BeneVision N1

Patient Monitor

Operator's Manual

CE 0123

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

WARNING

- **This equipment must be operated by skilled/trained clinical professionals.**
- **It is important for the hospital or organization that employs this equipment to carry out a reasonable service/maintenance plan. Neglect of this may result in machine breakdown or personal injury.**

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- Malfunction or damage caused by improper operation or repair by unqualified or unauthorized service people.
- Malfunction of the instrument or part whose serial number is not legible enough.
- Others not caused by instrument or part itself.

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These events, include device-related death and serious injury or illness. In addition, as part of our Quality Assurance Program, SHENZHEN MINDRAY BIO-MEDICAL ELECTRONICS CO., LTD. requests to be notified of device failures or malfunctions. This information is required to ensure that SHENZHEN MINDRAY BIO-MEDICAL ELECTRONICS CO., LTD. provides only the highest quality products.

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 your product. If you have any question, please contact us.

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 critically ill patients.

Illustrations

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

Contents

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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 to ensure that you get the most from your product.**

1.1.1 Warnings

WARNING

- **This equipment is used for single patient at a time.**
- **To avoid explosion hazard, do not use the equipment in the presence of oxygen-rich atmospheres, flammable anesthetics, or other flammable agents.**
- **The equipment is not intended to be used within the Magnetic Resonance (MR) environment.**
- **Before connecting the equipment to the power line, check 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. If a protective earth conductor is not provided, operate it on battery power, if possible.**
- **Do not use the multiple portable socket outlets (MPSO) or AC mains extension cords. Insure that the sum of the individual ground leakage currents does not exceed the allowable limits.**
- **Do not touch the patient and live parts simultaneously. Otherwise patient injury may result.**
- **Do not come into 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 exclusively rely on audible alarms for patient monitoring. Adjusting alarm volume to a low level or turning off alarm sound may result in patient hazards.**
- **Customize alarm settings according to patient situations and keep patients under close surveillance.**
- **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.**
- **Place and secure cables and tubings carefully to prevent from stumbling, entanglement and patient strangulation.**
- **If any measurement seems questionable, first check the patient's vital signs by alternate means and then check the equipment for proper functioning.**

- Physiological data and alarm messages provided by the monitor should not be used as the only basis for diagnosis or therapy decisions. They must be used in conjunction with clinical signs and symptoms. Misinterpreting measured values or other parameters may result in patient hazards.
- The software equipment 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.

1.1.2 Cautions

CAUTION

- Use and store 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.
- Use only parts and accessories specified in this manual.
- Ensure that the equipment is supplied with continuous electric power during work. Sudden power failure may cause data loss.
- 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 phone, X-ray equipment or MRI devices are a possible source of interference as they may emit higher levels of electromagnetic radiation.
- Always install or carry the equipment properly to avoid damage caused by drop, impact, strong vibration or other mechanical force.
- 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 us.

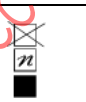
1.1.3 Notes

NOTE

- Put the equipment in a location where you can easily view and operate the equipment.
- The equipment uses a mains plug as isolation means to the mains power. Do not locate the equipment in a place difficult to operate the mains plug.
- In normal use, the operator is expected to be in front of the equipment.
- The software was developed in compliance with IEC62304.
- This manual includes information related to all features of the monitor. Some features may not be available on your monitor.
- Keep this manual in the vicinity of the equipment so that it can be obtained conveniently when needed.

1.2 Equipment Symbols

Symbol	Description	Symbol	Description
MD	Medical device	UDI	Unique device identifier
	General warning sign		Refer to instruction manual/booklet
SN	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°
	Direct current		Polarity of d.c. power connector
	Battery indicator		Alternating current
	Equipotentiality		Computer network
	DEFIBRILLATION-PROOF TYPE CF APPLIED PART		DEFIBRILLATION-PROOF TYPE BF APPLIED PART
	Calibration		Zero key
	Gas outlet		Gas inlet
	Video output		Input/output
	Start		Stop

Symbol	Description	Symbol	Description
	Unlocking		Locking
	Direction and angle off rotation		Lock; tighten
	Stacking limit by number		Keep dry
	This way up		Fragile, handle with care
	Humidity limitation		Atmospheric pressure limitation
	Temperature limit		Non-ionizing electromagnetic radiation
	Dispose of in accordance to your country's requirements		Plastic identification symbol
EC REP	Authorized representative in the European Community/European Union		Stand-by
CE 0123	The product bears CE mark indicating its conformity with the provisions of the REGULATION (EU) 2017/745 on medical devices and fulfills the general safety and performance requirements of Annex I of this regulation. The number adjacent to the CE marking (0123) is the number of the EU-notified body certified for meeting the requirements of the Regulation. Note: The product complies with the Council Directive 2011/65/EU, amended by Directive 2015/863/EU.		
TrueBP™	TrueBP™ is Mindray's new non-invasive blood pressure measurement algorithm using linear inflation technology, which can measure the blood pressure quickly and comfortably during cuff inflation.		

General meaning of geometric shapes and safety colors are as follows:

Geometric shape	Meaning	Safety color	Contrast color	Graphical symbol color
	Mandatory action	Blue	White	White
	Warning	Yellow	Black	Black

2 Equipment Introduction

2.1 Intended Use

2.1.1 Intended Purpose Statement

The patient monitor is intended for monitoring, displaying, reviewing, storing, alarming and transferring of multiple physiological parameters.

2.1.2 Indications for Use

The BeneVision N1 patient monitors are intended to be used for monitoring, displaying, reviewing, storing, alarming and transferring of multiple physiological parameters including ECG (3-lead, 5-lead, 6-lead, and 12-lead selectable, arrhythmia detection, ST segment analysis, QT/QTc monitoring, and heart rate (HR)), respiration (Resp), temperature (Temp), pulse oxygen saturation (SpO2), pulse rate (PR), non-invasive blood pressure (NIBP), invasive blood pressure (IBP), carbon dioxide (CO2), oxygen (O2), continuous cardiac output (CCO).

The monitor also provides interpretation of resting 12-lead ECG and CrozFusion.

2.1.3 Medical Conditions

The product is expected to be used in medical institutions, and its application fields include: operating room, anesthesia induction and postoperative recovery, intensive care unit, emergency care, respiratory care, Cardiac Care Unit, neural care, dialysis care, neonatal care, elderly care, obstetric care, internal medicine and surgical care.

2.1.4 Intended Users

This monitor is to be used in healthcare facilities by clinical professionals or under their guidance.

2.1.5 Intended Patient Population

All the parameters can be monitored on single adult, pediatric, and neonatal patients with the exception of the following:

- The CCO monitoring is intended for adult and pediatric patients only.
- The CrozFusion function is intended for adult patients only.

2.1.6 Contra-indications

The CrozFusion function is contraindicated in the following situations:

- Performing CPR
- Performing CPB or using V-A ECMO
- Using IABP
- Patients in persistent and regular restlessness

2.1.7 Side-effects

None.

According to the conclusion of clinical evaluation and residual risk evaluation, for the intended patients, there is no known side effects that can occur during or after the use of the medical device. And there is no need for the operator to make extra preparations. Thus, no residual risk associated with using the medical device should be disclosed.

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 the following 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, BeneVision N12, or BeneVision N12C patient monitor, hereafter referred to as "the host monitor".
- As a multi-parameter module (MPM) for the Mindray BeneView T5, BeneView T5 OR, BeneView T6, BeneView T8, BeneView T9 or BeneView T9 OR patient monitor, hereafter referred to as "the host monitor".
- As a multi-parameter module (MPM) for the BeneHeart DX or BeneHeart DM defibrillator/monitor.

In this manual, the N1 is generally referred to as "the monitor" except in the situation describing its use with a host monitor or the defibrillator/monitor, where it is referred to as "the N1".

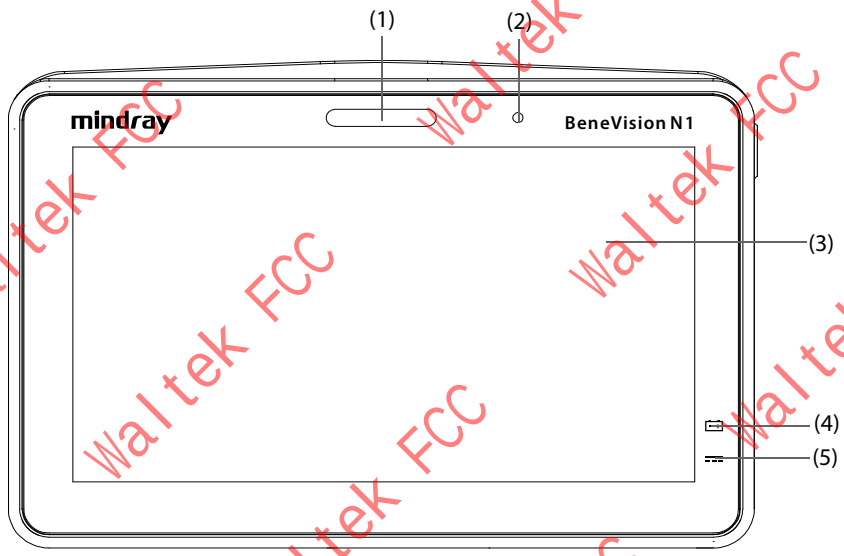
2.3 Applied Parts

The applied parts of the monitor are:

- ECG electrode and leadwire
- SpO_2 sensor
- Temp probe
- NIBP cuff
- IBP transducer
- PiCCO sensor
- CO_2 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 brightens according to the strength of ambient light.

