-00	Keyboard, wired USB connector, black
023-000248-00	Mouse, wired USB connector, black
115-039575-00	2D Barcode reader, HS-1M, JADAK
115-039635-00	2D Barcode reader, HS-1R, JADAK
042-007382-00	Cable management hook

A Product Specifications

A.1 Monitor Safety Specifications

The monitor is classified, according to IEC 60601-1: 2005:

Degree of protection against electrical shock	Type CF defibrillation proof for ECG, Resp, TEMP, IBP, SpO ₂ , and NIBP Type BF defibrillation proof for CO ₂
Type of protection against electrical shock	Class I
Degree of protection against harmful ingress of water	N1 monitor: IP44 (protected against ingress of foreign objects no less than 1.0 mm, and against access to hazardous parts with wire; protect against harmful effects of splashing water) Dock/Modular Rack/AC Adapter: IPX1 (protected against harmful effects of vertically falling water drops) Transport Dock: IP22 (protected against ingress of foreign objects no less than 12.5 mm and against access to hazardous parts with finger; protected against harmful effects of vertically falling water drops with the device tilted at any angle up to 15°)
Degree of safety of application in the presence of flammable anesthetic mixture with air or with oxygen or nitrous oxide	The equipment is not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide
Mode of operation	Continuous

A.2 Physical Specifications

Item	Maximum Weight (kg)	W × H × D (mm, maximum)	Comments
N1 main unit	1.1	150 × 103 × 81	With 5 lead ECG, NIBP, Mindray SpO ₂ , Resp and temp; with two batteries; without IBP, analog output, Wi-Fi module, or accessories
Modular Rack	0.60	165 × 130 × 168	/
Dock	0.97	190 × 125 × 155	/
Transport Dock	2.51	162.4 × 253 × 195.5	with cable box
Transport Dock	1.80	162.4 × 113 × 195.5	without cable box
Microstream™ CO ₂ module	0.38	136.5 × 40 × 102	/
Sidestream CO ₂ module	0.54	136.5 × 40 × 102	without O ₂
IBP module	0.26	136.5 × 40 × 102	/

A.3 Environmental Specifications

WARNING

- The monitor may not meet the performance specifications if stored or used outside the specified temperature and humidity ranges. If the performance of the equipment is degraded due to aging or environmental conditions, contact your service personnel.
- The monitor cannot be transported in the temperature lower than -30°C.

- When the monitor and related products have differing environmental specifications, the effective range for the combined products is that range which is common to the specifications for all products.

NOTE

- The environmental specification of unspecified parameter modules are the same as those of the main unit.

Components	Property (unit)	Operating Condition	Storage Condition
Main Unit/ Transport Dock/ AC Adapter	Temperature (°C)	0 to 40	-30 to 70
	Relative humidity (noncondensing) (%)	5 to 95	5 to 95
	Barometric (mmHg)	427.5 to 805.5	375 to 805.5 (with CO ₂) 120 to 805.5 (without CO ₂)
Modular Rack/ Dock	Temperature (°C)	0 to 40	-20 to 60
	Relative humidity (noncondensing) (%)	15 to 95	10 to 95
	Barometric (mmHg)	427.5 to 805.5	120 to 805.5
Microstream™ CO ₂ module	Temperature (°C)	0 to 40	-20 to 60
	Relative humidity (noncondensing) (%)	15 to 95	10 to 95
	Barometric (mmHg)	430 to 790	430 to 790
Sidestream CO ₂ module	Temperature (°C)	5 to 40	-20 to 60
	Relative humidity (noncondensing) (%)	15 to 95	10 to 95
	Barometric (mmHg)	430 to 790	375 to 805.5

Transient operating conditions

The monitor is operated in normal use for a period not less than 20 minutes when moved from room temperature (20°C ± 2°C) to an environment of a temperature range from - 20 °C to 50 °C, and relative humidity range from 15% to 95% (non-condensing).

The monitor is operated in normal use for a period not less than 20 minutes when moved from storage temperature (range from - 30 °C to 70 °C) to room temperature (20°C ± 2°C), and started up within 10 minutes after the movement.

A.4 Power Supply Specifications

A.4.1 External Power Supply Specifications

N1 main unit	
Input voltage	12VDC (±10%)
Input current	2 A
AC Adapter	
Input	100 to 240 VAC (-15%, +10%), 50/60 Hz (±3 Hz), 1.0A to 0.6A
Output	12VDC (±10%), 2.5A
Dock	
Input voltage	100 to 240VAC (±10%)

Input current	0.65A to 0.35A
Frequency	50/60Hz (±3Hz)
Transport Dock	
Input	100 to 240 VAC (-15%, +10%), 50/60 Hz (±3 Hz), 1.0A to 0.6A AC waveform: sine
Output	12VDC (±10%), 2.5A

A.4.2 Battery Specifications

Battery type	Rechargeable lithium-Ion battery
Voltage	7.2 VDC
Capacity	2500 mAh
Run time	<p>At least 8 hours when the monitor without internal CO₂ module is powered by two new fully-charged batteries at 25°C ± 5°C with factory default screen brightness, Wi-Fi disabled or WMTS connected, ECG and SpO₂ cable connected, and auto NIBP measurements at an interval of 15 minutes.</p> <p>At least 3 hours when the monitor with internal CO₂ module is powered by one new fully-charged battery at 25°C ± 5°C with factory default screen brightness, Wi-Fi enabled or WMTS connected, CO₂ sampling line connected, Temp, IBP, ECG and SpO₂ cable connected, and auto NIBP measurements at an interval of 15 minutes.</p> <p>Shutdown delay: at least 15 minutes after the low battery alarm first occurs.</p>
Charge time	<p>For the monitor without internal CO₂ module: no more than 6 hours to 90% when the monitor is off. no more than 10 hours to 90% when the monitor is on.</p> <p>For the monitor with internal CO₂ module: no more than 3 hours to 90% when the monitor is off. no more than 5 hours to 90% when the monitor is on.</p>

A.5 Display Specifications

N1 main unit	
Screen type	Color TFT LCD
Screen Size (diagonal)	5.5 inches
Resolution	1280 x 720 pixels
Pixel per inch (PPI)	269
External display	
Screen type	Medical-grade color TFT LCD
Screen Size (diagonal)	22 inches
Resolution	1280 x 720 pixels

A.6 Touchscreen Specifications

Screen type	Capacitive, multi-point touch
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A.7 LEDs

A.7.1 Main Unit

Alarm lamp	1 (three color-coded: red, yellow, and cyan)
Power-on LED	1 (green)
External power LED	1 (green)
Battery LED	1 (two color-coded: yellow and green)

A.7.2 Dock

Connection status LED	1 (green)
External power supply LED	1 (green)

A.7.3 Transport Dock

Power-on LED	1 (green)
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A.7.4 AC Adapter

Power-on LED	1 (green)
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A.8 Audio Indicator

Speaker	Give alarm tones (45 to 85 dB), reminder tones, key tones, QRS tones; support PITCH TONE and multi-level tone modulation; alarm tones comply with IEC 60601-1-8:2012.
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A.9 Monitor Interface Specifications

A.9.1 Interface Specifications of the Main Unit

DC power input connector	1
Multifunctional connector	1
Multi-pin connector	1
Communication interface	4
Infrared filter	1
Contact	2
Power switch	1
Sample line connector of the Sidestream CO ₂	1
Gas outlet	1
ECG cable connector	1
SpO ₂ sensor connector	1
NIBP cuff connector	1
IBP cable connector	1

Temperature probe connector	2
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A.9.2 Interface Specifications of the Modular Rack

Multi-pin connector	2
Infrared filter	1
Pogo pin	3
Contact	2

A.9.3 Interface Specifications of the Dock

Network connector	1
Equipotential grounding terminal	1
AC power input connector	1
VGA connector	1
Host monitor connector	1
USB connector	2
Multi-pin connector	1

A.10 Signal Outputs Specifications

ECG Analog Output	
Bandwidth (-3dB; reference frequency: 10Hz)	Diagnostic mode: 0.05 to 150 Hz Monitor mode: 0.5 to 40 Hz Surgical mode: 1 to 20 Hz ST mode: 0.05 to 40 Hz
Maximum QRS delay	25 ms (in diagnostic mode, and non-paced)
Gain (reference frequency 10Hz)	1V/mV ($\pm 5\%$)
Pace enhancement	Signal amplitude: $V_{oh} \geq 2.5V$ Pulse width: 10 ms $\pm 5\%$ Signal rise and fall time: $\leq 100\mu s$
IBP Analog Output	
Bandwidth (-3dB; reference frequency: 1Hz)	0 to 40 Hz
Maximum transmission delay	30 ms
Gain (reference frequency 1 Hz)	1 V/100 mmHg, $\pm 5\%$
Defib Sync Pulse	
Output impedance	$\leq 100 \Omega$
Maximum time delay	35 ms (R-wave peak to leading edge of pulse)
Amplitude	High level: 3.5 to 5 V, $\pm 5\%$, providing a maximum of 10 mA output current; Low level: $< 0.5 V$, receiving a maximum of 5 mA input current.
Pulse width	100 ms $\pm 10\%$
Video Output	
Video signals	VGA signal

Alarm output	
Alarm delay time from the monitor to remote equipment	The alarm delay time from the monitor to remote equipment is ≤ 2 seconds, measured at the monitor signal output connector.
Alarm signal sound pressure level range	45 dB(A) to 85 dB(A) within a range of one meter

A.11 Data Storage

Trends	A minimum of 120 hours of trend data for trend interval as low as 1 minute.
Events	1000 events
NIBP measurements	1000 sets
Interpretation of resting 12-lead ECG results	20 sets
Full-disclosure waveforms	48 hours at maximum. The specific storage time depends on the waveforms stored and the number of stored waveforms.
OxyCRG view	At least 24 hours of oxyCRG events, including HR, SpO ₂ , and Resp waveforms

A.12 Out-Of-Hospital Transport - Standards Compliance

- **Shock Tests** according to IEC TR 60721-4-7, Class 7M3. Test procedure according to IEC/EN60068-2-27 (peak acceleration up to 100g).
- **Random Vibration** according to IEC TR 60721-4-7, Class 7M3. Test procedure according to IEC/EN 60068-2-64 (RMS acceleration 5g).
- **Sinusoidal Vibration** according to IEC TR 60721-4-7, Class 7M3. Test procedure according to IEC/EN 60068-2-6 (acceleration up to amplitude 2g).
- **Bump Test** according to IEC/EN60068-2-29 (peak acceleration 15 g, 1000 bumps).
- **Free Fall Test** according to EN 60068-2-32 (height 1.2 m).
- EN 1789:2007+A2:2014 Medical vehicles and their equipment - Road ambulances.
- EN 13718-1:2008 Medical vehicles and their equipment-Air ambulances-Part 1: Requirements for medical devices used in air ambulances.
- IEC 60601-1-12:2014 Medical electrical equipment -Part 1-12: General requirements for basic safety and essential performance -Collateral Standard: Requirements for medical electrical equipment and medical electrical systems intended for use in the emergency medical services environment.
- **RTCA DO-160G** Environmental Conditions and Test Procedures for Airborne Equipment.
 - ◆ Section 7 Operational Shocks and Crash Safety
 - ◆ Section 8 Vibration (Category S for fixed wing and Category U2 for rotary wing)
- **MIL-STD-810G** Environmental engineering considerations and laboratory tests
 - ◆ Method 514.6 Category 13 - Fixed Wing Propeller Aircraft
 - ◆ Method 514.6 Category 14 Category 14 Helicopter, General, UH-60
 - ◆ Method 514.6 Category 20 - Ground vehicles - ground mobile
 - ◆ Method 514.6 Category 24 - Helicopter minimum integrity test
- **Radiated susceptibility** 20 V/m according to IEC 80601-2-30: 2018 (NIBP), ISO80601-2-55: 2018 (CO₂), ISO80601-2-56: 2017 (TEMP), ISO 80601-2-61: 2017 (SpO₂).
- **Extended radiated susceptibility tests**
 - ◆ TETRA 400: 27V/m
 - ◆ GMRS 460; FRS 460; GSM 800/900; TETRA 800; iDEN 820; CDMA 850; LTE Band 5; GSM 1800; CDMA 1900; GSM 1900; DECT; LTE Band 1, 3, 4, 25; UMTS; Bluetooth; WLAN; 802.11 b/g/n; RFID 2450; LTE Band 7: 28V/m
 - ◆ LTE Band 13, 17; WLAN 802.11 a/n: 9V/m

- **Magnetic Field emission** according to MIL STD 461F, Chapter RE101: Radiated emissions, magnetic field, 30Hz to 100KHz. Limit class: Army.
- **Magnetic Field susceptibility:** Radiated susceptibility, magnetic field, 50 and 60 Hz, 30 A/m.

A.13 Wi-Fi Specifications (for N1 Supporting Wi-Fi)

A.13.1 Wi-Fi Technical Specifications (MSD45N)

Protocol	IEEE 802.11a/b/g/n
Modulation mode	BPSK, QPSK, 16QAM, 64QAM
Operating frequency	2.4 GHz to 2.495 GHz. 5.15 GHz to 5.25 GHz, 5.725 GHz to 5.85 GHz
Channel spacing	IEEE 802.11b/g: 5 MHz IEEE 802.11n (at 2.4 GHz): 5 MHz IEEE802.11a: 20 MHz IEEE802.11n (at 5 GHz): 20 MHz
Wireless data rate	IEEE 802.11b: 1 Mbps to 11 Mbps IEEE 802.11g: 6 Mbps to 54 Mbps IEEE 802.11n: 6.5 Mbps to 72.2 Mbps (MCS0-MCS7) IEEE 802.11a: 6 Mbps to 54 Mbps
Output power	<20 dBm (CE requirements, detection mode: RMS) <30 dBm (FCC requirements, detection mode: peak power)
Operating mode	As station, access AP for data transmission
Data security	Standards: WPA-PSK, WPA2-PSK, WPA-Enterprise, WPA2-Enterprise, WPA CCKM, WPA2 CCKM EAP method: EAP-FAST, EAP-TLS, EAP-TTLS, PEAP-GTC, PEAP-MSCHAPv2, PEAP-TLS, LEAP Encryption: AES

A.13.2 Wi-Fi Performance Specifications

WARNING

- **All network functions of data communication are designed to operate on a private network.**

A.13.2.1 System Capacity

Number of the monitors supported by a single AP: ≤ 16

Testing conditions are as follows:

- Each monitor can communicate with the CMS.
- Two monitors are used to view other monitors.
- Only one monitor can transmit history data.
- The weakest strength of the AP signal where the monitor is located cannot be less than -65 dBm.