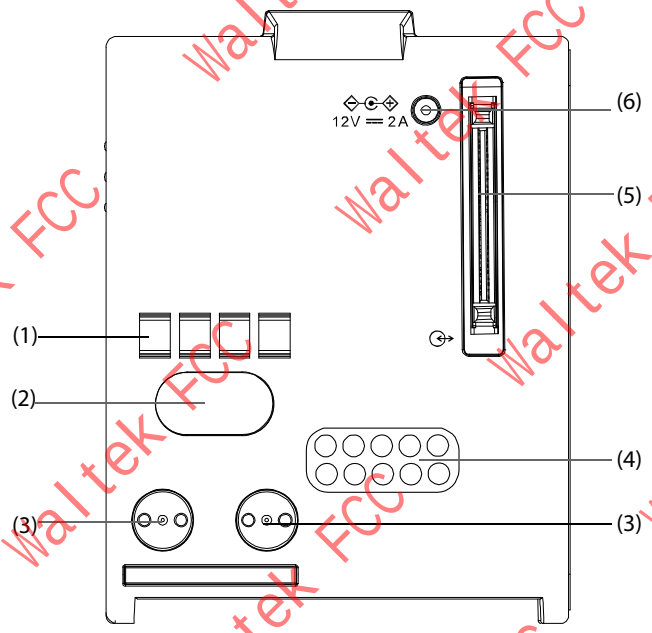
(3) Display

(4) Battery LED

(5) External power LED

- 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 BeneView T series monitor; 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 (BeneView T series monitor or BeneVision N series monitor).

(4) Communication interface (optional): used for communication between the N1 and an the BeneHeart DX or BeneHeart DM defibrillator/monitor.

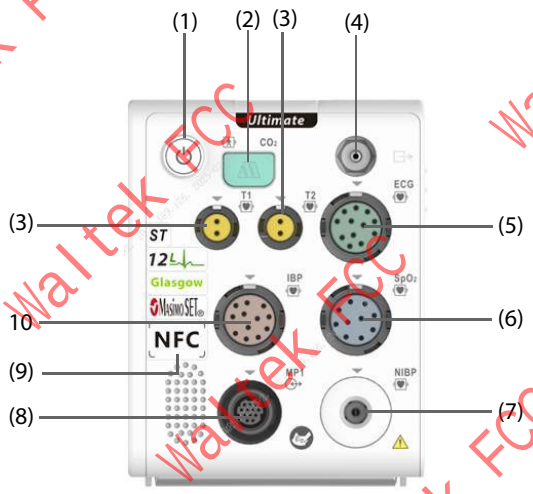
(5) Multi-pin connector: connects the N1 to the Modular Rack or Dock.

(6) External DC power input connector: connects the N1 to the AC adapter

NOTE

- **Dry the Multi-pin connector of the N1 before connecting the N1 to the Modular Rack or Dock in case of water spray.**

2.4.3 Right View



(1) Power switch

(2) Sample line connector of the sidestream CO_2

(3) Temp probe connector

(4) Gas outlet

(5) ECG cable connector

(6) SpO_2 cable connector

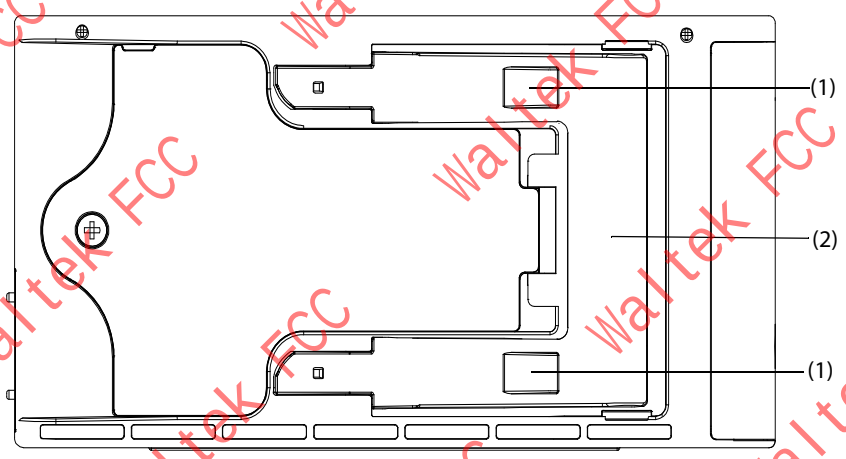
(7) NIBP cuff connector

(8) Multifunctional connector: outputs analog and defib synchronization signal, or connects MRV Pod

(9) NFC label: used to pair an NFC device for data transmission.

(10) IBP cable connector

2.4.4 Bottom View



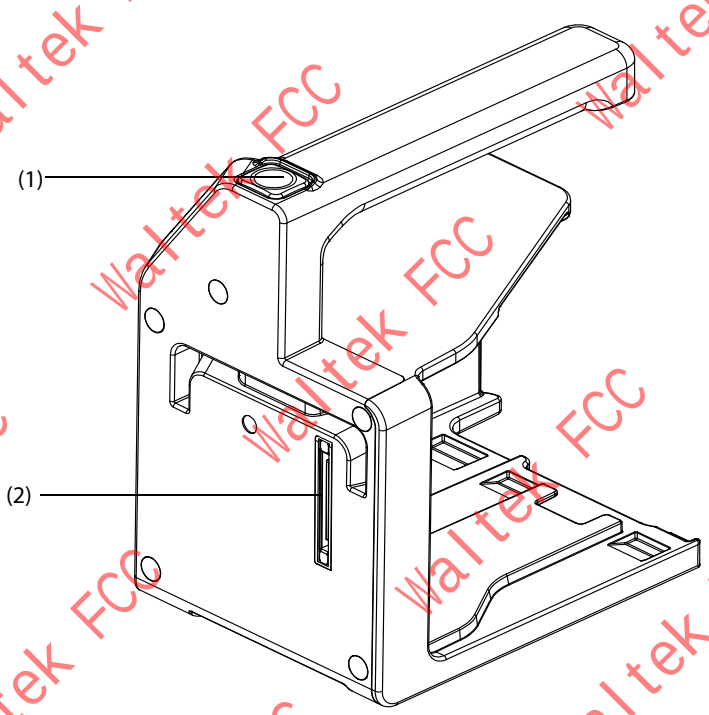
(1) Clip: fasten the N1 when N1 is in use with the host monitor, Dock or Modular Rack.

(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 you can remove the N1 from the host monitor, Dock or Modular Rack.

2.5 Modular Rack

Modular Rack is used for connecting a N1 and an external parameter module.

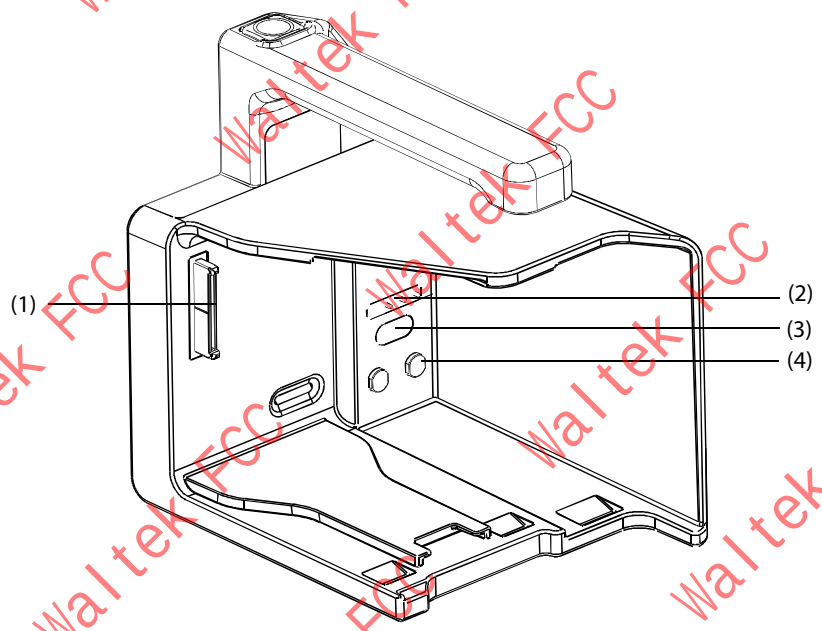
2.5.1 Left View



(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.

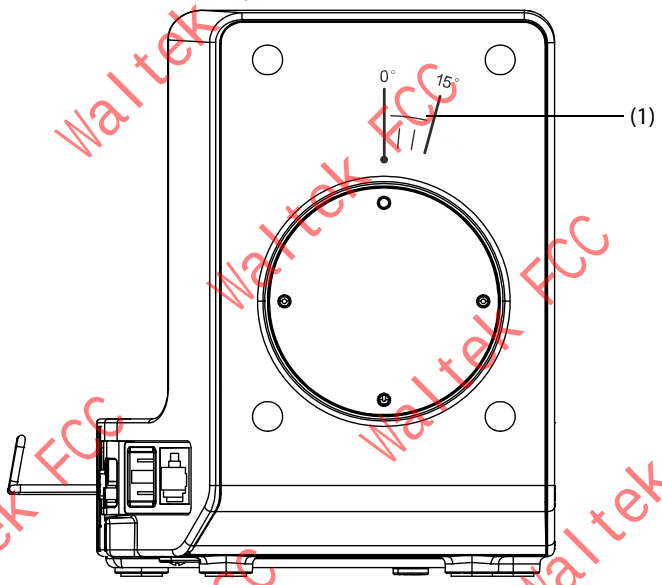
(3) Infrared filter: used for communication between the Modular Rack and external parameter module.

(4) Contact: power input connector of the external parameter module.

2.6 Dock

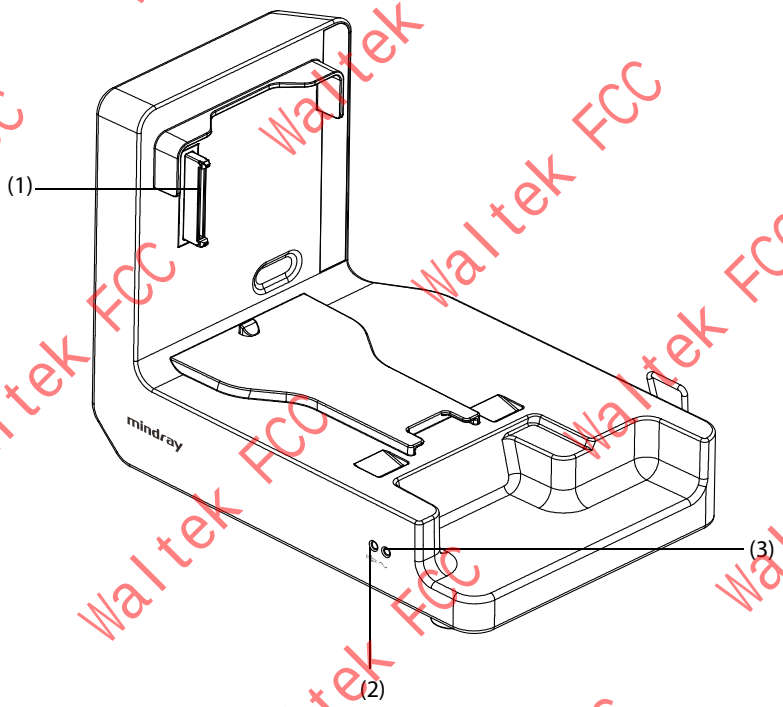
Dock is used to connect the N1 or Modular Rack.

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.

2.6.2 Right View

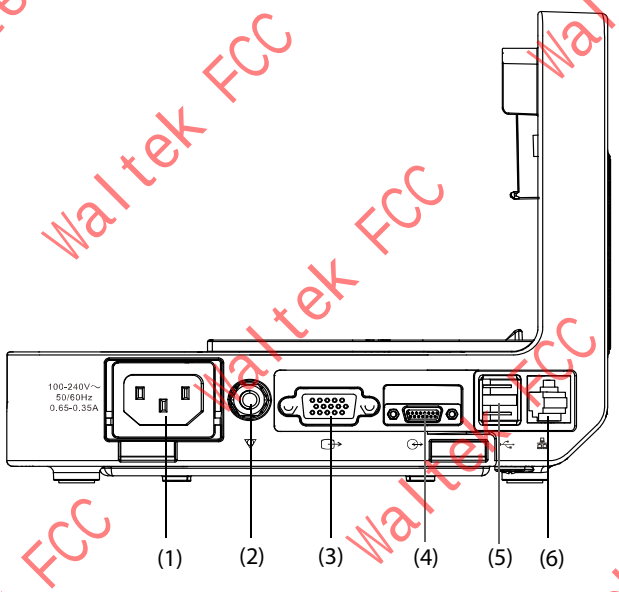


(1) Multi-pin connector: power input and communication connector of the N1.

(2) Connection status LED: it is on when the N1 is properly connected to the Dock.

(3) External power LED: 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

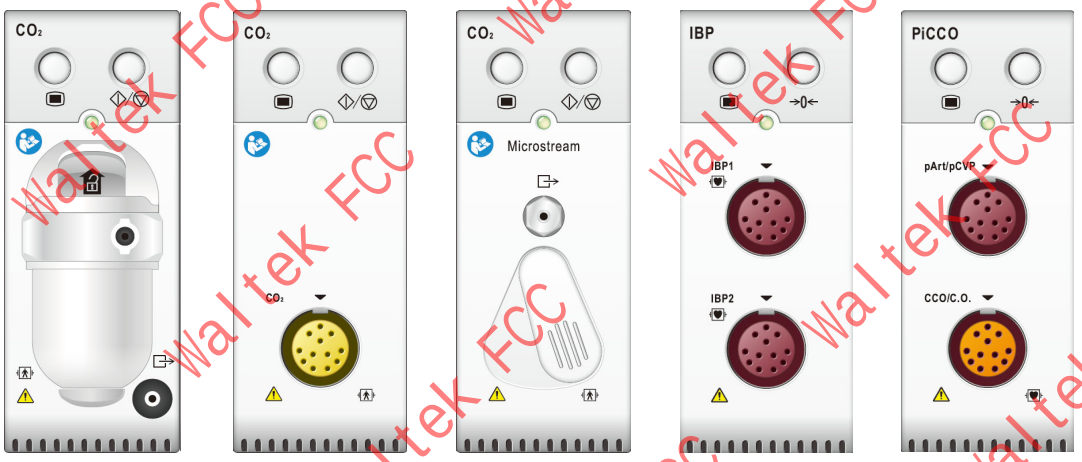
(4) Host monitor connector: connects the N1 to the host monitor.

(5) USB connector: connects USB devices.

(6) Network connector: a standard RJ45 connector.

2.7 External Parameter Modules

The monitor can connect the following external parameter modules to perform CO_2 monitoring, IBP monitoring, and CCO monitoring through the Modular Rack.

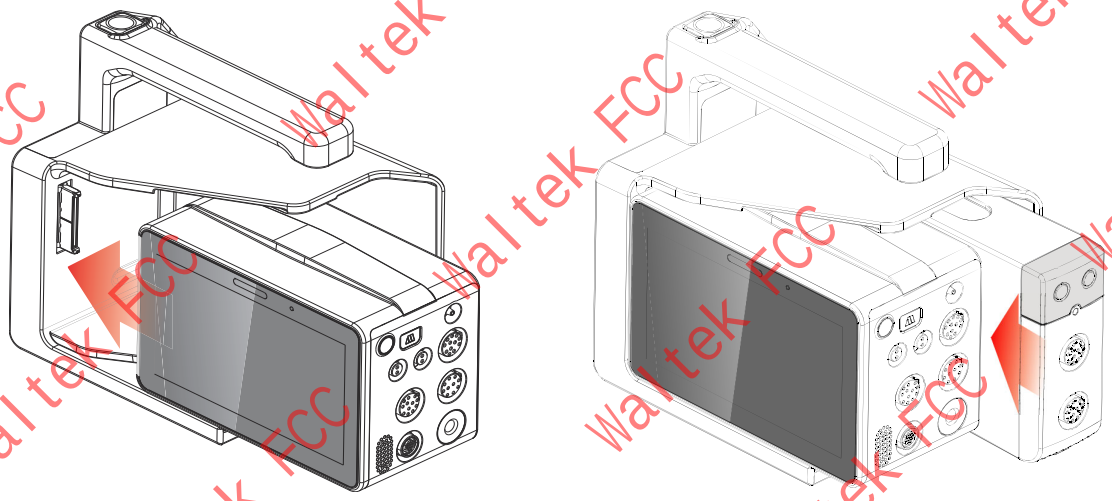


Sidestream CO_2 module | Mainstream CO_2 module | Microstream CO_2 module | IBP module | PiCCO module

2.8 Installation

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

You can 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 you hear that the clip (refer to *2.4.4 Bottom View*) engages 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 properly engages the Modular Rack if you cannot pull it out.

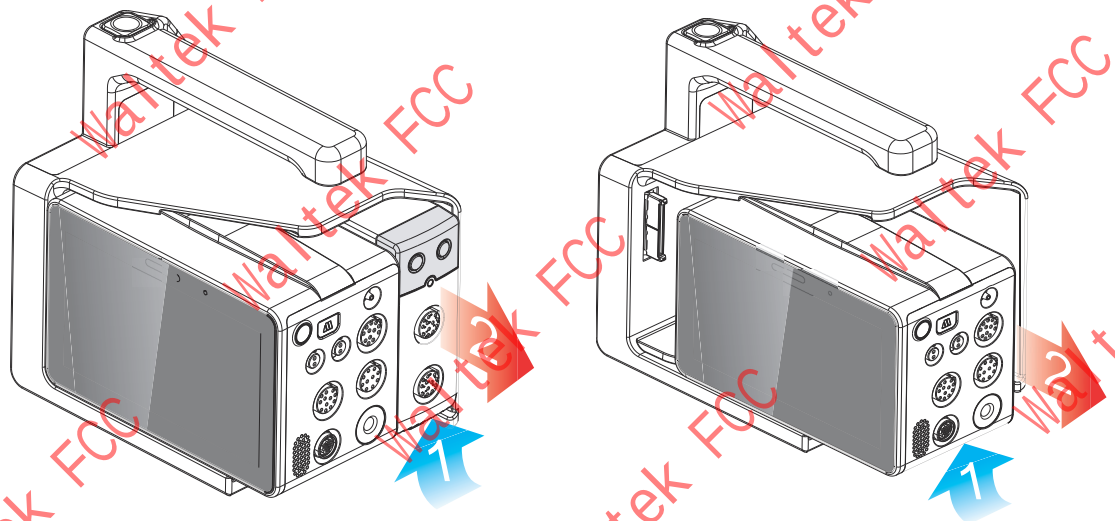
NOTE

- **To prevent N1 or the external module from falling off, after insert N1 or the external module into the Modular Rack, always check that N1 or the external module properly engages the Modular Rack.**
- **When the external module is properly installed, you should further fasten the module 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

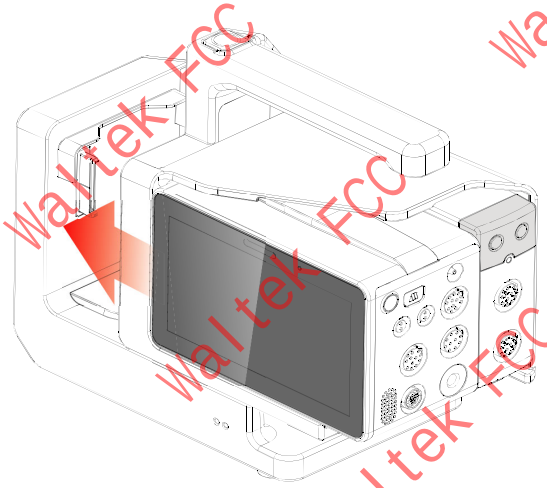
To remove the N1 or external parameter module, follow this procedure:

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:

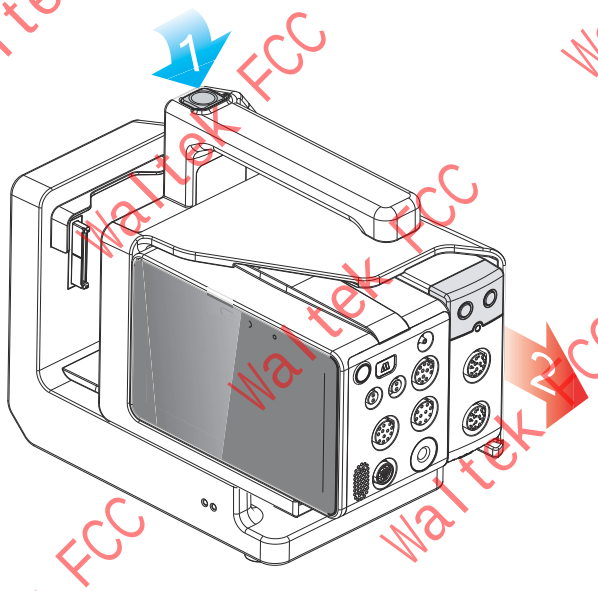


You hear a click when the Modular Rack is pushed into place.