A.13.2.2 Resistance to Wireless Interference

The distance between the interfering devices and the monitor is greater than 20 cm. A Wi-Fi interference (no greater than -85 dBm) in the same channel and a Wi-Fi interference (no greater than -50 dBm) in an adjacent-channel are presented synchronously. The interfering devices include, but are not limited to, 2.4 GHz wireless devices, cellular mobile networks, microwave ovens, intercoms, cordless phones, and ESU equipment. The interfering devices do not include Wi-Fi devices.

The monitoring network must support the following requirements:

- All the monitors do not encounter communication loss.

- The total delay of data transmission from the monitor to the CMS: ≤ 2 seconds.
- The delay for monitor-related settings configured at the CMS to be effective: ≤ 2 seconds.
- The total delay of data transmission from one monitor to the other: ≤ 2 seconds.
- The delay for the monitor to reset alarms of another to be effective: ≤ 2 seconds.

A.13.2.3 Wi-Fi Network Stability

The ratio of the communication data loss on the CMS from any monitor does not exceed 0.1% over a 24-hour period (12 of the 16 monitors connected to the network roam for 30 times).

Testing conditions are as follows:

- Number of the monitors supported by a single AP: ≤ 16 .
- Each monitor can communicate with the CMS.
- Two monitors are used to view other monitors.
- Only one monitor can transmit history data.
- The weakest strength of the AP signal where the monitor is located cannot be less than -65 dBm.

A.13.2.4 Line of Sight Distance

The line of sight distance between the monitor and the AP is no less than 50 meters.

A.14 WMTS Specifications (for N1 Supporting WMTS)

A.14.1 WMTS Technical Specifications

Specification	608M	1.4G
Modulation mode	GFSK	GFSK
Operating frequency	608MHz (608 - 614MHz)	1.4GHz (1395 - 1400 MHz, 1427 - 1432 MHz)
Channel spacing	600 kHz	800kHz or 600 kHz
Wireless baud rate	≤ 400 kbps	≤ 433 kbps for 800 kHz channel spacing ≤ 400 kbps for 600 kHz channel spacing
Output power	≤ 10 dBm	≤ 10 dBm
Receiver sensitivity	≤ -87 dBm	≤ -87 dBm
Data security	Authentication: based on TLS Encryption: AES-128 bit	Authentication: based on TLS Encryption: AES-128 bit
Radio Frequency Accuracy during normal operation	$\leq \pm 50$ KHz relative to channel frequency	$\leq \pm 50$ KHz relative to channel frequency
Occupied bandwidth as defined by power in 99% BW	$\leq \pm 300$ KHz	$\leq \pm 400$ KHz

A.14.2 Implemented Functions

N1 transmits waveforms, parameters, status and alarms of ECG, SPO2, RESP, CO2, IBP; and parameters, status and alarms of NIBP, TEMP, to the central monitoring system. The waveforms, parameters, status, and alarms displayed on central monitoring system are consistent with those on N1.

N1 can work well with APs which support POE, If the RSSI from APs is higher than -70 dBm.

A.14.3 Function Specifications

Data integrity	The probability of N1 failing to transmit data to the central monitoring system shall not exceed 0.1% over a 24-hour period.
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Data latency	Total delay of data transmitted from the N1 to the central monitoring system: ≤ 5 s
Transmission distance	Distinct vision distance from the N1 to the AP shall be no less than 50 m for LOS.
Roaming	The network switchover is automatically implemented when N1 moves from the coverage area of AP1 to the coverage area of AP2
System capacity	<p>Number of N1s supported by a single AP:</p> <p>Typical configuration (5-lead ECG+SpO2+TEMP+RESP+NIBP):</p> <ul style="list-style-type: none"> • 608 MHz: 14 for 5-lead ECG • 1.4GHz: 16 for 800 kHz channel spacing and 5-lead ECG; 14 for 600 kHz channel spacing and 5-lead ECG <p>Max. configuration (12-lead ECG+SpO2+TEMP+RESP+NIBP +CO2+ IBP):</p> <ul style="list-style-type: none"> • 608MHz: 8 for 600kHz channel spacing • 1.4GHz: 10 for 800kHz channel spacing; 8 for 600kHz channel spacing <p>Each N1 can communicate with the central monitoring system.</p>
Resistance to wireless interference ¹	<p>When the distance between the interfering devices and N1 is farther than 20cm, the co-channel interference WMTS network (should be no greater than -85 dBm) and an adjacent-channel WMTS network (adjacent-channel power should be no greater than -40 dBm@1.2 MHz) also exist, N1 does not encounter network interruption alarm event.</p> <p>Note: The interfering devices includes wireless equipment operated at 2.4GHz, cellular mobile communications network device, microwave oven, and cordless phone</p>
Dynamic networking stability	When N1 is moving at the rate of no more than 3.75 m/s within a 15m non-blocking linear distance, it does not encounter network interruption alarm event.
Network interruption alarm	<p>When the network interruption occurs, the central monitoring system initiates the related alarms in 10s.</p> <p>When the network is reconnected, wireless connection recovers automatically.</p>
Wireless networking stability	Each of the N1 roam 30 times, at least 3 N1s roam at the same time? the amount of time each N1 transporting data to central monitoring system is not available shall be less than 0.1% over a 24 hour period.

¹: In the application scenario, the most serious interference source is other WMTS telemetry products not from MINDRAY. To make sure the N1 works well, users should make sure the separation distance between the N1 and the unintended interference devices be greater than the separation distance below:

Working Frequency Band	Unintended Signal	Separation Distance Between N1 and Interfering Network	Separation Distance Between AP70 and Interfering Network
608MHz (608-614MHz)	Adjacent	4.5 m	4.5 m
	Co-channel	19 m	20 m
1.4G (1395-1400MHz)	Adjacent	4 m	5 m
	Co-channel	20 m	21.5 m
1.4G (1427-1432MHz)	Adjacent	4 m	5 m
	Co-channel	20 m	21.5 m

A.15 Measurement Specifications

The adjustable range of alarm limits is the same with the measurement range of signals unless otherwise specified.

A.15.1 ECG Specifications

ECG	
Standards	Meets the requirements of IEC 60601-2-27: 2011 and IEC 60601-2-25: 2011
Lead set	3-lead: I, II, III 5-lead: I, II, III, aVR, aVL, aVF, V 6-lead: I, II, III, aVR, aVL, aVF, Va, Vb 12-lead: I, II, III, aVR, aVL, aVF, V1 to V6
ECG standard	AHA, IEC
Display sensitivity	1.25 mm/mV (×0.125), 2.5 mm/mV (×0.25), 5 mm/mV (×0.5), 10 mm/mV (×1), 20 mm/mV (×2), 40 mm/mV (×4), Auto, less than 5% error
Sweep speed	6.25 mm/s, 12.5 mm/s, 25 mm/s, 50 mm/s, less than 5% error
Bandwidth (-3dB)	Diagnostic mode: 0.05 to 150 Hz Monitor mode: 0.5 to 40 Hz Surgery mode: 1 to 20 Hz ST mode: 0.05 to 40 Hz High frequency cut-off (for 12-lead ECG analysis): 350 Hz (0.05 to 350 Hz), 150 Hz (0.05 to 150 Hz), 35 Hz (0.05 to 35 Hz), 20 Hz (0.05 to 20 Hz) selectable
Common mode rejection ratio	Diagnostic mode, monitor mode, surgery mode, ST mode, High Freq Cut-off: >90 dB (with notch filter off) Monitor mode, surgery mode, ST mode: >105 dB (with notch filter on)
Notch filter	50/60 Hz Monitor, surgical, and ST mode: notch filter turns on automatically Diagnostic mode and High Freq Cut-off: notch filter is turned on/off manually
Differential input impedance	≥5 MΩ
Input signal range	±8 mV (peak-to-peak value)
Accuracy of signal reproduction	Use A and D methods based on IEC 60601-2-25: 2011 to determine frequency response.
Electrode offset potential tolerance	±500 mV
Lead-off detection current	Measuring electrode: <0.1 μA Drive electrode: <1 μA
Input offset current	≤0.1 μA, (drive lead ≤1 μA)
Defibrillation protection	Withstands 5000V (360 J) charge without data loss or corruption Baseline recovery time: <5 s Polarization recovery time: <10 s Defibrillation energy absorption: ≤10% (100 Ω load)
Patient leakage current	<10 uA
Calibration signal	1mV (peak-to-peak value) ±5%
ESU protection	Cut mode: 300 W Coagulate mode: 100 W Recovery time: ≤10 s In compliance with the requirements in clause 202.6.2.101 of IEC 60601-2-27: 2011
Pace Pulse	

Pace pulse markers	<p>Pace pulses meeting the following conditions are labelled with a PACE marker:</p> <p>Amplitude: ± 2 mV to ± 700 mV</p> <p>Width: 0.1 ms to 2 ms</p> <p>Rise time: 10 μs to 100 μs (< 10% of pulse width)</p> <p>No overshoot</p>
Pace pulse rejection	<p>When tested in accordance with the IEC 60601-2-27: 2011: 201.12.1.101.13, the heart rate meter rejects all pulses meeting the following conditions.</p> <p>Amplitude: ± 2 mV to ± 700 mV</p> <p>Width: 0.1 ms to 2 ms</p> <p>Rise time: 10 μs to 100 μs (< 10% of pulse width)</p> <p>No overshoot</p>

HR	
Measurement range	<p>Neonate: 15 to 350 bpm</p> <p>Pediatric: 15 to 350 bpm</p> <p>Adult: 15 to 300 bpm</p>
Resolution	1 bpm
Accuracy	± 1 bpm or $\pm 1\%$, whichever is greater.
Sensitivity	200 μ V (lead II)
Minimum QRS detection threshold	<p>Adult and pediatric: 0.16 – 0.48 mV</p> <p>Neonate: 0.12 – 0.40 mV</p>
HR averaging method	<p>In compliance with the requirements in Clause 201.7.9.2.9.101 b) 3) of IEC 60601-2-27: 2011, the following method is used:</p> <p>If the last 3 consecutive RR intervals are greater than 1200 ms, the 4 most recent RR intervals are averaged to compute the HR. Otherwise, heart rate is computed by subtracting the maximum and minimum ones from the most recent 12 RR intervals and then averaging the remaining 10 RR intervals.</p> <p>The HR value displayed on the monitor screen is updated no more than one second.</p>
Response to irregular rhythm	<p>In compliance with the requirements in Clause 201.7.9.2.9.101 b) 4) of IEC 60601-2-27: 2011, the heart rates for the specified test signals after 20 seconds of stabilization are:</p> <p>Ventricular bigeminy (waveform A1): 80 ± 1 bpm</p> <p>Slow alternating ventricular bigeminy (waveform A2): 60 ± 1 bpm</p> <p>Rapid alternating ventricular bigeminy (waveform A3): 120 ± 1 bpm</p> <p>Bidirectional systoles (waveform A4): 90 ± 2 bpm</p>
Response time to heart rate change	<p>Meets the requirements of IEC 60601-2-27: 2011: Clause 201.7.9.2.9.101 b) 5).</p> <p>From 80 to 120 bpm: less than 11 s</p> <p>From 80 to 40 bpm: less than 11 s</p>
Time to alarm for tachycardia	<p>Meets the requirements in Clause 201.7.9.2.9.101 b) 6) of IEC 60601-2-27: 2011.</p> <p>Waveform</p> <p>B1h-range: <11 s</p> <p>B1-range: <11 s</p> <p>B1d-range: <11 s</p> <p>B2h-range: <11 s</p> <p>B2-range: <11 s</p> <p>B2d-range: <11 s</p>
Tall T-wave rejection capability	<p>When the test is performed based on Clause 201.12.1.101.17 of IEC 60601-2-27: 2011, the heart rate calculation is not affected for QRS of 1 mV amplitude and 100 ms duration, T-wave duration of 180 ms and amplitude lower than 1.2 mV, and QT interval of 350 ms.</p>

Arrhythmia Analysis Classifications	Asystole, V-Fib/V-Tach, V-Tach, Vent Brady, Extreme Tachy, Extreme Brady, Vent Rhythm, PVCs/min, Pauses/min, Couplet, Bigeminy, Trigeminy, R on T, Run PVCs, PVC, Tachy, Brady, Missed Beats, Pacer Not Pacing, Pacer Not Capture, Multiform PVC, Nonsus V-Tach, Pause, Irr Rhythm, A-Fib, SVT, SVCs/min
ST Segment Analysis	
Measurement range	-2.0 mV to +2.0 mV RTI
Accuracy	-0.8 mV to +0.8 mV: ± 0.02 mV or $\pm 10\%$, whichever is greater Beyond this range: not specified
Resolution	0.01mV
QT/QTc Analysis	
Measurement range	QT: 200 to 800 ms QTc: 200 to 800 ms QT-HR: 15 bpm to 150 bpm for adult, 15 bpm to 180 bpm for pediatric and neonate
Accuracy	QT: ± 30 ms
Resolution	QT: 4 ms QTc: 1 ms
12-lead ECG Interpretation	
Sampling rate	1000 samples/s (waveform) 500 samples/s (ECG algorithm)
Amplitude quantisation	24 bits
PVCs/min	
Measurement range	Adult: 0 to 300 Pediatric, neonate: 0 to 350

Alarm limit	Range	Step
HR High	HR ≤ 40 bpm: (low limit + 2 bpm) to 40 bpm HR > 40 bpm: (low limit + 5 bpm) to 295 bpm (Adult/Pediatric) (low limit + 5 bpm) to 300 bpm (Neonate)	HR ≤ 40 bpm: 1 bpm HR > 40 bpm: 5 bpm
HR Low	HR ≤ 40 bpm: 16 bpm to (high limit - 2 bpm) (Adult/Pediatric) 15 bpm to (high limit - 2 bpm) (Neonate) HR > 40 bpm: 40 bpm to (high limit - 5 bpm)	
ST High	(low limit + 0.2 mV) to 2.0 mV (ST alarm mode: Absolute) 0 mV to 2.0 mV (ST alarm mode: Relative)	0.05 mV
ST Low	-2.0 mV to (high limit - 0.2 mV) (ST alarm mode: Absolute) -2.0 mV to 0 mV (ST alarm mode: Relative)	
QTc High	200 ms to 800 ms	10 ms
Δ QTc High	30 ms to 200 ms	

A.15.2 Resp Specifications

Technique	Trans-thoracic impedance
Lead	Options are lead I, II, and Auto.
Respiration excitation waveform	<300 μ A RMS, 62.8 kHz ($\pm 10\%$)
Minimum respiration impedance threshold	0.3 Ω

Baseline impedance range	200 to 2500 Ω (using an ECG cable with 1k Ω resistance)	
Bandwidth	0.2 to 2.5 Hz (-3 dB)	
Sweep speed	3mm/s, 6.25 mm/s, 12.5 mm/s, 25 mm/s or 50 mm/s, less than 10% error	
Respiration Rate		
Measurement range	Adult: 0 to 120 rpm Pediatric, neonate: 0 to 150 rpm	
Resolution	1 rpm	
Accuracy	7 to 150 rpm: ± 2 rpm or $\pm 2\%$, whichever is greater 0 to 6 rpm: not specified	
Apnea alarm delay	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s	
Alarm limit	Range (rpm)	Step (rpm)
RR High	Adult, pediatric: RR ≤ 20 (low limit + 2) to 20 RR > 20 (low limit + 5) to 100 Neonate: RR ≤ 20 (low limit + 2) to 20 RR > 20 (low limit + 5) to 150	RR ≤ 20 : 1 RR > 20 : 5
RR Low	RR ≤ 20 : 0 to (high limit - 2) RR > 20 : 20 to (high limit - 5)	

A.15.3 SpO₂ Specifications

Refer to *E SpO₂ Sensor Accuracy* for the clinical study results of SpO₂ sensor accuracy.