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.

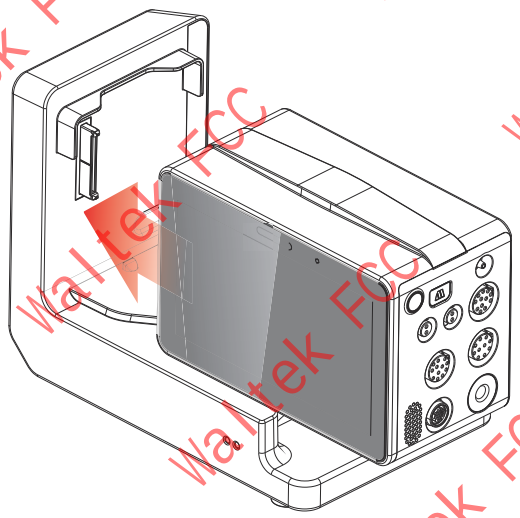


CAUTION

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

2.8.5 Installing the N1 to the Dock

You can also install N1 directly to the Dock as shown below:

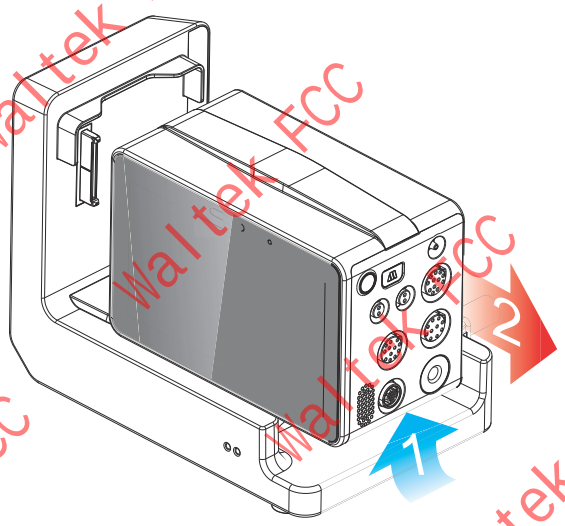


Firmly push N1 until you hear that the clip (refer to *2.4.4 Bottom View*) engages the Dock. To ensure that N1 is properly connected, try to pull N1 outward. N1 properly engages the Dock if you cannot pull it out.

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 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 or BeneView T series monitor, the N1 works as the parameter module while BeneVision N series monitor or BeneView T series monitor works as the host monitor. For more information, see section *3.7.2 Module Mode*.

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

BeneVision N series and BeneView T series monitor that can be used as N1 host monitor are as follows:

- BeneVision N22, BeneVision N19, BeneVision N17, BeneVision N15, BeneVision N12, and BeneVision N12C
- BeneView T5, BeneView T5 OR, BeneView T6, BeneView T8, BeneView T9, and BeneView T9 OR

CAUTION

- **If you need the analog signals, use the multifunctional connector of the N1 instead of the Micro-D connector of the BeneView T series monitor when the two monitors are connected.**

2.9.1 Connecting 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 N1 to the host monitor's module rack. Firmly push N1 until you hear that the clip (refer to *2.4.4 Bottom View*) engages the module rack.
2. To ensure that N1 is properly connected, try to pull N1 outward. N1 properly engages the module rack if you cannot pull N1 out.

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

CAUTION

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

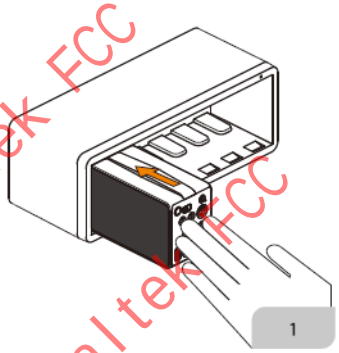
NOTE

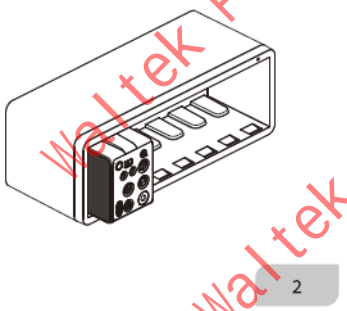
- **There is no module rack for the BeneVision N22 or BeneVision N19 monitor. The N1 can be connected to the BeneVision N22 and BeneVision N19 monitor through the SMR or Dock.**

2.9.2 Connecting 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 N1 to the SMR. Firmly push N1 until you hear that the clip (refer to *2.4.4 Bottom View*) engages the SMR.
3. To ensure that N1 is properly connected, try to pull N1 outward. N1 properly engages the module rack if you cannot pull N1 out.





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

CAUTION

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

2.9.3 Connecting 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.

NOTE

- **Use AC power source when the N1 is in use with the Dock.**

2.10 N1 in Use with the Defibrillator/Monitor

N1 can be connected with the BeneHeart DX or BeneHeart DM defibrillator/monitor through the optional communication interface or in a wireless way. When the N1 is connected to the defibrillator/monitor, the N1 works as a parameter module of the defibrillator/monitor. Data from the N1, including parameter values, waveforms, and events, are sent to the defibrillator/monitor. For more information, see section *3.7.2 Module Mode*.

2.11 N1 in Use with the Transport Dock

N1can be used together with the Transport Dock to transport patient through road ambulance, airplane or helicopter. For the installation of the N1 and Transport Dock, refer to the *Transport Dock Indication for Use (PN: 046-011365-00)* and the *Quick Guide for the Dock-T N1 Transport Dock (with DC Input) (PN: 046-019005-00)*.

WARNING

- **If the N1 is configured with the CO_2 module, only the N1 with the label**  **can be used with Transport Dock with DC input.**
- **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.**

2.12 Input Devices

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

2.13 Printing Devices

You can use Mindray specified printer to output patient information and data.

3 Getting Started

3.1 Equipment Preparation Safety Information

WARNING

- Use only installation accessories specified by Mindray.
- 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.
- 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, 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.
- If the accuracy of any value displayed on the monitor, central station, or printed on a graph strip or report is questionable, determine the patient's vital signs by alternative means. Verify that all equipment is working correctly.

CAUTION

- The equipment should be installed by authorized Mindray 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 patients.
- Make sure that the equipment operating environment meets the specific requirements. Otherwise unexpected consequences, e.g. damage to the equipment, could result.
- Avoid rude handling during transport.
- Observance of this manual is a prerequisite for proper product performance and correct operation and ensures patient and operator safety.

NOTE

- Put the equipment in a location where you can easily view and operate the equipment.
- Keep this manual in the vicinity of the equipment so that it can be conveniently referenced when needed.
- Save packing cases and packaging material as they can be used if the equipment must be reshipped.

3.2 Monitor Installation

3.2.1 Unpacking and Checking

Before unpacking, examine the packing case carefully for signs of damage. If any damage is detected, contact the carrier or us.

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 us in case of any problem.

NOTE

- **If your monitor contains the internal CO_2 module, connect the CO_2 adapter to the CO_2 receptacle as soon as you unpack the monitor to avoid losing the CO_2 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 disappears.

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.

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.

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.

WARNING

- **Always use the accompanying power cord delivered with the monitor.**

- **Always use the AC adapter specified by Mindray.**
- **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.**
- **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.**
- **Use the battery if the integrity of the protective earth conductor or the protective earthing system in the installation is in doubt.**

3.3.2 Connecting the Input Devices

Connect the mouse, keyboard, and barcode reader if necessary.

3.3.3 Installing the External Parameter Module

If 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 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 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 for a while and then turn on the monitor to activate the battery.**
- **The time for the monitor to cool 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 Operations on the Screen

Screen elements include parameter values, waveforms, quick keys, menus, information area, alarms areas, and so on. Almost all screen elements are interactive.

You can access the same element in different ways. For example, you can enter a parameter menu by selecting 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 touch the screen or swipe across the screen with your fingers to operate the monitor.

3.5.1.1 Tapping the screen or Swiping across the Screen

- Tapping the screen
  - To select an item from menus or lists, tap on the item with your finger.
  - To select a quick key, tap on the key with your finger.
  - To enter a parameter menu, tap corresponding numeric area or waveform area. For example, select the ECG numeric area or waveform area to enter the **ECG** menu.
  - 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 across the screen with a single finger:
  - To scroll through a list and a menu, swipe up and 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 form top to bottom.

3.5.1.2 Locking the Touchscreen

You can use the touchscreen to select a screen element by pressing directly on the monitor's screen. To avoid misuse, the touchscreen is locked in the following situation:

- 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 of the touchscreen and swipe the slider up as instructed.

NOTE

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

3.5.2 Using the Barcode Reader

The monitor supports both linear (1D) barcode reader and two-dimension (2D) barcode reader.

NOTE

- **You can use the Mindray custom barcode reader to scan both the 2D and 1D barcodes. Using other barcode readers can only output the patient's medical record number (MRN) and visit number.**

3.5.2.1 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.

Before configuring the Mindray custom barcode reader, clear old data formats. 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 your hospital's data format.