Alarm limit	Range (%)	Step (%)
SpO ₂ High	(low limit + 2) to 100	1
SpO ₂ Low	Masimo: (Desat+1) to (high limit - 2) Nellcor: (Desat+1) or 20 (whichever is greater) to (high limit - 2)	
SpO ₂ Desat Low	0 to (SpO ₂ low limit - 1)	

Masimo SpO₂ Module

Standards	Meets the requirements of ISO 80601-2-61: 2017
Measurement range	1 to 100%
Resolution	1%
Response time	≤ 20 s (normal perfusion, no disturbance, SpO ₂ value sudden change from 70% to 100%)
Accuracy*	70 to 100%: $\pm 2\%$ ABS (adult/pediatric, without motion) 70 to 100%: $\pm 3\%$ ABS (adult/pediatric, with motion) 70 to 100%: $\pm 3\%$ ABS (neonate) 1% to 69%: Not specified.

*The Masimo SET technology with Masimo sensors has been validated for no motion accuracy in human blood studies on healthy adult male and female volunteers with light to dark skin pigmentation in induced hypoxia studies in the range of 70-100% SpO₂ against a laboratory CO-Oximeter and ECG monitor. This variation equals ± 1 standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

The Masimo SET technology with Masimo sensors has been validated for motion accuracy in human blood studies on healthy adult male and female volunteers with light to dark skin pigmentation in induced hypoxia studies while performing rubbing and tapping motions, at 2 to 4 Hz at an amplitude of 1 to 2 cm and a non-repetitive motion between 1 to 5 Hz at an amplitude of 2 to 3 cm in induced hypoxia studies in the range of 70-100% SpO₂ against a laboratory CO-Oximeter and ECG monitor. This variation equals ± 1 standard deviation, which encompasses 68% of the population.

The Masimo SET technology has been validated for low perfusion accuracy in bench top testing against a Biotek Index 2™ simulator and Masimo's simulator with signal strengths of greater than 0.02% and transmission of greater than 5% for saturations ranging from 70 to 100%. This variation equals ± 1 standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

The Masimo SET Technology with Masimo Neo sensors has been validated for neonatal motion accuracy in human blood studies on healthy adult male and female volunteers with light to dark skin pigmentation in induced hypoxia studies while performing rubbing and tapping motions, at 2 to 4 Hz at an amplitude of 1 to 2 cm and a non-repetitive motion between 1 to 5 Hz at an amplitude of 2 to 3 cm in induced hypoxia studies in the range of 70-100% SpO₂ against a laboratory CO-Oximeter and ECG monitor. This variation equals ± 1 standard deviation. Plus or minus one standard deviation encompasses 68% of the population. 1% has been added to the results to account for the effects of fetal hemoglobin present in neonates.

Refresh rate	≤ 1 s
SpO ₂ averaging time	2-4 s, 4-6 s, 8 s, 10 s, 12 s, 14 s, 16 s
Low perfusion conditions	Pulse amplitude: $>0.02\%$ Light penetration: $>5\%$
Low perfusion SpO ₂ accuracy ²	$\pm 2\%$
PI measurement range	0.02 to 20%

Nellcor SpO₂ Module

Standard	Meet the requirements of ISO 80601-2-61 2017
Measurement range	0 to 100%
Resolution	1%
Refresh rate	≤ 1 s
Response time	≤ 30 s (normal perfusion, no disturbance, SpO ₂ value sudden changes from 70% to 100%)
Accuracy*	70 to 100%: $\pm 2\%$ ABS (adult/pediatric) 70 to 100%: $\pm 3\%$ ABS (neonate) 0 to 69%: Not specified.
*When the SpO ₂ sensor is applied for neonatal patients as indicated, the specified accuracy range is increased by $\pm 1\%$, to compensate for the theoretical effect on oximeter measurements of fetal hemoglobin in neonatal blood.	

A.15.4 PR Specifications

Alarm limit	Range (bpm)	Step (bpm)
PR High	PR ≤ 40 : (low limit + 2) to 40 PR > 40 : (low limit + 5) to 295 (Adult/Pediatric), (low limit + 5) to 300 (Neonate)	PR ≤ 40 : 1 PR > 40 : 5
PR Low	PR ≤ 40 : 16 to (high limit - 2) (Adult/Pediatric), 15 to (high limit - 2) (Neonate) PR > 40 : 40 to (high limit - 5)	

PR from Masimo SpO₂

Measurement range	25 to 240 bpm
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Resolution	1 bpm
Response time	≤20 s (with normal perfusion, no disturbance, and a PR value transition from 25 to 220 bpm)
Accuracy*	±3 bpm (without motion) ±5 bpm (with motion)
*The Masimo SET technology with Masimo sensors has been validated for pulse rate accuracy for the range of 25 -240 bpm in bench top testing against a Biotek Index 2™ simulator. This variation equals ±1 standard deviation. Plus or minus one standard deviation encompasses 68% of the population.	
Refresh rate	≤1 s

PR from Nellcor SpO₂

Measurement range	20 to 300 bpm
Resolution	1 bpm
Response time	≤30 s (with normal perfusion, no disturbance, and a PR value transition from 25 to 250 bpm)
Accuracy	20 to 250 bpm: ±3 bpm 251 to 300 bpm: not specified
Refresh rate	≤1 s

PR from NIBP

Measurement range	30 to 300 bpm
Resolution	1 bpm
Accuracy	±3 bpm or ±3%, whichever is greater

PR from IBP

Measurement range	25 to 350 bpm
Resolution	1 bpm
Accuracy	±1 bpm or ±1%, whichever is greater

A.15.5 Temp Specifications

Standard	Meets the requirements of ISO 80601-2-56: 2018	
Technique	Thermal resistance	
Operating mode	Direct mode	
Measurement range	0 to 50 °C (32 to 122 °F)	
Resolution	0.1 °C	
Accuracy	±0.1 °C or ±0.2 °F (excluding probe error)	
Minimum time for accurate measurement	Body surface: <100 s Body cavity: <80 s	
Alarm limit	Range	Step

Txx High (xx refers to temperature site)	(low limit +1.0) to 50.0 °C (low limit +2.0) to 122.0 °F	0.1 °C 0.1 °F
Txx Low (xx refers to temperature site)	0.1 to (high limit - 1.0) °C 32.2 to (high limit - 2.0) °F	
ΔT High	0.1 to 50.0 °C 0.2 to 90.0 °F	

A.15.6 NIBP Specifications

Standard	Meets the requirements of IEC 80601-2-30: 2018			
Technique	Oscillometry			
Mode of operation	Manual, Auto, STAT, Sequence			
Auto mode repetition intervals	1, 2, 2.5, 3, 5, 10, 15, 20, 30, 60, 90, 120, 180, 240 or 480 min			
STAT mode cycle time	5 min			
Max measurement time	Adult, pediatric: 180 s Neonate: 90 s			
Heart rate range	30 to 300 bpm			
Measurement ranges (mmHg)		Adult	Pediatric	Neonate
	Systolic:	25 to 290	25 to 240	25 to 140
	Diastolic:	10 to 250	10 to 200	10 to 115
	Mean:	15 to 260	15 to 215	15 to 125
Accuracy	Max mean error: ±5 mmHg Max standard deviation: 8 mmHg			
Resolution	1 mmHg			
Initial cuff inflation pressure range (mmHg)	Adult: 80 to 280 Pediatric: 80 to 210 Neonate: 60 to 140			
Default initial cuff inflation pressure (mmHg)	Adult: 160 Pediatric: 140 Neonate: 90			
Re-inflation increment (mmHg)	Adult/Pediatric: 40 Neonate: 15			
Software overpressure protection	Adult: 297±3 mmHg Pediatric: 297±3 mmHg Neonate: 147±3 mmHg			
Static pressure measurement range	0 mmHg to 300 mmHg			
Static pressure measurement accuracy	±3 mmHg			
Alarm limit	Range (mmHg)		Step (mmHg)	

NIBP-S High	Adult: (low limit + 5) to 285 Pediatric: (low limit + 5) to 235 Neonate: (low limit + 5) to 135	NIBP ≤ 50: 1 NIBP > 50: 5
NIBP-S Low	26 to (high limit - 5)	
NIBP-M High	Adult: (low limit + 5) to 255 Pediatric: (low limit + 5) to 210 Neonate: (low limit + 5) to 120	
NIBP-M Low	16 to (high limit - 5)	
NIBP-D High	Adult: (low limit + 5) to 245 Pediatric: (low limit + 5) to 195 Neonate: (low limit + 5) to 110	
NIBP-D Low	11 to (high limit - 5)	
NIBP-S Extreme High	NIBP-S high limit < 50 Adult: (NIBP-S high limit + 1) to 290 Pediatric: (NIBP-S high limit + 1) to 240 Neonate: (NIBP-S high limit + 1) to 140 NIBP-S high limit ≥ 50 Adult: (NIBP-S high limit + 5) to 290 Pediatric: (NIBP-S high limit + 5) to 240 Neonate: (NIBP-S high limit + 5) to 140	NIBP ≤ 50: 1 NIBP > 50: 5
NIBP-S Extreme Low	NIBP-S low limit ≤ 50 25 to (NIBP-S low limit - 1) NIBP-S low limit > 50 25 to (NIBP-S low limit - 5)	
NIBP-M Extreme High	NIBP-M high limit < 50 Adult: (NIBP-M high limit + 1) to 260 Pediatric: (NIBP-M high limit + 1) to 215 Neonate: (NIBP-M high limit + 1) to 125 NIBP-M high limit ≥ 50 Adult: (NIBP-M high limit + 5) to 260 Pediatric: (NIBP-M high limit + 5) to 215 Neonate: (NIBP-M high limit + 5) to 125	NIBP ≤ 50: 1 NIBP > 50: 5
NIBP-M Extreme Low	NIBP-M low limit ≤ 50 15 to (NIBP-M low limit - 1) NIBP-M low limit > 50 15 to (NIBP-M low limit - 5)	
NIBP-D Extreme High	NIBP-D high limit < 50 Adult: (NIBP-D high limit + 1) to 250 Pediatric: (NIBP-D high limit + 1) to 200 Neonate: (NIBP-D high limit + 1) to 115 NIBP-D high limit ≥ 50 Adult: (NIBP-D high limit + 5) to 250 Pediatric: (NIBP-D high limit + 5) to 200 Neonate: (NIBP-D high limit + 5) to 115	NIBP ≤ 50: 1 NIBP > 50: 5
NIBP-D Extreme Low	NIBP-D low limit ≤ 50 10 to (NIBP-D low limit - 1) NIBP-D low limit > 50 10 to (NIBP-D low limit - 5)	

*Measurement accuracy verification: In adult and pediatric modes, the blood pressure measurements measured with this device are in compliance with the Standard for Non-invasive sphygmomanometers (ISO 81060-2: 2013) in terms of mean error and standard deviation by comparing with intra-arterial or auscultatory measurements (depending on the configuration) in a typical patient population. For auscultatory reference, the 5th Korotkoff sound was used to determine the diastolic pressure.

In neonatal mode, the blood pressure measurements measured with this device are in compliance with the American National Standard for Non-invasive sphygmomanometers (ISO 81060-2) in terms of mean error and standard deviation by comparing with intra-arterial measurements (depending on the configuration) in a typical patient population.

A.15.7 IBP Specifications

Standard	Meets the requirements of IEC 60601-2-34: 2011	
Technique	Direct invasive measurement	
IBP		
Measurement range	-50 to 300 mmHg	
Resolution	1 mmHg	
Accuracy	±2% or ±1 mmHg, whichever is greater (excluding sensor error)	
PPV		
Measurement range	0% ~ 50%	
Pressure transducer		
Excitement voltage	5 VDC, ±2%	
Sensitivity	5 μV/V/mmHg	
Zero adjustment range	±200 mmHg	
Impedance range	300 to 3000Ω	
Volume displacement	<0.04 mm ³ /100 mmHg	
Alarm limit	Range (mmHg)	Step (mmHg)
Sys High	IBP ≤ 50: (low limit + 2) to 50 IBP > 50: (low limit + 5) to 295	IBP ≤ 50: 1 IBP > 50: 5
Mean High		
Dia High		
Sys Low	IBP ≤ 50: -49 to (high limit - 2) IBP > 50: 50 to (high limit - 5)	
Mean Low		
Dia Low		
Art-S Extreme High	High limit < 50: (High limit+ 1) to 300 High limit ≥ 50: (High limit+ 5) to 300	IBP ≤ 50: 1 IBP > 50: 5
Art-M Extreme High		
Art-D Extreme High		
Art-S Extreme Low	low limit ≤ 50: -50 to (low limit- 1) low limit > 50: -50 to (low limit- 5)	
Art-M Extreme Low		
Art-D Extreme Low		

A.15.8 CO₂ Specifications

Standard	Meet the standard of ISO 80601-2-56: 2018
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Test method described in ISO 80601-2-55 201.12.1.102 is used to determine the rated respiration rate range and the corresponding effects of end-tidal gas reading accuracy as a function of respiratory rate.

End-tidal CO₂ reading is calculated as per the maximum measurement value of expiratory phase.