NOTE

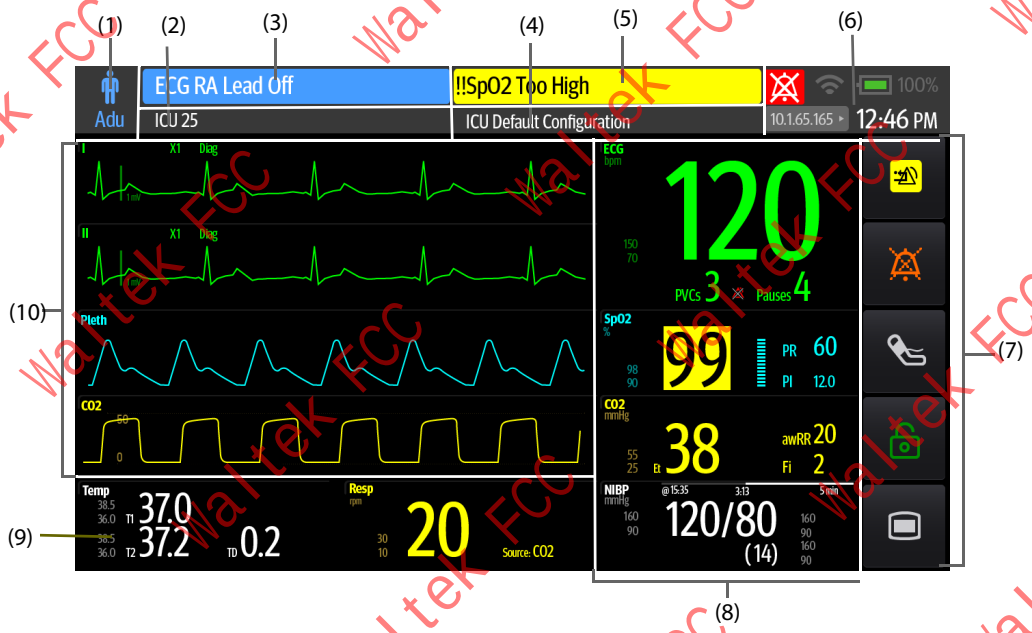
- **Contact the scanner manufacturer or Mindray to obtain the engineering barcodes for clearing data formats and containing the hospital's data format.**

3.5.2.2 Setting the Barcode Reader

For information on setting the barcode reader, see *23.15 The Scanner Settings*.

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** menu. For more information, see *5.3 Managing 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** menu. For more information, see *5.3 Managing Patient Information*.

(3) Technical alarm information area: displays technical alarm message or prompt message.

(4) The current configuration

(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. Selecting a parameter numeric block enters corresponding parameter menu. For more information, see *3.11.4 Accessing Parameter Setup Menus*.

(9) Parameter waveform/ numerics area: displays parameter waveforms or parameter values, alarm limits, and alarm status. Selecting a parameter waveform of numeric block enters corresponding parameter menu. For more information, see *3.11.4 Accessing Parameter Setup Menus*.

(10) Parameter waveform area: displays parameter waveforms. Select a waveform enters corresponding parameter menu. For more information, see *3.11.4 Accessing Parameter Setup Menus*.

3.6.1 On-screen Symbols

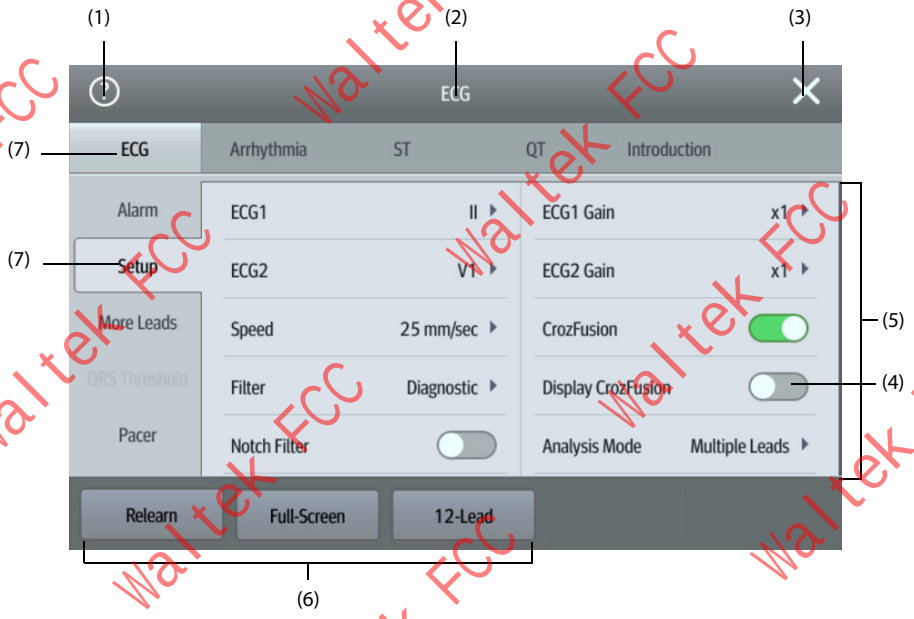
The following table lists the on-screen symbols displayed on the system status information area:

Symbol	Description	Symbol	Description
	Adult, male		Adult, female
	Pediatric, male		Pediatric, female
	Neonate, male		Neonate, female
	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 works 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 soon automatically shut down.
	The battery is being charged.		No battery is installed.
	Battery fault, battery communication fault, or battery charging fault. Contact service personnel for help.		Wireless network is connected. The solid part indicates network signal strength.
	Wireless network is not connected.		Wireless network is disabled.
	Wired network is connected.		Wired network is not connected.
	When the N1 is used with the defibrillator/ monitor, the defibrillator/monitor is connected.		When the N1 is used with the defibrillator/ monitor, the defibrillator/monitor is not connected.
	MRV Pod battery works correctly. The solid portion represents the remaining charge.*		MRV Pod has low power and needs to be charged.*
	MRV Pod has critically low charge and needs to be charged immediately. Otherwise, the MRV Pod will soon automatically shut down.*		MRV Pod battery is being charged.*

Symbol	Description	Symbol	Description
* The symbols at the right bottom of battery symbols indicate the connection status of the MRV pod with wireless network. • :MRV Pod is connected to wireless network and working normally. • :MRV Pod is in poor connection with the wireless network. • :MRV Pod is in disconnected from wireless network.			

3.6.2 Menus

All menus 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 items are followed by question marks. Then you can see help when these menu items are selected.

(2) Menu heading

(3) Exit button: closes the current menu page.

(4) Switch:
- Green: the switch is on.
- Gray: the switch is off.

(5) Main body area: includes menu items and options.

(6) Operation buttons

(7) Submenu tabs

3.6.3 Quick Keys of the 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.

Symbol	Label	Function	Symbol	Label	Function
	Alarm Reset	Resets the alarm system.		Screen Setup	Enters the **Screen Setup** menu.
	Alarm Pause	Pauses the physiological alarm system.		Print	Starts printing a real-time report.

Symbol	Label	Function	Symbol	Label	Function
	Audio Pause	Pauses alarm tone.		Standby	Enters the Standby mode.
	NIBP Start/ Stop	Starts an NIBP measurement or stops the current NIBP measurement.		Manual Event	Manually triggers and saves an event.
	Lock	Selects and operates as instructed to unlock the touchscreen		NIBP Measure	Enters the **NIBP Measure** menu.
	Unlock	Selects and operates as instructed to lock the touchscreen		Main Menu	Enters the main menu.

3.7 Operating Modes

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

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 or the defibrillator/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*. For connection of the N1 and the defibrillator/monitor, see section *2.10 N1 in Use with the Defibrillator/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, the host monitor, and the defibrillator/monitor will be synchronized. For data transfer strategy, see the corresponding operator's manual of the host monitor or the defibrillator/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 or the defibrillator/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 or the defibrillator/monitor.
- Turning on or off the host monitor or the defibrillator/monitor simultaneously powers on or off the N1.
- The main screen of the N1is off when it is connected to the host monitor through the SMR or the module rack of the host monitor or the defibrillator/monitor.

The N1 resumes to monitor mode when it is disconnected from the host monitor or the defibrillator/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 inactivate alarm tone and alarm light of all other alarms.
- The monitor suppresses all system sounds, including heart beat tone, pulse tone, and prompt tone.

WARNING

- **In 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 occurs.**

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 switch on or off the night mode. This is password protected. For more information, see **Disable Night Mode** in *23.4.7 The Other Tab*.

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.**

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. See the **Nighttime** setting from *23.10.1 The Time Synchronization Tab*.
   - 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 night mode 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

To silence the monitor in the Night mode, switch on **All Mute** from the **Night Mode Setup** menu.

Local password for accessing the **Maintenance** menu 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.

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 when being disconnected from the CMS.**
- **The monitor resumes the previous settings after exiting the night mode.**

3.7.5 Standby Mode

You can temperately 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

If you need 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 exists the standby mode and resumes monitoring, the alarms are paused for two minutes. Then 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

If configured to manually enter the outdoor mode, follow this procedure:

1. Select the **Main Menu** quick key.
2. From the **Display** column select **Enter Outdoor Mode**.

If configured to auto, the monitor can enter the outdoor mode automatically if the strength of ambient light is greater than the threshold. For more information, see *23.11 The Other Settings*.

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.

3.8 Configuring Your Monitor

Configure your 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 savings time, switch on **Daylight Savings Time**. You can manually switch on or off the daylight savings time only when the auto daylight savings time function is disabled. For more information, see *23.10 The Time Settings* for details.

If your 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 from your 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 the **Brightness**.

NOTE

- **If you set Brightness to Auto, screen brightness automatically changes according to the ambient light level.**

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**.

3.8.4 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 Starting Monitoring a Patient

After turning on your 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 your patient. Change them if necessary.
3. Perform desired measurements. For more information, see corresponding measurement chapters.

3.10 Stopping a Parameter Measurement

To stop monitoring a parameter, follow this procedure:

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

4. If you are using the disposable sensor, discard it.

3.11 General Operation

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

3.11.1 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** by any 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.

If setting parameter switches is password protected, to set parameter switches, switch on **Parameters On/Off Protected**. See **Parameters On/Off Protected** of *23.11 The Other Settings*.

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

NOTE

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

3.11.2 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 displayed.

3.11.3 Displaying the Parameter List

You can display trends of HR, SpO_2, 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**.

3.11.4 Accessing Parameter Setup Menus

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

- Select the parameter numeric area or waveform area.
- Press the setup hard key on the front panel of the external 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 menu. But you can use any method you prefer.**

3.11.5 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.

3.11.6 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. You can quickly switch 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 you want to display in this area.

3.11.7 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.

3.12 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.

The selecting or editing manual event name functionality is available only if the **Manual Event Edit** switch is turned on. For more information, see *23.11 The Other Settings*.

You can review the manual events. For more information, see *19.2.7 Reviewing Events*.

3.13 Using the On-Screen Timers

The monitor has a Timer function to notify you when a preset time period is expired. You can simultaneously display up to four timers.