Measurement mode	Sidestream, Microstream™	
Technique	Infrared absorption	
Apnea delay	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s	
Alarm limit	Range	Step
EtCO ₂ High	(low limit + 2) to 99 mmHg	1 mmHg
EtCO ₂ Low	1 to (high limit - 2) mmHg	
FiCO ₂ High	1 to 99 mmHg	

Sidestream CO₂ Module

Standard	Meets the requirements of ISO 80601-2-55: 2018
CO ₂ Measurement range	0 to 150 mmHg
CO ₂ absolute accuracy*	Full accuracy mode: 0 - 40 mmHg: ±2mmHg 41 - 76 mmHg: ±5% of reading 77 - 99 mmHg: ±10% of reading 100 - 150 mmHg: ±(3mmHg + 8% of reading) ISO accuracy mode: Add ±2mmHg to the full accuracy mode
Accuracy specifications are affected by the breath rate and I:E. The EtCO ₂ accuracy is within specification for breath rate ≤ 60 rpm and I/E ratio ≤ 1:1, or breath rate ≤ 30 rpm and I/E ratio ≤ 2:1.	
CO ₂ resolution	1 mmHg
Accuracy drift	Meets the requirements for measurement accuracy within 6 hours
Sample flowrate	Using internal CO ₂ module: 50 ml/min Using the external CO ₂ module Adult, pediatric: 120 ml/min Neonatal: 70 ml/min, 90 ml/min
Sample flowrate tolerance	±15% or ±15 ml/min, whichever is greater.
Start-up time	Maximum: 90 s
Rise time	For CO ₂ measurements (using external CO ₂ module): Measured with a DRYLINE II neonatal watertrap and a 2.5-meter neonatal sampling line: ≤250 ms@70 ml/min. Measured with a DRYLINE II neonatal watertrap and a 2.5-meter neonatal sampling line: ≤250 ms@90 ml/min. Measured with a DRYLINE II adult watertrap and a 2.5-meter adult sampling line: ≤300 ms@120 ml/min For CO ₂ measurements (using internal CO ₂ module): Measured with a standard Oridion sampling line: ≤250 ms@50 ml/min Measured with a prolonged Oridion sampling line: ≤280 ms@50 ml/min

Response time	For CO ₂ measurements (using external CO ₂ module): Measured with a DRYLINE II neonatal watertrap and a 2.5-meter neonatal sampling line: ≤5.0 s @ 70 ml/min Measured with a DRYLINE II neonatal watertrap and a 2.5-meter neonatal sampling line: ≤4.5 s @ 90 ml/min Measured with a DRYLINE II adult watertrap and a 2.5-meter adult sampling line: ≤5.0 s @ 120 ml/min For CO ₂ measurements (using internal CO ₂ module): Measured with a standard Oridion sampling line: ≤5.0 s@50 ml/min Measured with a prolonged Oridion sampling line: <6.5 s@50 ml/min	
awRR measurement range	0 to 150 rpm	
awRR measurement precision	≤ 60 rpm: ±1 rpm 61 to 150 rpm: ±2 rpm	
awRR resolution	1 rpm	
Data sample rate	100 Hz	
Effect of interference gases on CO ₂ measurements		
Gas	Concentration (%)	Quantitative effect*
N ₂ O	≤60	±1 mmHg
Hal	≤4	
Sev	≤5	
Iso	≤5	
Enf	≤5	
Des	≤15	±2 mmHg
*: means an extra error should be added in case of gas interference when CO ₂ measurements are performed between 0 to 40 mmHg.		

Microstream™ CO₂ Module

Standard	Meets the requirements of ISO 80601-2-55: 2018	
CO ₂ Measurement range	0 to 99 mmHg	
Accuracy*	0 to 38 mmHg:	±2 mmHg
	39 to 99 mmHg:	± [5% × reading + 8% × (reading - 39 mmHg)]
Accuracy drift	Meets the requirements for measurement accuracy within 6 hours	
* Accuracy applies for respiration rate up to 80 rpm. For respiration rate above 80 rpm and EtCO ₂ exceeding 18 mmHg, the accuracy is 4 mmHg or ±12% of the reading, whichever is greater. For respiration rate above 60 rpm, the above accuracy can be achieved by using the FilterLine H Set for Infant/Neonatal. In the presence of interfering gases, the above accuracy is maintained to within 4%.		
Resolution	1 mmHg	
Sample flow rate	50 (- 7.5/+15) ml/min	
Initialization time	Maximum 180 s	
Response time	4.3 s (with any 2-meter FilterLine) 5.5 s (with any 4-meter FilterLine)	

Rise time	190 msec (with any 2-meter FilterLine) 210 msec (with any 4-meter FilterLine)
awRR measurement range	0 to 150 rpm
awRR measurement accuracy	0 to 70 rpm: ± 1 rpm 71 to 120 rpm: ± 2 rpm 121 to 150 rpm: ± 3 rpm
awRR resolution	1 rpm
Data sample rate	40 Hz

A.16 Software Specifications

Mindray's software	The BeneVision N1 patient monitor system software
OTS software	OS: Linux 3.2.0

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B EMC and Radio Regulatory Compliance

B.1 EMC

The device meets the requirements of IEC 60601-1-2: 2014.

WARNING

- **Use of accessories, transducers and cables other than those specified or provided by the manufacturer of this equipment could result in increased electromagnetic emissions or decreased electromagnetic immunity of this equipment and result in improper operation.**
- **The non-ME EQUIPMENT (e.g. information technology equipment (ITE)) that is a part of an ME SYSTEM may be disrupted by the electromagnetic interference of nearby equipment. It may be necessary to take mitigation measures, such as re-orienting or relocating the non-ME EQUIPMENT or shielding the location.**
- **Use of this equipment adjacent to, or stacked with, other equipment should be avoided because it could result in improper operation. If such use is necessary, this equipment and the other equipment should be observed to verify that they are operating normally.**
- **This equipment is intended for use in professional healthcare facility EMC environment and home healthcare EMC environment. If it is used in a special environment, such as a magnetic resonance imaging environment, the equipment/system may be disrupted by the operation of nearby equipment.**
- **Portable RF communications equipment (including peripherals such as antenna cables and external antennas) should be used no closer than 30 cm (12 inches) to any part of the this device, including cables specified by the manufacturer. Otherwise, degradation of the performance of this equipment could result.**

Guidance and Declaration - Electromagnetic Emissions		
The device is intended for use in the electromagnetic environment specified below. The customer or the user of the device should assure that it is used in such an environment.		
Emission tests	Compliance	Electromagnetic environment - guidance
Conducted and radiated RF EMISSIONS CISPR 11	Group 1	The device uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
Conducted and radiated RF EMISSIONS CISPR 11	Class B	The device is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Conducted and radiated RF EMISSIONS CISPR 11	Class A (Used with Dock)	The device 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.
Harmonic distortion IEC 61000-3-2: 2014	Class A	The device is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Voltage fluctuations and flicker IEC 61000-3-3: 2013	Complies	

If the system is operated within the electromagnetic environment listed in Table Guidance and Declaration – Electromagnetic Immunity, the system will remain safe and provide the following essential performance:

- Operating mode

- Accuracy
- Function
- Accessories identification
- Data stored
- Alarm
- Wireless (for N1 Supporting WMTS)
- Detect for connection

NOTE

- If the essential performance is lost or degraded, it may be necessary to take mitigation measures, such as re-orienting or relocating the ME EQUIPMENT or ME SYSTEM or shielding the location. During this time, the user should stop using the monitor and contact the service personnel.
- The device needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided below.
- Other devices may interfere with this device even though they meet the requirements of CISPR.
- When an input signal is below the minimum amplitude provided in technical specifications, erroneous measurements could result.
- The EMISSIONS characteristics of this device make it suitable for use in industrial areas and hospitals (CISPR 11 class A). If it is used in a residential environment (for which CISPR 11 class B is normally required) this device might not offer adequate protection to radio-frequency communication services. The user might need to take mitigation measures, such as relocating or re-orienting the device.


Guidance and Declaration - Electromagnetic Immunity			
The device is intended for use in the electromagnetic environment specified below. The customer or the user of the device should assure that it is used in such an environment.			
Immunity test	IEC60601test level	Compliance level	Electromagnetic environment - guidance
Electrostatic discharge (ESD) IEC 61000-4-2: 2008	±8 kV contact ±15 kV air	±8 kV contact ±15 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4: 2012	±2 kV for power supply lines ±1 kV for input/output lines (length greater than 3 m)	±2 kV for power supply lines ±1 kV for input/output lines (length greater than 3 m)	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5: 2014	±1 kV line(s) to line(s) ±2 kV line(s) to earth	±1 kV line(s) to line(s) ±2 kV line(s) to earth	
Voltage dips and voltage interruptions IEC 61000-4-11: 2004	0 % U_T for 0.5 cycle: at 0°, 45°, 90°, 135°, 180°, 225°, 270° and 315° 0 % U_T for 1 cycle and 70 % U_T for 25/30 cycles: at 0° 0 % U_T for 250/300 cycle	0 % U_T for 0.5 cycle: at 0°, 45°, 90°, 135°, 180°, 225°, 270° and 315° 0 % U_T for 1 cycle and 70 % U_T for 25/30 cycles: at 0° 0 % U_T for 250/300 cycle	Mains power quality should be that of a typical commercial or hospital environment. If the user of our product requires continued operation during power mains interruptions, it is recommended that our product be powered from an uninterruptible power supply or a battery.
RATED power frequency magnetic fields IEC 61000-4-8: 2009	30 A/m 50 Hz/60 Hz	30 A/m 50 Hz/60 Hz	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.

Guidance and Declaration - Electromagnetic Immunity

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

Guidance and Declaration - Electromagnetic Immunity

The device is intended for use in the specified electromagnetic environment. The customer or the user of the device should assure that it is used in such an environment as described below.

Immunity test	IEC60601 test level	Compliance level	Electromagnetic environment - guidance
Conducted disturbances induced by RF fields IEC61000-4-6: 2013	3 Vrms 150 kHz to 80 MHz	3Vrms	Portable and mobile RF communications equipment should be used no closer to any part of the system, including cables, than the recommended separation distance calculated from the equation appropriate for the frequency of the transmitter. Recommended separation distances: $d = 1.2\sqrt{P}$
	6 Vrms in ISM bands and amateur radio bands ^a between 0.15 MHz and 80 MHz	6 Vrms	
Radiated RF EM fields IEC61000-4-3	10 V/m 80 MHz to 2.7 GHz	10 V/m	Recommended separation distances: 80 MHz to 800 MHz: $d = 1.2\sqrt{P}$ 800MHz - 2.7GHz: $d = 2.3\sqrt{P}$ Where, P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m) ^b . Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey ^a should be less than the compliance level in each frequency range ^b . Interference may occur in the vicinity of equipment marked with the following symbol: 
	20V/m 80 MHz to 2.5 GHz (IEC80601-2-30: 2018, ISO 80601-2-55: 2018, ISO 80601-2-56: 2017, ISO 80601-2-61: 2017)	20V/m	
Proximity fields from RF wireless communications equipment IEC61000-4-3: 2006+A1:2007+A2:2010	27 V/m 380 - 390 MHz	27 V/m	/
	28 V/m 430 - 470 MHz, 800 - 960 MHz 1700 - 1900 MHz, 2400 - 2570 MHz	28 V/m	
	9 V/m 704 - 787 MHz, 5100 - 5800 MHz	9 V/m	

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

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

^a The ISM (industrial, scientific, and medical) bands between 150 kHz and 80 MHz are 6.765 MHz to 6.795 MHz; 13.553 MHz to 13.567 MHz; 26.957 MHz to 27.283 MHz; and 40.66 MHz to 40.70 MHz. The amateur radio bands between 0,15 MHz and 80 MHz are 1,8 MHz to 2,0 MHz, 3,5 MHz to 4,0 MHz, 5,3 MHz to 5,4 MHz, 7 MHz to 7,3 MHz, 10,1 MHz to 10,15 MHz, 14 MHz to 14,2 MHz, 18,07 MHz to 18,17 MHz, 21,0 MHz to 21,4 MHz, 24,89 MHz to 24,99 MHz, 28,0 MHz to 29,7 MHz and 50,0 MHz to 54,0 MHz.

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

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

WARNING

- The device is configured with a wireless network connector to receive wireless signal. Other devices may interfere with this device even though they meet the requirements of CISPR.
-

Recommended separation distances between portable and mobile RF communications equipment and the device			
The device is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the device can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the device as recommended below, according to the maximum output power of the communications equipment.			
Rated maximum output power of transmitter (W)	Separation distance in meters (m) according to frequency of the transmitter		
	150 kHz to 80 MHz $d = 1.2\sqrt{P}$	80 MHz to 800 MHz $d = 1.2\sqrt{P}$	800 MHz to 2.7 GHz $d = 2.3\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.20	1.20	2.30
10	3.80	3.80	7.30
100	12.00	12.00	23.00
For transmitters rated at a maximum output power not listed above, the recommended separation distance d in metres (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in Watts (W) according to the transmitter manufacturer. Note 1: At 80 MHz and 800 MHz, the higher frequency range applies. Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			

B.2 Radio Regulatory Compliance

This device complies with Part 15 of the FCC Rules and RSS-210 of Industry Canada. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Any changes or modifications to this equipment not expressly approved by Mindray may cause harmful radio frequency interference and void your authority to operate this equipment.

The maximum antenna gain permitted complies with the e.i.r.p. limits as stated in RSS-210.

The maximum antenna gain permitted complies with the e.i.r.p. limits specified for point-to-point operation, as stated in RSS-210.

WARNING

- Changes or modifications not expressly approved by the party responsible compliance could void the user's authority to operate the equipment.
-

B.3 RF parameters (for N1 Supporting WMTS)

Operating Frequency	608 - 6144MHz 1395 - 1400MHz 1427 - 1432MHz
Modulation Mode	GFSK
Output Power	<10dBm (Peak Power)

Operation of this equipment requires the prior coordination with a frequency coordinator designated by the FCC for the Wireless Medical Telemetry Service. This equipment here refers to BeneVision N1.

The device including Wireless module complies with part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

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C

Default Settings

C.1 ECG, Arrhythmia, ST and QT Default Settings

C.1.1 ECG Default Settings

Item		Default Setting
HR	Alarm switch	On
	High limit	Adult: 120 bpm Pediatric: 160 bpm Neonate: 200 bpm
	Low limit	Adult: 50 bpm Pediatric: 75 bpm Neonate: 100 bpm
	Priority	Med
	Alarm Outputs	Off
	Alarm Source	Auto
ECG1		II
ECG2 (5-lead, 6-lead, 12-lead)		V (for 5-lead).Va (for 6-lead), V1 (for 12-lead)
Va (for 6-lead only)		Va
Vb(for 6-lead only)		Vb
ECG Gain		×1
Speed		25 mm/sec
Filter		OR: Surgery CCU: Diagnostic Other departments: Monitor
Notch Filter		On
Lead Set		Auto
Smart Lead		On
QRS Volume		General and OR: 2 Other departments: 0
Baseline Drift Removal (for 12-lead only)		On
Waveform Layout (for 12-lead only)		Standard
QRS Threshold		0.16 mV
Paced		Adult: Unspecified Pediatric/neonate: No
Pacer Reject		Off

C.1.2 Arrhythmia Default Settings

C.1.2.1 Arrhythmia Alarm Default Settings

Item	Alarm Switch	Priority	Alarm Outputs
Asystole	On	High, unadjustable	Off
V-Fib/V-Tach	On	High, unadjustable	Off
V-Tach	On	High, unadjustable	Off
Vent Brady	On	High, unadjustable	Off
Extreme Tachy	On	High, unadjustable	Off
Extreme Brady	On	High, unadjustable	Off
R on T	CCU: On Other departments: Off	Med	Off
Run PVCs	Off	Low	Off
Couplet	Off	Prompt	Off
Multiform PVC	Off	Med	Off
PVC	Off	Prompt	Off
Bigeminy	CCU: On Other departments: Off	Med	Off
Trigeminy	CCU: On Other departments: Off	Med	Off
Tachy	Off	Med	Off
Brady	Off	Med	Off
Pacer Not Capture	Off	Prompt	Off
Pacer Not Pacing	Off	Prompt	Off
Missed Beat	Off	Prompt	Off
Nonsus V-Tach	CCU: On Other departments: Off	Med	Off
Vent Rhythm	CCU: On Other departments: Off	Med	Off
Pause	Off	Low	Off
Irr Rhythm	Off	Prompt	Off
A-Fib	Off	Prompt	Off
PVCs/min	CCU: On Other departments: Off	Med	Off
Pauses/min	CCU: On Other departments: Off	Med	Off
SVT	CCU: On Other departments: Off	Med	Off
SVCs/min	Off	Med	Off

C.1.2.2 Arrhythmia Threshold Default Settings

Item	Adult	Pediatric	Neonate
Asystole Delay	5 sec	5 sec	3 sec
Tachy	120 bpm	160 bpm	200 bpm
Brady	50 bpm	75 bpm	100 bpm
Extreme Tachy	160 bpm	180 bpm	220 bpm
Extreme Brady	35 bpm	50 bpm	60 bpm
Multif PVCs Window	15 beats	15 beats	15 beats
PVCs/min	10	10	10
Pauses/min	8	8	8
Pause Threshold	2.0 sec	2.0 sec	2.0 sec
AF/Irr Rhy End Time	2 min	2 min	2 min
V-Tach Rate	130 bpm	130 bpm	160 bpm
V-Brady Rate	40 bpm	40 bpm	40 bpm
V-Tach PVCs	6	6	6
V-Brady PVCs	5	5	5
SVT SVCs	5	5	5
SVT HR	180 bpm	200 bpm	210 bpm
SVCs/min	10	10	10

C.1.3 ST Default Settings

Item		Default Setting
ST Alarm Mode		Absolute
ST Alarm Mode set to Absolute : ST-I, ST-II, ST-III, ST-aVR, ST-aVL, ST-aVF, ST-V1, ST-V2, ST-V3, ST-V4, ST-V5, ST-V6, ST-Va, ST-Vb	Alarm switch	Off
	High limit	0.2 mV
	Low limit	-0.2 mV
	Priority	Med
	Alarm Outputs	Off
ST Alarm Mode set to Relative : ST Single, ST Dual	Alarm switch	Off
	High limit	0.1 mV
	Low limit	-0.1 mV
	Priority	Med
	Alarm Outputs	Off
ST Analysis		Off
ST Segment		Auto
Show Marker		Off
ST Point		J+60
Auto Adjust		On
J		48

Item	Default Setting
ISO	-80

C.1.4 QT Default Settings

Item		Default Setting
QTc	Alarm switch	Off
	High limit	Adult: 500 Pediatric: 480 Neonate: 460
	Priority	Med
	Alarm Outputs	Off
ΔQTc	Alarm switch	Off
	High limit	60
	Priority	Med
	Alarm Outputs	Off
QT Analysis		Off
QT Lead		All

C.1.5 Glasgow 12-lead ECG Algorithm Default Settings

Item	Default Setting
High Freq Cut-off	35 Hz
Baseline Drift Removal	On
Tachy	100
Brady	50
Waveform Layout	Standard
Median Complex	Off
Measurements	On
Interpretation	On
Interpretation Summary	On

C.2 Respiration Default Settings

Item		Default Setting
RR	Alarm switch	On
	High limit	Adult: 30 Pediatric: 30 Neonate: 100
	Low limit	Adult: 8 Pediatric: 8 Neonate: 30
	Priority	Med
	Alarm Outputs	Off
Apnea	Alarm switch	On
	Priority	High, unadjustable
	Alarm Outputs	Off
Apnea Delay		20 sec
RR Source		Auto
Resp Lead		Adult: Auto Pediatric: Auto Neonate: II
Gain		×2
Speed		6.25 mm/s
Auto Threshold Detection		On

C.3 SpO₂ Default Settings

Item		Default Setting
SpO ₂	Alarm switch	On
	High limit	Adult: 100% Pediatric: 100% Neonate: 95%
	Low limit	Adult/pediatric: 90% Neonate: 85%
	Priority	Med
	Alarm Outputs	Off
SpO ₂ Desat	Alarm switch	On
	Low limit	80%
	Priority	High
	Alarm Outputs	Off
Satsecond (for Nellcor SpO ₂)		Off
NIBP Simul		Off
FastSAT (for Masimo SpO ₂)		Off
Display SIQ (for Masimo SpO ₂)		Off

Item		Default Setting
Display PI (for Masimo SpO ₂)		On
Speed		25 mm/s
SpO ₂ Position		None
PR	Alarm switch	On
	High limit	Adult: 120 Pediatric: 160 Neonate: 200
	Low limit	Adult: 50 Pediatric: 75 Neonate: 100
	Priority	Med
	Alarm Outputs	Off
	Alarm Source	Auto
	PR Source	Auto
	Display PR	On
	QRS Volume	General, OR: 2 Other departments: 0

C.4 Temperature Default Settings

Item		Default Setting
Txx (xx refers to temperature site)	Alarm switch	On
	High limit	38.0 °C
	Low limit	35.0 °C
	Priority	Med
	Alarm Outputs	Off
ΔT	Alarm switch	On
	High limit	2.0 °C
	Priority	Med
	Alarm Outputs	Off

C.5 NIBP Default Settings

Item		Default Setting
NIBP-S	Alarm switch	On
	High limit	Adult: 160 mmHg Pediatric: 120 mmHg Neonate: 90 mmHg
	Low limit	Adult: 90 mmHg Pediatric: 70 mmHg Neonate: 40 mmHg
	Priority	Med
	Alarm Outputs	Off
NIBP-D	Alarm switch	On
	High limit	Adult: 90 mmHg Pediatric: 70 mmHg Neonate: 60 mmHg
	Low limit	Adult: 50 mmHg Pediatric: 40 mmHg Neonate: 20 mmHg
	Priority	Med
	Alarm Outputs	Off
NIBP-M	Alarm switch	On
	High limit	Adult: 110 mmHg Pediatric: 90 mmHg Neonate: 70 mmHg
	Low limit	Adult: 60 mmHg Pediatric: 50 mmHg Neonate: 25 mmHg
	Priority	Med
	Alarm Outputs	Off
NIBP-S Extreme	Alarm switch	Off
	High limit	Adult: 175 mmHg Pediatric: 130 mmHg Neonate: 95 mmHg
	Low limit	Adult: 75 mmHg Pediatric: 60 mmHg Neonate: 35 mmHg
	Priority	High
	Alarm Outputs	Off

Item		Default Setting
NIBP-D Extreme	Alarm switch	Off
	High limit	Adult: 105 mmHg Pediatric: 80 mmHg Neonate: 65 mmHg
	Low limit	Adult: 35 mmHg Pediatric: 30 mmHg Neonate: 15 mmHg
	Priority	High
	Alarm Outputs	Off
NIBP-M Extreme	Alarm switch	Off
	High limit	Adult: 125 mmHg Pediatric: 100 mmHg Neonate: 75 mmHg
	Low limit	Adult: 45 mmHg Pediatric: 40 mmHg Neonate: 20 mmHg
	Priority	High
	Alarm Outputs	Off
Initial Pressure		Adult: 160 mmHg Pediatric: 140 mmHg Neonate: 90 mmHg
Interval		OR: 5 min Neonatology: 30 min Other departments: 15 min
Start Mode		Clock
NIBP End Tone		Off
Venipuncture Pressure		Auto
Display Format		Sys/Dia (Mean)
Display Alarm Limits		Off
Display PR		Off

C.6 IBP Default Settings

Item		Default Setting
IBP-S	Alarm switch	On
	High limit	<ul style="list-style-type: none"> ■ Art/Ao/UAP/BAP/FAP/LV/P1-P2 arterial pressure Adult: 160 mmHg Pediatric: 120 mmHg Neonate: 90 mmHg ■ PA Adult: 35 mmHg Pediatric and neonate: 60 mmHg
	Low limit	<ul style="list-style-type: none"> ■ Art/Ao/UAP/BAP/FAP/LV/P1-P2 arterial pressure Adult: 90 mmHg Pediatric: 70 mmHg Neonate: 55 mmHg ■ PA Adult: 10 mmHg Pediatric and neonate: 24 mmHg
	Priority	Med
	Alarm Outputs	Off
IBP-D	Alarm switch	On
	High limit	<ul style="list-style-type: none"> ■ Art/Ao/UAP/BAP/FAP/LV/P1-P2 arterial pressure Adult: 90 mmHg Pediatric: 70 mmHg Neonate: 60 mmHg ■ PA Adult: 16 mmHg Pediatric and neonate: 4 mmHg
	Low limit	<ul style="list-style-type: none"> ■ Art/Ao/UAP/BAP/FAP/LV/P1-P2 arterial pressure Adult: 50 mmHg Pediatric: 40 mmHg Neonate: 20 mmHg ■ PA Adult: 0 mmHg Pediatric and neonate: -4 mmHg
	Priority	Med
	Alarm Outputs	Off
IBP-M	Alarm switch	On
	High limit	<ul style="list-style-type: none"> ■ Art/pArt/Ao/UAP/BAP/FAP/LV/P1-P2 arterial pressure Adult: 110 mmHg Pediatric: 90 mmHg Neonate: 70 mmHg ■ PA Adult: 20 mmHg Pediatric and neonate: 26 mmHg ■ CVP Adult: 14 cmH₂O Pediatric and neonate: 5 cmH₂O ■ ICP/RAP/LAP/UVP/P3-P4 venous pressure Adult: 10 mmHg Pediatric and neonate: 4 mmHg

Item		Default Setting
	Low limit	<ul style="list-style-type: none"> ■ Art/Ao/UAP/BAP/FAP/LV/P1-P2 arterial pressure Adult: 70 mmHg Pediatric: 50 mmHg Neonate: 35 mmHg ■ PA Adult: 0 mmHg Pediatric and neonate: 12 mmHg ■ CVP Adult: 0 cmH₂O Pediatric and neonate: 0 cmH₂O ■ ICP/RAP/LAP/UV/P3-P4 venous pressure Adult: 0 mmHg Pediatric and neonate: 0 mmHg
	Priority	Med
	Alarm Outputs	Off
Art-S Extreme	Alarm switch	Off
	High limit	Adult: 175 mmHg Pediatric: 130 mmHg Neonate: 95 mmHg
	Low limit	Adult: 75 mmHg Pediatric: 60 mmHg Neonate: 50 mmHg
	Priority	High
	Alarm Outputs	Off
Art-D Extreme	Alarm switch	Off
	High limit	Adult: 105 mmHg Pediatric: 80 mmHg Neonate: 65 mmHg
	Low limit	Adult: 35mmHg Pediatric: 30 mmHg Neonate: 15 mmHg
	Priority	High
	Alarm Outputs	Off
Art-M Extreme	Alarm switch	Off
	High limit	Adult: 125 mmHg Pediatric: 100 mmHg Neonate: 75 mmHg
	Low limit	Adult: 55 mmHg Pediatric: 40 mmHg Neonate: 30 mmHg
	Priority	High
	Alarm Outputs	Off

Item		Default Setting
CPP	Alarm switch	On
	High limit	Adult: 130 mmHg Pediatric: 100 mmHg Neonate: 90 mmHg
	Low limit	Adult: 50 mmHg Pediatric: 40 mmHg Neonate: 30 mmHg
	Priority	Med
	Alarm Outputs	Off
Measure (for P1, P2)		All
Measure (for P3, P4)		Mean Only
Sensitivity		Med
Speed		25 mm/sec
Scale	ICP/RAP/LAP/UVF venous pressure	0- 20 mmHg
	Art/Ao/BAP/FAP/LV/P1/ P2 arterial pressure	0-160 mmHg
	UAP/P3/P4 venous pressure	0-80 mmHg
	CVP/PA	CVP: 0-30 cmH2O PA: 0 - 30 mmHg
Display Format		Sys/Dia (Mean)
Display Alarm Limits		Off
Use PA-D as PAWP (only available for independent external display)		Off
PPV Measure		Off
PPV Source		Auto
PAWP	Reference Waveform 1	II
	Reference Waveform 2	Resp
	Speed	12.5 mm/sec
	PA Scale	0-30 mmHg
Overlapping Waveform Setup	Left Scale	0-160 mmHg
	Right Scale	0-20 mmHg
	CVP Scale	0-30 cmH2O
	ICP Scale	0-20 mmHg
	PA Scale	0-30 mmHg
	Speed	25 mm/sec
	Gridlines	Off

C.7 CO₂ Default Settings

C.7.1 General Settings

Item		Default Setting
EtCO ₂	Alarm switch	On
	High limit	Adult and pediatric: 50 mmHg Neonate: 45 mmHg
	Low limit	25mmHg
	Priority	Med
	Alarm Outputs	Off
FiCO ₂	Alarm switch	On
	High limit	4 mmHg
	Priority	Med
	Alarm Outputs	Off
Apnea Delay		20 sec
RR Source		Auto
Speed		6.25 mm/s
Scale		50 mmHg
Waveform Type		Draw

C.7.2 Sidestream CO₂ Default Settings

Item	Default Setting
BTPS Compensation	Off
O ₂ Compensation (for CO ₂ module without O ₂ measurement)	OR: 100% Other departments: 21%
N ₂ O Compensation	0%
AG Compensation	0%
Auto Standby	60 min
Operating Mode	Measure

C.7.3 Microstream™ CO₂ Default Settings

Item	Default Setting
BTPS Compen	Off
Maximum Hold	20 sec
Auto Standby	Off
Operating Mode	Measure

C.8 Alarm Default Settings

Item	Default Setting
Alarm Volume	Neonatology: 7 CCU: 2 Other departments: 4
High Alarm Volume	Alarm Volume + 3
Reminder Volume	2
Printing Duration on Alarm	20 sec
V-Tach Latching	On

C.9 Alarm Delay Default Settings

Item	Default Setting
Alarm delay	6 sec
ST Alarm delay	30 sec
SpO2 Alarm delay	10 sec
SpO2 Desat Alarm delay	Off
Apnea Delay	20 sec

C.10 Display Default Settings

Item		Default Setting
Choose Screen		Normal Screen
Display	Screen Lock Duration (Only Available for the Independent External Display)	General: Permanent CCU: Permanent Other departments: 10 sec
	Brightness	Auto
	Key Volume	2
Night Mode	Brightness	Auto
	All Mute	Off
	Alarm Volume	2
	QRS Volume	0
	Key Volume	0
	Reminder Volume	1
	NIBP End Tone	Off
	Stop NIBP	Off
	Auto Night Mode	Off
	Night Time Period	22:00 - 6:00

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D Alarm Messages

This chapter lists only the physiological and technical alarm messages. Some messages appearing on your monitor may not be included. In the “Cause and solution” column, corresponding solutions are given instructing you to troubleshoot problems. If the problem persists, contact your service personnel.