3.13.1 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 parameter area where you want to display the timer, and then select a timer from the popup list.

3.13.2 Controlling the Timer

The timer provides the following controls:

- **Start**: starts timing.
- **Pause**: pauses timing.
- **Resume**: continues timing after the timer is paused.
- **Reset**: clears the timer and end this timing episode.

WARNING

- **Do not use the timers for tasks related to critical patients.**

3.13.3 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** menu.
2. Set **Timer Type**:
   - **Normal**: The timer has a single and defined run time, and stops when the run time is reached.
   - **Advanced**: The timer has a single and defined run time. When the run time is reached, the timer 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 restarts automatically. The cycles is also displayed.
   - **Unlimited**: The timer displays the time elapsed since the timer was started.
   - **Clock**: The timer displays the system time.
3. Set **Direction**.
   - **Down**: the timer counts down.
   - **Up**: the timer counts up.
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 to expire.

NOTE

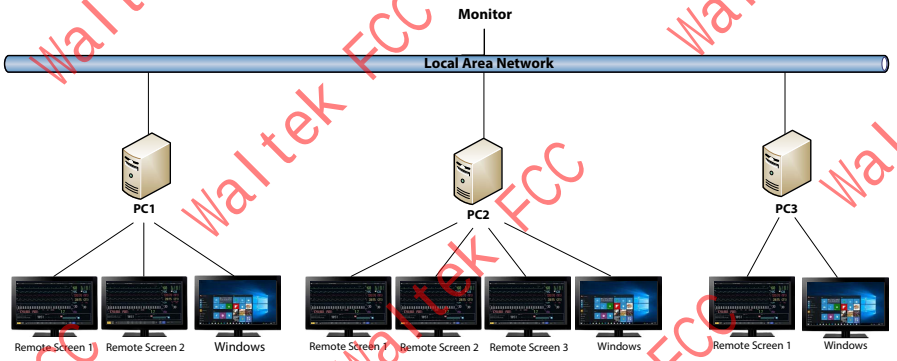
- **You cannot change timer settings when a timer is running.**
- **You can set Direction, Run Time, and Reminder Volume only for normal, advanced, and cycled timers.**

3.14 Using the nView Remote Displays

By using the nView, you can remotely view an independent monitor screen on a PC-based display.

The nView consists of PC-based hardware platform, application software (nView tool), and an local area network (LAN) connecting PCs and the monitor. Each PC can start three remote screens at most. A monitor supports six remote screens in total.

The remote screen is displays independently. you can operate the monitor via the remote screen. The following figure shows the nView connection:



WARNING

- **The remote screen is not a primary alarming device. Do not rely the remote screens for alarm notification.**
- **Data displayed on remote screens may have a delay.**

NOTE

- **A license is required for the nView function.**

3.14.1 Recommended Hardware and Network Requirements

3.14.1.1 Hardware Requirements

Recommended requirements for PCs and nView displays are as follows:

PC	Display
• Hard disk: minimum 20 G • Memory: 600 M (for one remote screen), 1200M (for two remote screens), 1400 M (for three remote screens) • CPU: i5, dual-core (for one remote screen), quad-core (for two or three remote screens)	Resolution: supports 1280×720 pixel

3.14.1.2 Network Requirements

Recommended requirements for the LAN connecting the monitor and PCs are as follows:

- Bandwidth: 100 M
- Supports multicast
- Requirements for ports are listed in the following table:

Protocol	nView Port	Monitor Port	Function
TCP	Any	6600	Communicates with the monitor.
TCP	Any	6602	Communicates with the monitor.
TCP	Any	6603	Communicates with the monitor.
TCP	Any	6604	Communicates with the monitor.
TCP	Any	6587	Communicates with the monitor.
TCP	Any	6588	Communicates with the monitor.

Protocol	nView Port	Monitor Port	Function
UDP	6678	Any	Discovers the monitor via multicast.
TCP	6606	Any	Communicates with the monitor. 6606 is the default nView port. You can modify the port via the nView tool.

3.14.2 Installing the nView Tool

The nView tool is a Windows-based PC application. It supports Windows 7 and Windows 10 operating system.

To install the nView tool, follow this procedure:

1. Extract the installation package.
2. Run nViewSetup.exe.
3. Follow installation instructions. Check the **Import Power Policy** box if necessary.

At the completion of installation, the nView tool icon displays on the desktop.

The nView tool automatically starts when the PC is power on.

CAUTION

- **The PC for nView may have a power policy of turning off or putting into sleep after a preset time. If you need the PC always on and not sleep when running the nView, check the Import Power Policy box when installing the nView tool.**

3.14.3 Manually Starting Remote Screen

You can only start remote screens from the PC. To start a remote screen, follow this procedure:

1. Double-click the nView tool icon to run the nView tool.
2. If you are starting the remote screen for the first time, configure it first. For more information, see *3.14.4 Configuring the Remote Screen*.
3. Select the desired monitor:
   a Select the **Select Device** tab.
   b Select **Refresh Device List**.
   c From the monitor list, select the desired monitor.
4. Select the **nView Tool** tab → **Start Remote Screen**.

After the remote screen is started, the remote screen icon displays on the task bar.

3.14.4 Configuring the Remote Screen

To configure the remote screen, follow this procedure:

1. Double-click the nView tool icon to run the nView tool.
2. Select the **Setup** tab to set the following parameters:
   - **Language**: the language of the remote screen and nView Tool user interface.
   - **Local IP address**: the IP address of the PC. The PC must be connected to the same LAN as the monitor.
   - **Remote Screen Port**: used as the port for TCP service and shall not conflict with other applications runs on the PC.
   - **Monitor Multicast Address**: used to discover the monitor.
   - **Start nView Screen When Monitor Online**: If this switch is on, the remote screen automatically starts when the monitor is connected to the network.
   - **Shut Down PC When Monitor Shutdown**: If this switch is on, the PC automatically shuts down when the monitor shuts down.

- **Shut Down PC When Monitor Shutdown**: selects the number of displays used for nView. When the PC connects multiple displays, the maximum number of displays for nVeiw is 3.
- **Screen X Position**: selects where the remote screen is displayed. For example, if **Screen 1 Position** is set to **Display 3**, remote screen 1 will be on display 3. To identify the displays, select Identify Display.
- **Full Screen**: if this switch is on, the remote screen displays in full size. If this switch is off, you can zoom in or out the remote screen. To achieve optimal full screen, setting the display resolution to 1280×720 is recommended.
- **Remote Screen Always on Top**: if this switch is on, the remote screen is always on the front ground.

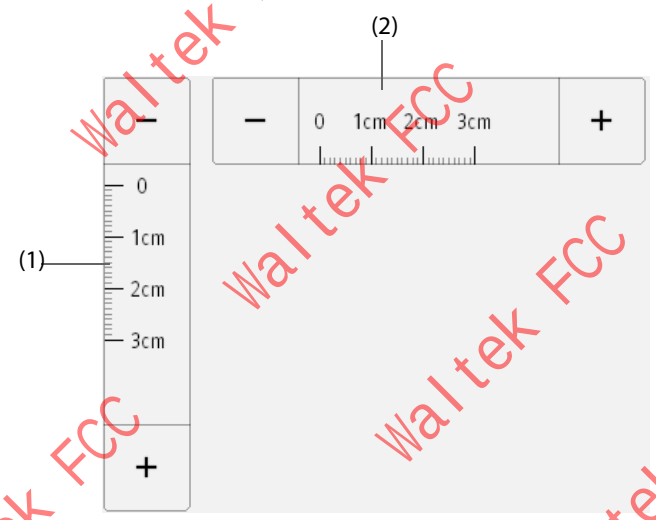
WARNING

- **If the Remote Screen Always on Top switch is off, the remote screen may be covered by other applications. If you need constant access to the patient data, make sure the remote screen is always in the foreground.**

3.14.5 Setting the ECG Waveform Size for the Remote Screen

For displays of different dimensions, you can set the speed and amplitude of the ECG waveforms for the remote screen to achieve the best display effect. To do so, follow this procedure:

1. From the remote screen, select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select **Display** → select the **Screen Size** tab.
3. Set the speed and amplitude of the ECG waveform corresponding to one centimeter.



(1) the amplitude ECG waveform corresponding to one centimeter
(2) the speed of the ECG waveform corresponding to one centimeter

NOTE

- **The setting of Screen Size takes effect only after the remote screen restarts.**

3.14.6 Selecting a Different Monitor for nView

To switch the monitor you want to view remotely, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **nView Tool**.
2. Select the **Select Device** tab.
3. Select **Refresh Device List**.
4. From the monitor list, select the desired monitor.
5. From the popup dialog box, select **OK** to restart the remote screen.

3.14.7 Restarting a Remote Screen

If you changed the settings for a remote screen, restart it for the changes to take effect. To do so, follow this procedure:

1. On the remote screen, select the **Main Menu** quick key → from the **System** column select **nView Tool** to call out the nView Tool.
2. Select the **Remote Screen** tab.
3. Select **Restart Remote Screen**.

3.14.8 Closing Remote Screens

Remote screens automatically close if the monitor is turned off or disconnected from the network for one minute. To manually close remote screens, follow this procedure:

1. On the remote screen, select the **Main Menu** quick key → from the **System** column select **nView Tool** to call out the nView Tool.
2. Select the **Remote Screen** tab.
3. Select the **Exit Remote Screen**. This will exit all remote screens.

If you started multiple remote screens, you can close any of them separately.

- If the remote screen is not in full screen, select the close button at the top right corner. From the popup dialog box, select **Close This Screen**.
- If the remote screen is in full screen, select the Windows key to call out the taskbar. Right-click the remote screen icon and select **Close Window**. From the popup dialog box, select **Close This Screen**.

3.15 Checking Software Licenses

To run the following functions in your monitor, software licenses are required:

- BoA Dashboard
- SepsisSight
- Early Warning Score (EWS)
- CPR Quality Index (CQI)
- CPR Record
- ECG 24h Summary
- nView
- Numeric Data HL7 Output
- Waveform HL7 Output
- NeuroSight
- AF Summary

To check the licenses, select the **Main Menu** quick key → select **License** → **Local**.