D.1 Physiological Alarm Messages

D.1.1 General Physiological Alarm Messages

Alarm messages	Default priority	Cause and solution
XX High	Med	XX value has risen above the high alarm limit or fallen below the low alarm limit. Check the patient’s condition and check if the patient category and alarm limit settings are correct.
XX Low	Med	

Note: XX represents a measurement or parameter label, such as HR, NIBP, PVCs, RR, SpO₂, PR, etc.

D.1.2 Arrhythmia Alarm Messages

Alarm message	Default priority
Asystole	High
V-Fib/V-Tach	High
V-Tach	High
Vent Brady	High
Extreme Tachy	High
Extreme Brady	High
R on T	Med
Run PVCs	Low
Couplet	Prompt
Multiform PVC	Med
PVC	Prompt
Bigeminy	Med
Trigeminy	Med
Tachy	Med
Brady	Med
Pacer Not Pacing	Prompt
Pacer Not Capture	Prompt
Missed Beats	Prompt
Nonsus. Vtac	Med
Vent Rhythm	Med
Pause	Low

Alarm message	Default priority
Irr Rhythm	Prompt
PVCs/min High	Med
Pauses/min High	Med
A-Fib	Prompt
SVT	Med
SVCs/min High	Med

Note: When arrhythmia alarms occur, check the patient's condition and the ECG connections.

D.1.3 Resp Physiological Alarm Messages

Alarm message	Default priority	Cause and solution
Resp Artifact	High	The patient's heartbeat has interfered with the impedance respiration measurement. Check the patient's condition and the ECG connections.
Apnea	High	The respiration signal is so weak that the monitor cannot perform respiration analysis. Check the patient's condition, module and patient connections.

D.1.4 SpO₂ Physiological Alarm Messages

Alarm message	Default priority	Cause and solution
SpO ₂ Low (YY hrs YY min YYsec)	High	The SpO ₂ value falls below the alarm limit. Check the patient's condition and check if the alarm limit settings are correct.
SpO ₂ Desat (YY hrs YY min YYsec)	High	The SpO ₂ value falls below the desaturation alarm limit. Check the patient's condition and check if the alarm limit settings are correct.

Note: YY hrs YY min YY sec represents the period of time that the ECG Lead Off alarm lasts.

D.1.5 PR Physiological Alarm Messages

Alarm message	Default priority	Cause and solution
No Pulse	High	The pulse signal is so weak that the monitor cannot perform pulse analysis. Check the patient's condition and the source of the PR, such as IBP or SpO ₂ sensor, and measurement site.

D.1.6 NIBP Physiological Alarm Messages

Alarm message	Default priority	Cause and solution
NIBP-S Extremely High/NIBP-D Extremely High/NIBP-M Extremely High	High	The NIBP value is higher than the NIBP Extreme alarm high limit. Check the patient's condition and check if the alarm limit settings are correct.
NIBP-S Extremely High/NIBP-D Extremely High/NIBP-M Extremely Low	High	The NIBP value is lower than the NIBP Extreme alarm low limit. Check the patient's condition and check if the alarm limit settings are correct.

D.1.7 IBP Physiological Alarm Messages

Alarm message	Default priority	Cause and solution
Art-S/Art-D/Art-M Extremely High	High	The Art value is higher than the Art Extreme alarm high limit. Check the patient's condition and check if the alarm limit settings are correct.
Art-S/Art-D/Art-M Extremely Low	High	The Art value is lower than the Art Extreme alarm low limit. Check the patient's condition and check if the alarm limit settings are correct.

D.1.8 CO₂ Physiological Alarm Messages

Alarm message	Default priority	Cause and solution
FiO ₂ Shortage	High	FiO ₂ concentration is less than 18%. Check the patient's condition, the ventilated O ₂ content and the airway connection.

D.1.9 Combined Alarm Messages

Alarm message	Default priority	Cause and solution
HR>XX with IBP-S<XX and RR>XX over YY min	High	The combined alarm parameter values exceed their configured limits for longer than the configured time. Check the patient's condition.
qSOFA score ≥2 over YY min	Med	The patient's systolic pressure and heart rate exceeds the configured limits for longer than the configured time. Check the patient's condition.
ICP-M > XX over YY min	High	The ICP value exceeds the configured limit for longer than the configured time. Check the patient's condition.
CPP > XX over YY min	Med	The CPP value exceeds the configured limit for longer than the configured time. Check the patient's condition.
CPP < XX over YY min	Med	
EtCO ₂ ≤ XX over YY min	High	The indicated parameter value exceeds the configured limit for longer than the configured time. Check the patient's condition.
EtCO ₂ ≥ XX over YY min		
RR ≤ XX over YY min		
SpO ₂ ≤ XX over YY min		
IBP-S ↓ XX within YY min	Prompt	The change of indicated parameter value exceeds the configured limit for longer than the configured time. Check the patient's condition.
IBP-S ↑ XX within YY min		
HR ↓ XX within YY min		
HR ↑ XX within YY min		
PR ↓ XX within YY min		
PR ↑ XX within YY min		
A-Fib with RVR over YY min	High	The A-Fib alarm occurs with rapid ventricular response (heart rate exceeds configured HR limit) for longer than the configured time. Check the patient's condition.
A-Fib with Long R-R Interval	High	The A-Fib alarm occurs and R-R interval exceeds configured limit. Check the patient's condition.
R on T with QT Prolonged	Med	The patient's QTc exceeds the configured limit with R on T premature ventricular contraction. Check the patient's condition.


Freq. PVCs with QT Prolonged	Med	More than 5 PVCs are detected per minute and the patient's QTc exceeds the configured limit. Check the patient's condition.
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Note: XX refers to a parameter threshold and YY represents a time threshold. ↓ represents a decrease of parameter measurement. ↑ represents an increase of parameter measurement.

D.2 Technical Alarm Messages

This section lists technical alarms, their default priority, responses on alarm reset, and the actions that can be taken when an alarm occurs. Some of alarms may not be included.

Various technical alarms respond differently when the alarm system is reset. For easy clarification, in this section the technical alarms are classified into three categories of response when the alarm system is reset:

- A: technical alarms are cleared. The monitor gives no alarm indications.
- B: technical alarms are changed to the prompt messages.
- C: the alarm is silenced and a check mark  appears before the alarm message.

In the following tables A, B, and C are used to refer to the responses on alarm reset.

D.2.1 General Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
XX Module Error	High	C	XX module does not work properly. Reinsert the module, if the alarm persists, contact your service personnel.

Note: XX represents a measurement or parameter label, such as HR, RR, SpO2, or EtCO2, etc.

D.2.2 ECG Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
ECG Noisy	Low/Prompt	A	The ECG signal is noisy. Check for any possible sources of signal noise around the cable and electrode, and check the patient for excessive motion.
ECG Amplitude Too Small	Low	C	The ECG amplitude does not reach the detected threshold. Check for any possible source of interference around the cable and electrode.
ECG XX Lead Off	Low	B	The electrode has become detached from the patient or the lead wire has become disconnected from the adapter cable. Check the connections of the electrodes and leadwires.
ECG Lead Off (YY hrs YY min YYsec)	Low	B	The electrode has become detached from the patient or the lead wire has become disconnected from the adapter cable. Check the connections of the electrodes and leadwires.
ECG Signal Invalid	Low	A	Patient skin impedance is too high. Check ECG electrode application.
ECG Learning	Prompt	/	ECG learning is manually or automatically triggered.
Cannot Analyze QT	Prompt	/	/

Note: XX represents ECG lead name, for example LL, V, Va, Vb, etc.

Note: YY hrs YY min YY sec represents the period of time that the ECG Lead Off alarm lasts.

D.2.3 Resp Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Resp Interference	Prompt	/	The respiration circuit is disturbed. Check for any possible sources of signal noise.
Electrode Poor Contact	Prompt	/	Check the electrode application. Reposition or replace the electrodes if necessary.

D.2.4 SpO₂ Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
SpO ₂ Sensor Off Sensor Off	Low	B	The SpO ₂ sensor has become detached from the patient or the module. Check the sensor connection. If the alarm persists, replace the sensor.
SpO ₂ No Sensor No Sensor	Low	A	The SpO ₂ extension cable is detached from the SpO ₂ module, or the SpO ₂ sensor is detached from the SpO ₂ extension cable. Check the SpO ₂ cable and the sensor connection. If the alarm persists, replace the sensor.
SpO ₂ Excess Light	Low	C	Ambient light is too strong. Move the sensor to a place with lower level of ambient light or cover the sensor to minimize the ambient light.
SpO ₂ No Pulse	Low	C	The SpO ₂ sensor failed to obtain pulse signal. Check the patient's condition and replace the sensor application site. If the alarm persists, replace the sensor.
SpO ₂ Sensor Incompatible	Low	C	Incompatible or an unspecified SpO ₂ sensor is used. Use specified sensors.
SpO ₂ Low Signal Quality	Low	C	1. Check the sensor and sensor position. 2. Make sure the patient is not shivering or moving. 3. The patient's pulse may be too low to be measured.
SpO ₂ Interference	Low	C	The SpO ₂ signal has interference. Check for any possible sources of signal noise and check the patient for excessive motion.
SpO ₂ Sensor Error	Low	C	Replace the sensor and measure again.
SpO ₂ Searching Pulse	Prompt	/	SpO ₂ is searching for pulse.
SpO ₂ Low Perfusion	Prompt	/	The SpO ₂ sensor is not properly placed or the patient's perfusion index is too low. 1. Check the sensor and sensor position. 2. Reposition the sensor if necessary.

D.2.5 Temp Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
T1/T2 Sensor Off	Low	A	Check the sensor connection and reconnect the sensor.

D.2.6 NIBP Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
NIBP Loose Cuff	Low	A	There is a leak in the cuff or air tubing. Use a cuff of correct type based on the patient size. Apply the cuff and connect the air tubing as instructed in the manual.
NIBP Air Leak	Low	A	Check the NIBP cuff and pump for leakages.
NIBP Airway Error	Low	A	The air tubing may be occluded. Check the air tubing for an occlusion or kinking. If the alarm persists, contact your service personnel.
NIBP Weak Signal	Low	A	The patient's pulse is weak or the cuff is loose. Check the patient's condition and replace the cuff application site.
NIBP Overrange	Low	A	The measured NIBP value exceeds the module measurement range. Check the patient's condition.
NIBP Excessive Motion	Low	A	Check the patient's condition and reduce patient motion.
NIBP Cuff Overpress	Low	A	The NIBP airway may be occluded. Check the airway and measure again. If the alarm persists, contact your service personnel.
NIBP Timeout	Low	A	The measurement time exceeds 120 seconds in the adult or pediatric mode, or exceeds 90 seconds in the neonatal mode, and the BP value cannot be obtained. Check the patient's condition and NIBP connections, or replace the cuff and measure again.
NIBP Cuff and Patient Mismatch	Low	A	The cuff type mismatches the patient category. Verify the patient category or replace the cuff if necessary. If patient category is correct, check that the tubing is not bent and the airway is not occluded.
NIBP Airway Leak	Low	A	Airway leakage is found during the NIBP leakage test. Check the NIBP cuff and pump for leakages.

D.2.7 IBP Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
XX Sensor Error	Med	C	The IBP sensor fails. Replace the sensor.
XX No Sensor	Med	A	The IBP patient cable and/or corresponding IBP sensor is not connected or detached. Check the cable and sensor connection.

Alarm message	Default priority	Indication on alarm reset	Cause and solution
XX No Pulse	Low	A	The catheter may be occluded. Please flush the catheter.
XX Disconnected	High	C	The tubing is disconnected from the patient, or the three-way valve is open to the air. Check the connection of the tubing, or check the valve is open to the patient. If the alarm persists, contact your service personnel.
Host Monitor Version Low	Low	A	The N Series system software version is too low. In order for the N Series monitor to connect to the N1 which connects to the external IBP module and perform IBP monitoring, the system software of N 1 and N series monitor should be V01.11.00 and above.

Note: XX represents an IBP label, for example PA, CVP, FAP, P1, etc.

D.2.8 CO₂ Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
CO2 Module High Temp	Low	C	Ambient temperature is too high or there is a module failure. 1. Lower the operating temperature. 2. Reinsert the module. 3. If the alarm persists, the CO ₂ module may have failed, contact your service personnel.
CO2 Module Low Temp	Low	C	Ambient temperature is too low or there is a module failure. 1. Raise the operating temperature. 2. Reinsert the module. 3. If the alarm persists, the CO ₂ module may have failed, contact your service personnel.
CO2 Zero Failed	Low	C	Reinsert the module. If the alarm persists, contact your service personnel.
CO2 No Watertrap	Low	B	Check the watertrap connections.
CO2 No Adaptor	Low	B	Check the adaptor connections.
CO2 High Airway Press.	Low	C	1. Check the airway pressure settings of the ventilator/anesthesia machine. 2. Disconnect the module from the ventilator/anesthesia machine. 3. Reinsert the module. 4. If the alarm persists, contact your service personnel.
CO2 Low Airway Press.	Low	C	1. Check the airway pressure settings of the ventilator/anesthesia machine. 2. Disconnect the module from the ventilator/anesthesia machine. 3. Reinsert the module. 4. If the alarm persists, contact your service personnel.