To install the licenses, follow this procedure:

1. Connect the N1 and Dock.
2. Connect the USB drive with the licenses in to the Dock's USB connector.
3. Select the **Main Menu** quick key →select **License** → select **External**.
4. Select **Install**.

3.16 Turning Off the Monitor

Before turn off the monitor, perform the following check:

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

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

Turning off the monitor does not disconnect the monitor from the AC mains. To completely disconnect the power supply, unplug the power cord.

CAUTION

- **Press and hold the power switch for 10 seconds to forcibly shut down the monitor if it could not be shut down normally. This may cause loss of patient data.**

NOTE

- **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, the monitor behaves the same as it is 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 either through the N1 or through the external display.

The external display configured as independent display can display differently with the N1. For the configuration of the independent external display, see section *4.1.3 Setting the External Display*.

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

- Minitrends Screen
- OxyCRG Screen
- Remote View Screen
- ECG Half-Screen
- BoA Dashboard
- PAWP Screen
- Calculations
- EWS
- GCS
- CPR Record
- ST Graphic
- Targeted Goal Screen
- SepsisSight

NOTE

- **The external display can share the mouse or keyboard with the monitor. If you need to use the mouse or keyboard, connect the mouse or keyboard 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 Using the Touchscreen of the External Screen

You can touch the screen or swipe across the screen with your fingers to operate the monitor. For more information, see *3.5.1 Using the Touchscreen*.

4.1.3 Setting the External Display

To set the external display, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select ↵.
2. Select the **Dock Setup** tab.
3. Set **External Screen Contents**.

- **Mirrored**: the contents of the external display is exactly the same with the monitor.
- **Independent**: you can separately configure the contents and layout of the monitor and external display.

NOTE

- **The N1 and the independent display cannot display simultaneously. To switch the display, gently press the power switch of the N1, or double click the display you want to use.**
- **In the situation that the Screen Content is set to Independent and you switch the display to the N1, if there is no operation on the monitor within one minute, the display will automatically switch back to the external display.**
- **When the N1 is connected to the Dock, the N1 can use the external screen setting of the Dock. For more information, see section *23.17 The Dock Setup Settings*.**

4.1.4 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	• 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 if the problem persists.
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 specified display. Using unspecified display may result in unknown problem.**

4.1.5 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.		More	Shows more quick keys.
	Alarm Setup	Enters the **Alarm** menu.		Alarm Reset	Resets the alarm system.
	Audio Pause	Pauses alarm tone.		Alarm Pause	Pauses the physiological alarms.
	Review	Enters the **Review** menu.		Standby	Enters the Standby mode.
	Patient Management	Enters the **Patient Management** menu.		Screen Setup	Enters the **Screen Setup** menu.
	NIBP Start/ Stop	Starts an NIBP measurement or stops the current NIBP measurement.		NIBP Stop All	Stops all NIBP measurements.
	NIBP STAT	Starts a five-minutes continuous NIBP measurement.		NIBP Measure	Enters the **NIBP Measure** menu.

Symbol	Label	Function	Symbol	Label	Function
	PAWP	Enters the **PAWP** screen.		Venipuncture	Inflates the NIBP cuff to help venous puncture.
	Parameters Setup	Enters the **Parameters Setup** menu.		Remote View	Opens the **Remote View** window.
	Manual Event	Manually triggers and saves an event.		Minitrends	Enters the Minitrends screen.
	OxyCRG	Opens the OxyCRG screen.		ECG Full-Screen	Enters 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** menu.		Freeze	Freezes waveforms.
	Calculations	Enters the **Calculations** menu.		Load Config	Enters the **Load Config** menu.
	Print	Starts printing a real-time report.		Resus Mode	Enters the Resus mode.
	ECG Lead/Gain	Enters the **ECG Lead/Gain** menu.		ECG 24h Sum	Opens the **ECG 24h Summary** window.
	BoA Dashboard	Enters the **BoA Dashboard** screen.		EWS	Enters the EWS screen.
	GCS	Enters the **GCS** menu.		SepsisSight	Enters the **SepsisSight** menu.
	Discharge Patient	Enters the **Discharge Patient** dialog box.		Discharged Patients	Enters the **Discharged Patients** dialog box.
	End Case Report	Prints the selected end case reports		Targeted Goal	Enters the Targeted Goal screen.
	NeuroSight	Opens the **NeuroSight** window		AF Summary	Opens the **AF Summary** window
	Zero IBP	Starts IBP zero calibration.			

4.1.6 Configuring the Displayed Quick Keys

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

1. Access **Quick Keys** in either of the following ways:
   - Select the **Screen Setup** quick key → the **Select 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

To enter the Minitrends screen, choose any of the following methods:

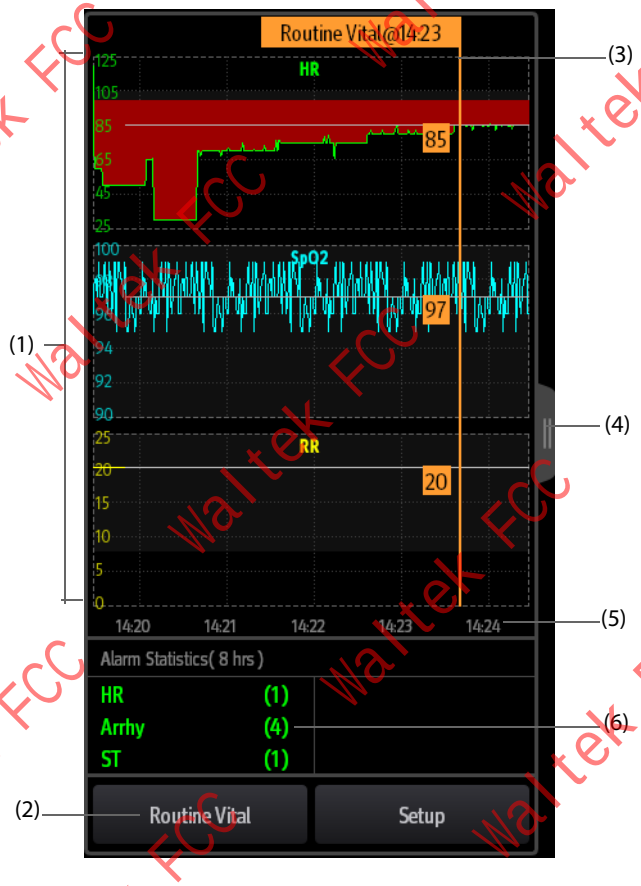
- Select the **Minitrends** quick key.
- Select the **Screen Setup** quick key → Select the **Choose Screen** tab→ select **Minitrends**.
- Select the **Main Menu** quick key → from the **Display** column select **Choose Screen** → select **Minitrends**.

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.



(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 Switching on the Routine Vital/Baseline Function

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.

To switch on the Baseline function, select the **Setup** button, and then switch on **Baseline**.

To switch on the Routine vital function, follow this procedure:

1. Enter the Minitrends screen.
2. Select the **Setup** button.
3. Select the **Routine Vital** tab.
4. Select **Auto** or **Manual** from the dropdown list of **Routine Vital**.

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

- **The Baseline button or Routine Vital button is available only if the baseline function or routine vital function is switched on. For more information, see *4.2.8 Switching on the Routine Vital/Baseline Function*.**

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 **Patient Category** is set to **Neo**. This screen displays 6-minute HR/btbHR, SpO_2 trends, CO_2/Resp compressed waveform, ABD parameters, and the latest ABD events.

The OxyCRG function is intended for neonatal patients only.

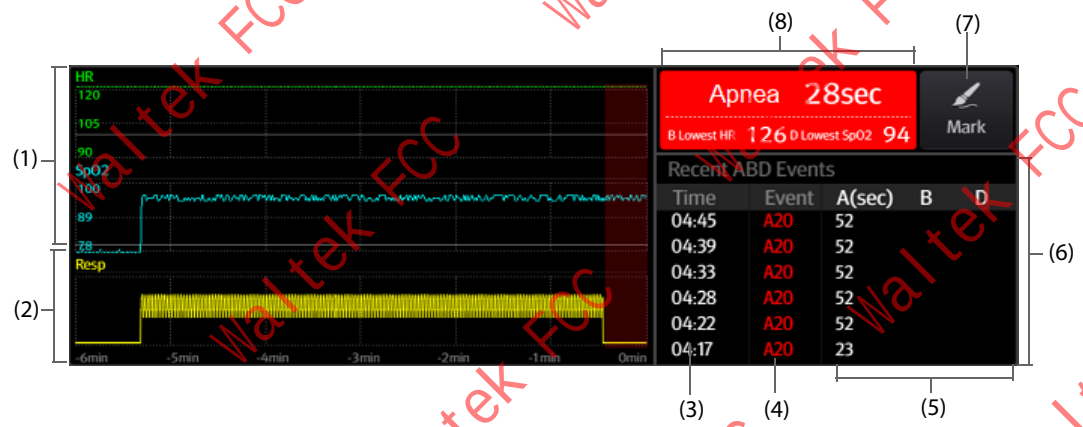
4.3.1 Entering the OxyCRG Screen

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

- Swipe left or right on the touchscreen with two fingers until you 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** menu to edit ABD event.

(8) ABD event prompt area: displays parameter values of currently active OxyCRG events.

NOTE

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

4.3.3 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. • 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	Bradycardia event: the duration of low heart rate, bradycardia, extreme bradycardia, or asystole exceeds the threshold.	/
D	Low SpO2 event: the duration of SpO_2 Desat exceeds the threshold.	/
BD	Bradycardia and low SpO_2 happen at the same time.	/
AB	Apnea and bradycardia happens at the same time.	Red event
AD	Apnea and low SpO_2 happen at the same time.	Red event
ABD	Apnea, bradycardia, and low SpO_2 happen at the same time.	Red event

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:

1. Select the **Mark** button to enter the **Mark** dialog box.
2. Drag the event list upwards and downwards to select the desired event.
3. Select the patient's status when the event happens.
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, SpO_2, IBP, PI, PR, CO_2, Resp, NIBP, and Temp. You can define the target parameter and secondary parameters. The measurements of these parameters displays in big numerics.