Alarm message	Default priority	Indication on alarm reset	Cause and solution
High Barometric	Low	C	The ambient pressure exceeds the operating pressure range or CO ₂ module fails. 1. Make sure that the ambient pressure meets the specifications, and check for sources that affect the ambient pressure. 2. Reinsert the module. If the alarm persists, contact your service personnel.
Low Barometric	Low	C	The ambient pressure exceeds the operating pressure range or CO ₂ module fails. 1. Make sure that the ambient pressure meets the specifications, and check for sources that affect the ambient pressure. 2. Reinsert the module. If the alarm persists, contact your service personnel.
CO2 Airway Occluded	Low	C	1. Check if the sample line is kinked or occluded. 2. Replace the sample line. 3. Reinsert the module. 4. If the alarm persists, contact your service personnel.
CO2 No Filterline	Low	A	Make sure that the filterline is connected.
CO2 Calibration Required	Low	C	Perform a calibration.
CO2 Airway Error	Low	C	1. Check if the sample line is kinked or occluded. 2. Replace the sample line. 3. Reinsert the module. 4. If the alarm persists, contact your service personnel.
CO2 Adapter Error	Low	A	Check, clean or replace the airway adapter. Perform a zero calibration.
CO2 No Sensor	Low	A	Make sure that the CO ₂ transducer is connected.
CO2: Change Watertrap	Low	C	Replace the watertrap.
CO2 Watertrap Mismatch	Low	C	Check the patient category and use a correct watertrap.

D.2.9 Power Supply Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Low Battery	Med	C	Connect the monitor to an AC power source and allow the batteries to charge.
Critically Low Battery	High	C	Connect the monitor to an AC power source and allow the batteries to charge.
Battery aged, replace the battery.	Low	B	The battery has reached its lifetime. Contact your service personnel.
Power Board Comm Error	High	C	Shutdown and restart the monitor. If the alarm persists, contact your service personnel.
Battery Err	High	C	The battery may have failed. Contact your service personnel.
Battery Charging Error	High	C	The charging circuit fails or the battery fails. Contact your service personnel.

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Battery Temperature Too High	High	C	Stop using the monitor after this alarm appears, and contact your service personnel.
Battery Off	High	C	Shutdown and restart the monitor. If the alarm persists, contact your service personnel.
RT Clock Need Reset	High	C	Contact your service personnel.
RT Clock Not Exist	High	C	Contact your service personnel.
XX V Too High	High	C	There is a problem with the system power supply. Shutdown and restart the monitor.
XX V Too Low	High	C	

Note: XX represents 2.5, 3.3, 5, or 12.

D.2.10 Printer Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Printer Buffer Full	Prompt	/	The printer buffer is full. Wait until the printer finishes the printing task.
Printing Failed	Prompt	/	The printer ran out of paper or cannot be found on the network. Check the printer.
Printing Stopped	Prompt	/	Printing was manually stopped.
Printer Unavailable	Prompt	/	The printer may have failed. Check the printer.
PDF storage space is nearly full	Prompt	/	Delete the files saved under the PDF file path to release storage space. Otherwise you cannot save new PDF files.
Error storing PDF file	Prompt	/	The PDF file path settings on the print server and the PDF Creator are not consistent or the PDF storage space is full. Check the PDF file path settings for consistency, or delete the files saved under the PDF file path to release storage space.
Change the print server language to be consistent with this monitor	Prompt	/	Verify that the language settings of the print server and the monitor are consistent, Otherwise you cannot perform printing.
Print Server Disconnected	Prompt	/	Check that the monitor is properly connected with the print server.

D.2.11 Technical Alarm Messages Related to Networked Monitoring

Alarm message	Default priority	Indication on alarm reset	Cause and solution
CMS/eGW Disconnected	Low	B	The monitor is disconnected from the CMS. Check the network connection.
View Bed XX YY-ZZ, Network Disconnected.	Low	A	The network is interrupted when the monitor is viewing the remote device. Check the network connection.
Viewed by Bed XX YY-ZZ, Network Disconnected.	Low	A	The network is interrupted when the monitor is viewed by another remote device. Check the network connection.
WLAN IP Address Conflict	Low	C	There is a wireless network IP address conflicts. Check the network settings.

Alarm message	Default priority	Indication on alarm reset	Cause and solution
LAN1 IP Address Conflict	Low	C	There is a wired network IP address conflicts. Check the network settings.
Fail To Get WLAN IP Address	Low	C	Unable to automatically obtain the wireless network IP address. Check the network settings.
Fail To Get LAN1 IP Address	Low	C	Unable to automatically obtain the wired network IP address. Check the network settings.

Note: XX refers to the department name, YY refers to the room number, and ZZ refers to the bed number.

D.2.12 Other System Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Storage Error	High	C	The storage card failed or files are damaged. Shutdown and restart the monitor. If the alarm persists, contact your service personnel.
Loading Default Config Failed	Low	A	The default configuration was not correctly loaded. The monitor will restore to the factory default configuration for the current patient category.
Read dock E2PROM error!	High	C	<ol style="list-style-type: none"> Check if you're using the specified external display. <ul style="list-style-type: none"> If you're using the specified external display, remove the N1 from the Dock, and reconnect the N1 and the Dock. If you're not using the specified external display, replace current external display with the specified external display. Then remove the N1 from the Dock, and reconnect the N1 and the Dock. If the alarm persists, contact your service personnel.
XX Conflicts (XX refers to the module label)	Prompt	/	The same type of corresponding module being used exceeds the supported number. Remove the conflict module.
XX Measurement has been closed (XX refers to the module label)	Prompt	/	The parameter module is disabled. Switch on the module if you want to use it. For more information, see <i>3.9.1 Switching On or Off a Parameter</i> .
The display setup for XX is disabled. (XX refers to the parameter label)	Prompt	/	The parameter of the newly inserted module is not displayed on the screen. Select a desired area to display the parameter numerics and waveforms. For more information, see <i>3.9.2 Displaying Parameter Numerics and Waveforms</i> .
The patient data storage space is nearly full. Please delete some discharged patients.	Med	B	The storage space of the monitor is full. Delete unnecessary discharged patients.
Patient ID conflicts with XX (XX represents Department-Room number-Bed number)	Med	B	Patient ID of the current patient conflicts with that on another device. Discharge the patient from unused device.

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Visit number conflicts with XX (XX represents Department-Room number-Bed number)	Med	B	Visit number of the current patient conflicts with that on another device. Discharge the patient from unused device.

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E SpO₂ Sensor Accuracy

E.1 The Accuracy of Masimo SpO₂ Sensors

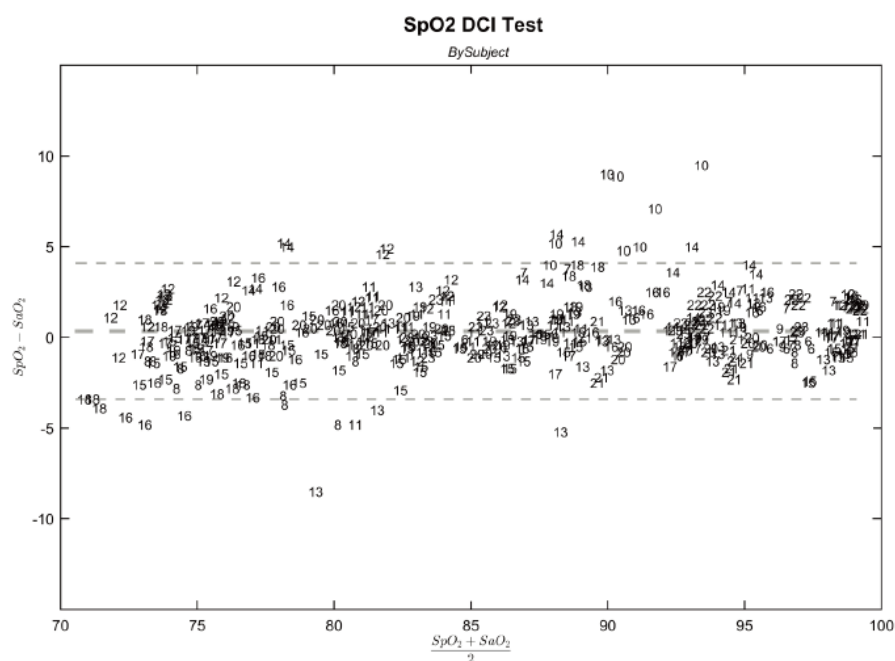
E.1.1 Measured Arms Values

The following table list Arms (Accuracy Root Mean Square) values measured using the Masimo sensors with Masimo SET Oximetry Technology in a clinical study.

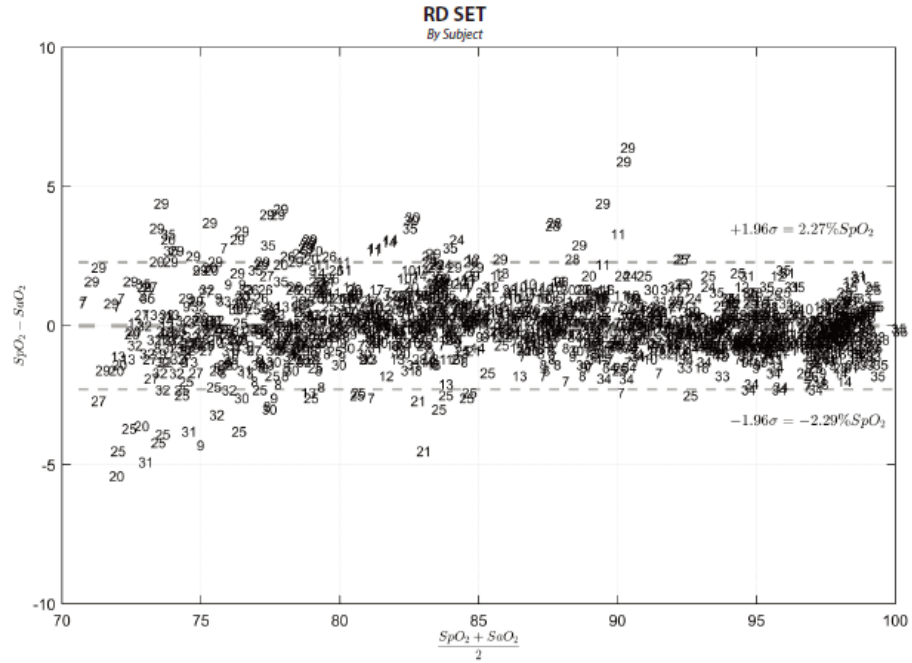
Model	90 - 100%	80 - 90%	70 - 80%	Overall (70 - 100%)
4050, 4051, LNCS DCI, DCI-P	1.44%	2.30%	1.84%	1.90%
4000, 4001, 4002, 4003, 4004, 4005	0.83%	1.11%	1.53%	1.15%
4053	2.16%	2.54%	3.97%	3.02%
LNCS Aidx, Pidx	1.64%	1.07%	1.55%	/
LNCS Inf, Neo-L, NeoPt	1.85%	1.44%	0.89%	/

E.1.2 (SpO₂-SaO₂) vs. (SpO₂+SaO₂)/2 Bland Altman fit and upper 95% and lower 95% limits of agreement

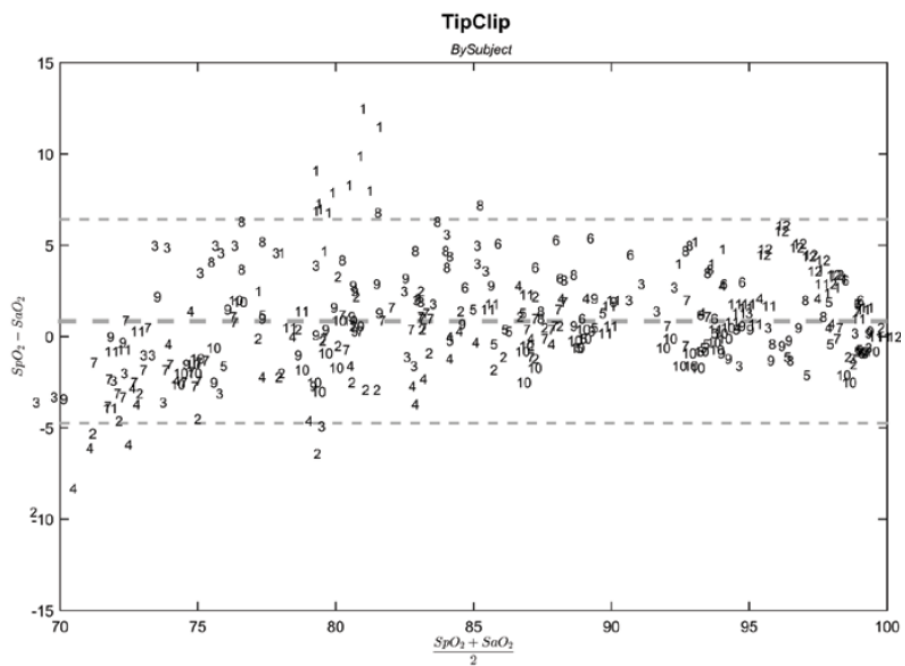
4050, 4051, LNCS DCI, DCI-P



4000, 4001, 4002, 4003, 4004, 4005

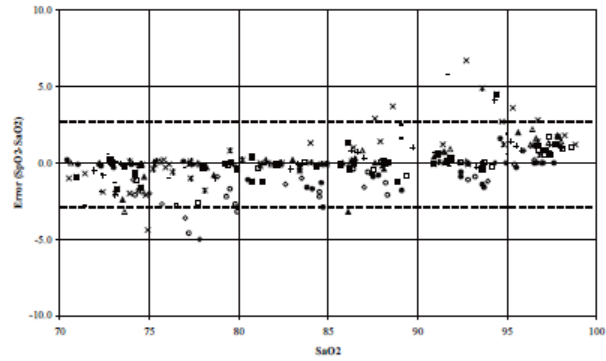


4053



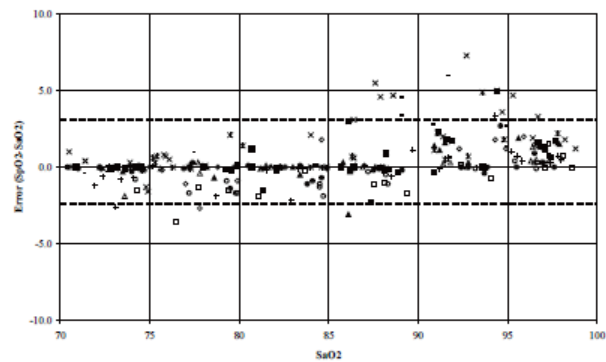
LNCS Adtx, Pdtx

M-LNCS/LNCS - Adtx/Pdtx



LNCS Inf, Neo-L, NeoPt

M-LNCS/LNCS - Inf/Neo/NeoPt

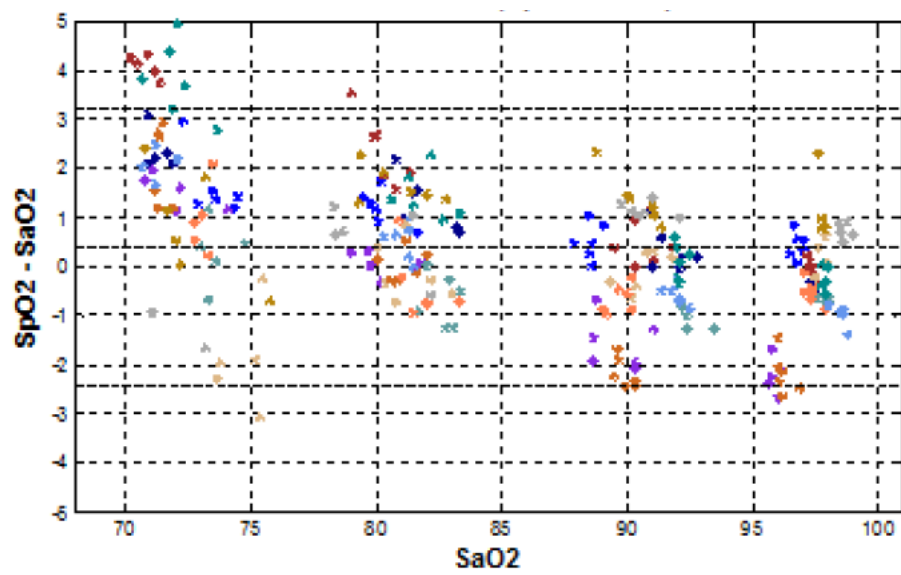


E.2 The Accuracy of Nellcor SpO₂ Sensors

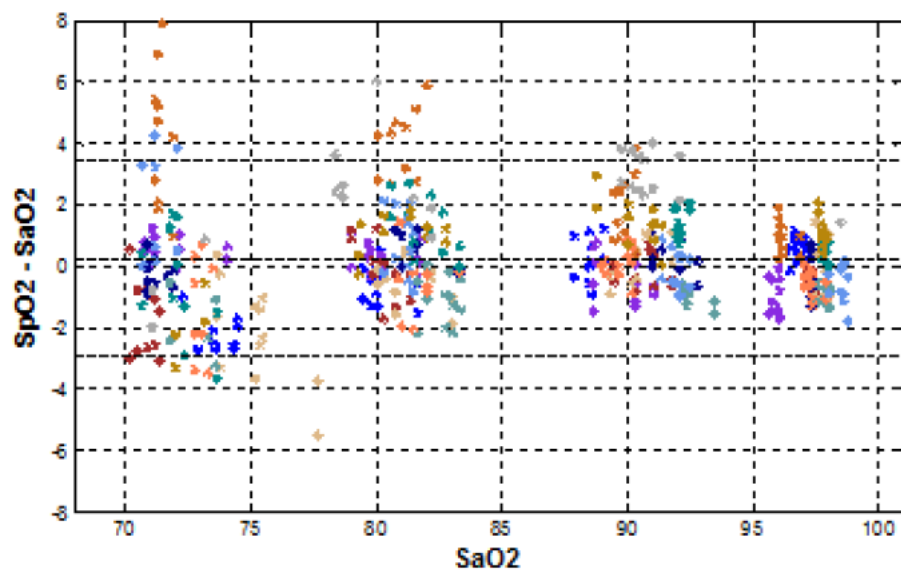
E.2.1 SpO₂ Accuracy for Nellcor Sensors vs. Co-Oximeters (Arms)

SpO ₂ Range	100% to 70%	100% to 90%	90% to 80%	80% to 70%
DS-100A	1.64%	1.16%	1.67%	2.25%
D-YS, OXI-P/I, OXI-A/N	2.41%	1.38%	2.50%	3.60%
MAXAI, MAXPI, MAXII	1.62%	1.49%	1.57%	2.50%
MAXNI	1.85%	1.71%	1.51%	1.59%

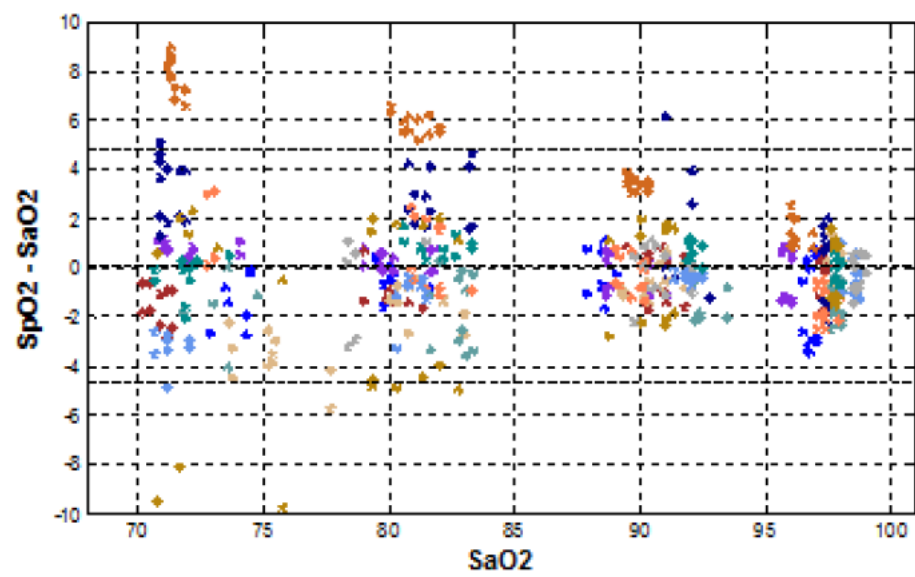
E.2.2 Modified Bland-Altman for SpO₂ - MAXAI, MAXPI, MAXII, MAXNI Sensors: (SpO₂ - SaO₂) vs.SaO₂



E.2.3 Modified Bland-Altman for SpO₂ - DS-100A Sensors: (SpO₂ - SaO₂) vs.SaO₂



E.2.4 Modified Bland-Altman for SpO₂ - D-YS, OXI-A/N, OXI-P/I Sensors: (SpO₂ - SaO₂) vs.SaO₂



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F Units, Symbols and Abbreviations

F.1 Units

Abbreviation	In Full
μA	microampere
μV	microvolt
μs	microsecond
A	Ampere
Ah	Ampere hour
bpm	beat per minute
bps	bits per second
°C	Celsius
cc	cubic centimeter
cm	centimeter
dB	decibel
DS	dyne second
°F	Fahrenheit
g	gram
GHz	gigahertz
GTT	gutta
h	hour
Hz	hertz
in	inch
k	kilo
kg	kilogram
kPa	kilopascal
L	litre
lb	pound
m	meter
mAh	milliampere hour
Mb	mega byte
mcg	microgram
mEq	milli-equivalents
mg	milligram
min	minute
ml	milliliter
mm	millimeter

Abbreviation	In Full
mmHg	millimeters of mercury
cmH ₂ O	centimeters of water
ms	millisecond
mV	millivolt
mW	milliwatt
MΩ	megaohm
nm	nanometer
rpm	breaths per minute
s	second
V	volt
VA	volt ampere
Ω	ohm
W	watt

F.2 Symbols

Symbol	Explanation
–	negative, minus
%	percent
/	per; divide; or
~	to
+	plus
=	equal to
<	less than
>	greater than
≤	less than or equal to
≥	greater than or equal to
±	plus or minus
×	multiply
©	copyright

F.3 Abbreviations

Abbreviation	In Full
AaDO ₂	alveolar-arterial oxygen gradient
AC	alternating current
Adu	adult
AG	anaesthesia gas
AHA	American Heart Association
Ao	aortic pressure
Art	arterial
ATMP	barometric pressure
aVF	left foot augmented lead
aVL	left arm augmented lead
aVR	right arm augmented lead
awRR	airway respiratory rate
BAP	brachial arterial pressure
BSA	body surface area
BT	blood temperature
BTPS	body temperature and pressure, saturated
CAA	Clinical Assistive Application
CaO ₂	arterial oxygen content
CCI	continuous cardiac index
CCO	continuous cardiac output
CCU	cardiac (coronary) care unit
CE	Conformité Européenne
CFI	cardiac function index
C.I.	cardiac index
CIS	clinical information system
CISPR	International Special Committee on Radio Interference
CMOS	complementary metal oxide semiconductor
CMS	central monitoring system
C.O.	cardiac output
CO ₂	carbon dioxide
COHb	carboxyhemoglobin
Compl	compliance
CPI	cardiac power index
CPO	cardiac power output
CVP	central venous pressure
DC	direct current
Des	desflurane

Abbreviation	In Full
Dia	diastolic
dpi	dot per inch
dPmx	left ventricular contractility
DVI	digital video interface
DO ₂	oxygen delivery
DO ₂ I	oxygen delivery index
ECG	electrocardiograph
EDV	end-diastolic volume
EEC	European Economic Community
EEG	electroencephalogram
EMC	electromagnetic compatibility
EMG	electromyograph
EMI	electromagnetic interference
Enf	enflurane
ESV	end systolic volume
ESVI	end systolic volume index
ESU	electrosurgical unit
Et	end-tidal
EtAA	end-tidal anesthetic agent
EtDes	end-tidal anesthetic agent
EtEnf	
EtHal	
EtIso	
EtSev	
EtCO ₂	
EtN ₂ O	end-tidal nitrous oxide
EtO	ethylene oxide
EtO ₂	end-tidal oxygen
EVLW	extravascular lung water
ELWI	extravascular lung water index
EWS	Early Warning Score
FAP	femoral arterial pressure
FCC	Federal Communication Commission
FDA	Food and Drug Administration
Fi	fraction of inspired
FiAA	inspired anesthetic agent

Abbreviation	In Full
FiDes	inspired anesthetic agent
FiEnf	
FiHal	
Filso	
FiSev	
FiCO ₂	fraction of inspired carbon oxygen
FiN ₂ O	fraction of inspired nitrous oxide
FiO ₂	fraction of inspired oxygen
FPGA	field programmable gate array
FV	flow-volume
GCS	Glasgow Coma Scale
GEDV	global end diastolic volume
GEDI	global end diastolic volume index
GEF	global ejection fraction
Hal	halothane
Hb	hemoglobin
Hct	haematocrit
HIS	hospital information system
HR	heart rate
IBP	invasive blood pressure
IBW	ideal body weight
ICP	intracranial pressure
ICT/B	intracranial catheter tip pressure transducer
ICU	intensive care unit
ID	identification
I:E	inspiratory time: expiratory time ratio
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
IP	internet protocol
Iso	isoflurane
ITBI	intrathoracic blood volume index
ITBV	intrathoracic blood volume
LA	left arm
LAP	left atrial pressure
LCD	liquid crystal display
LCW	left cardiac work
LCWI	left cardiac work index
LDAP	Lightweight Directory Access Protocol
LED	light emitting diode

Abbreviation	In Full
LL	left leg
LVET	left ventricular ejection time
LVSW	left ventricular stroke work
LVSWI	left ventricular stroke work index
MAC	minimum alveolar concentration
MAP	mean arterial pressure
Mb	myoglobin
MetHb	methemoglobin
MEWS	Modified Early Warning Score
MLDAP	Mindray LDAP, Mindray lightweight directory access protocol
MRI	magnetic resonance imaging
MV	minute volume
MVe	expiratory minute volume
MVi	inspiratory minute volume
N/A	not applied
N ₂	nitrogen
N ₂ O	nitrous oxide
Neo	neonate
NEWS	National Early Warning Score
NIBP	noninvasive blood pressure
NIF	negative inspiratory force
O ₂	oxygen
O ₂ %	oxygen concentration
OR	operating room
OxyCRG	oxygen cardio-respirogram
PA	pulmonary artery
Paw	airway pressure
PAWP	pulmonary artery wedge pressure
Ped	pediatric
PEEP	positive end expiratory pressure
PEF	peak expiratory flow
PEP	pre-ejection period
PI	perfusion index
PIF	peak inspiratory flow
PIP	peak inspiratory pressure
Pleth	plethysmogram
Pmean	mean pressure
PNC	Pacer not Capture
PNP	Pacer not Pacing

Abbreviation	In Full
PO ₂	oxygen supply pressure
Pplat	plateau pressure
PPV	pulse pressure variation
PR	pulse rate
PVC	premature ventricular contraction
PVPI	pulmonary vascular permeability index
PVR	pulmonary vascular resistance
PVRI	pulmonary vascular resistance index
qSOFA	quick Sepsis-Related Organ Failure Assessment
RA	right arm
RAP	right atrial pressure
Raw	airway resistance
Rec	record, recording
Resp	respiration
RL	right leg
RR	respiration rate
RSBI	rapid shallow breathing index
RVEF	right ventricular ejection fraction
SIQ	signal quality index
SOFA	Sepsis-Related Organ Failure Assessment
SpO ₂	arterial oxygen saturation from pulse oximetry
SR	suppression ratio
SSC	Surviving Sepsis Campaign
SSI	signal strength index
STR	systolic time ratio
SV	stroke volume
SVI	stroke volume index
SVR	systemic vascular resistance
SVRI	systemic vascular resistance index
SVV	stroke volume variation
SvO ₂	venous oxygen saturation
Sync	synchronization
Sys	systolic pressure
TB	blood temperature
TD	temperature difference
Temp	temperature
TFT	thin-film technology
TI	injectate temperature
TRC	tube resistance compensation

Abbreviation	In Full
UAP	umbilical arterial pressure
UPS	uninterruptible power supply
USB	universal serial bus
UVP	umbilical venous pressure
VAC	volts alternating current
VEPT	volume of electrically participating tissue
VPB	ventricular premature beat per minute