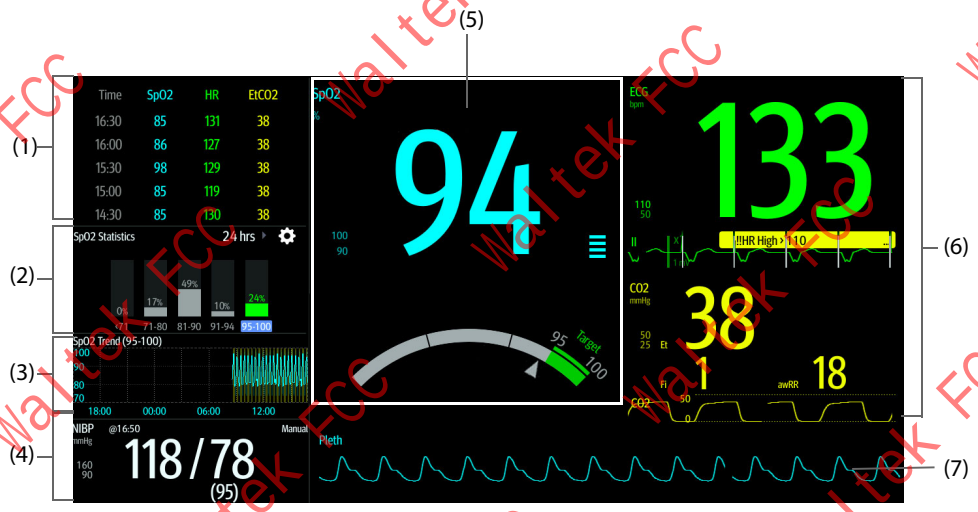
4.4.1 Entering the Targeted Goal Screen

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

- Select the **Targeted Goal** quick key.
- Select the **Screen Setup** quick key → select the **Choose Screen** tab → select **Targeted Goal**.
- Select the **Main Menu** quick key → from the **Display** column select **Choose Screen** → select **Targeted Goal**.
- 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.



(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 △ pointer below the dashboard indicates the current measurement value.
- Selecting this area enters the corresponding parameter setup menu.

(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.

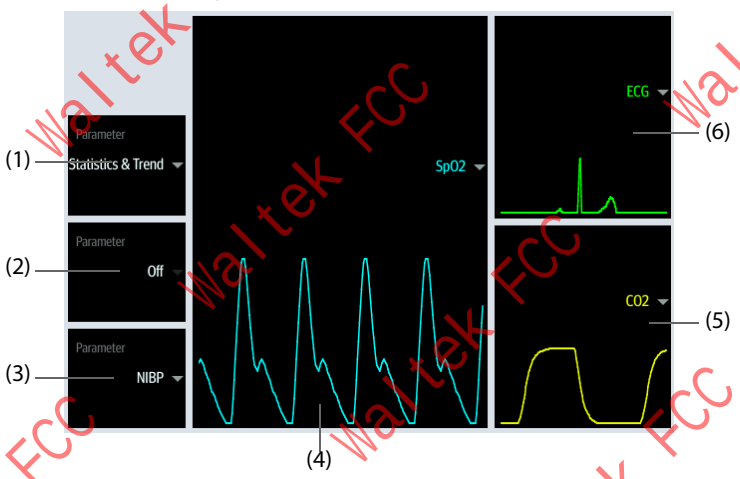
(7) Target parameter waveform area: displays the waveform of the target parameter.

- 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**.
   - ◆ Select the **Main Menu** quick key → from the **Display** column select **Choose Screen** → select **Targeted Goal**.
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 be displayed.



(1) Select this area to define items to be displayed for the target parameter:

- 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.

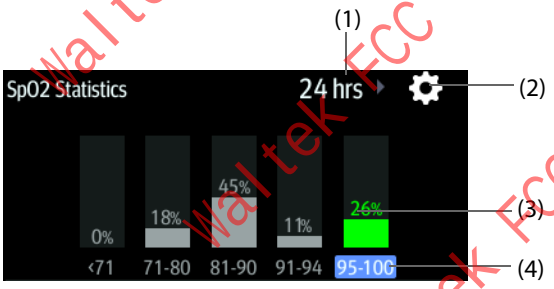
4.4.4 Setting Parameter Statistics

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 menu.

2. Select the range of each section: from the **To** column select the SpO2 value at which corresponding section ends.
3. From the **Target** column select the target section. The target section is highlighted in green in the SpO_2 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 SpO_2 is set as the target parameter.



(1) Statistics duration: select here to change the statistics duration.

(2) Statistics setup icon: select to enter the parameter statistics menu.

(3) Statistics results: the percentage of parameter measurements falling into the corresponding section.

(4) Sections for statistics: the section in green indicates the target range.

4.5 Remote View Screen

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, for example, a bedside monitor. You can simultaneously watch up to 12 remote devices. You can also view the realtime screen of one remote device (the main bed) on the external display.

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

From the **Remote View** screen you can watch the alarm status and alarm messages of up to 12 remote devices, as well as the realtime parameter values and waveforms from the main bed.

NOTE

- **You can also view this monitor from remote devices. This monitor can be viewed by at most 32 remote devices at the same time, in which eight remote devices can watch this monitor's waveforms.**

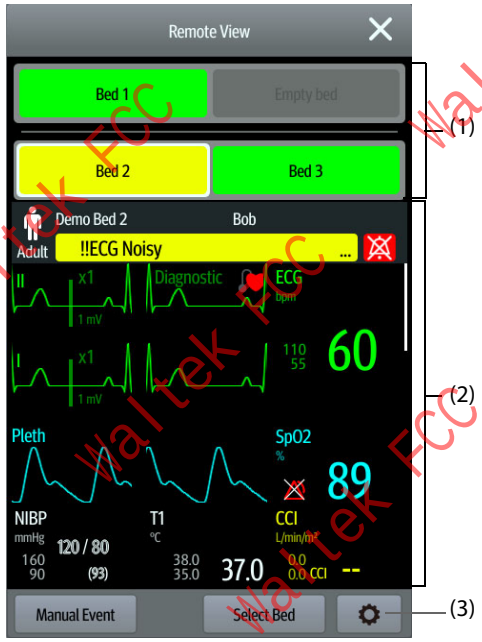
4.5.1 Entering the Remote View Screen

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 *4.5.7.2 Displaying the Alarm Watch Tile on the Main Screen* for configuring to display the tile on the main screen.
- Select the **Screen Setup** quick key → select the **Choose Screen** tab → select **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 the room number and bed number of the remote bed if only one remote device is watched.
- Each bed cyclically displays room number, bed number, and alarm of the highest priority if multiple remote beds are watched.
- The background color of each bed indicates the status of this bed as follows:

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

(2) Main body: displays the realtime parameters and waveforms from the main bed. Scrolling up and down can view more parameters and waveforms.

(3) Remote view setup button: select it to enter the **Remote View** setup menu.

4.5.2 Adding a Bed

You need to add the desired remote devices, and then the alarms from these devices can be watched on your monitor. To add a remote device, follow this procedure:

1. Enter the **Select Bed** menu. To do so, choose either of the following ways:
   - On the **Remote View** screen, select **Select Bed**. For more information, see *4.5.1 Entering the Remote View Screen* for entering the **Remote View** screen.
   - Select the setup icon at the alarm watch tile if the tile is configured to display on the main screen.

2. In the **Select Bed** menu, select a desired department. All the beds under this department will be listed. To select beds in the same care group during the shift of care groups in the CMS, select **Select Beds By Care Group**.
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 alarm watch area and the alarm watch tile if configured.

NOTE

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

4.5.3 Removing a Bed

If you do not want to monitor a remote device any longer, you can remove it. To remove a remote device, follow this procedure:

1. Enter the **Select Bed** menu. 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* for entering the **Remote View** screen.
   - Select the setup icon in the alarm watch tile if the tile is configured to display on the main screen.
2. In the **Select Bed** menu, 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**.

4.5.4 Displaying the Main Bed

To watch the real time monitoring screen of a remote bed, select the bed from the alarm watch area. This bed is called the main bed.

4.5.5 Saving a Manual Event

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

The manual event stores in the event review of the corresponding remote device.

4.5.6 Resetting Alarms for Remote Devices

To reset remote device alarms, from the **Remote View** screen, select **Alarm Reset**.

NOTE

- **You can reset remote device alarms only if the Alarm Reset by Other Bed switch is on at the remote devices. For more information, see *23.4.5 The Combined Alarm Tab*.**

4.5.7 Alarm Watch

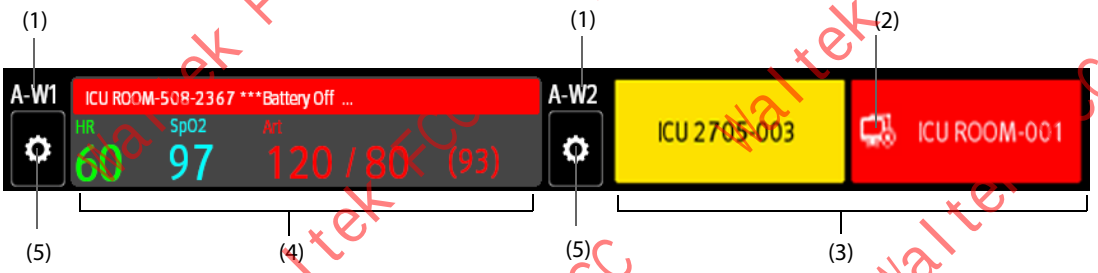
The alarm watch function provides the alarm notification by color and sound.

- 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 in the following areas:
  - At the top of the **Remote View** screen. For more information, see *4.5.1 Entering the Remote View Screen* for details.
  - In the Alarm Watch tile on the main screen. For more information, see *4.5.7.1 The Alarm Watch Tile on the Main Screen* for details.

4.5.7.1 The Alarm Watch Tile on the Main Screen

The main screen can display up to three 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.



The alarm watch tile on the main screen is similar to the alarm watch area on the **Remote View** screen. For more

(1) Alarm watch tile label

(2) Disconnection icon: this icon displays when the remote device is disconnected and the background color of this tile turns 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) Bed selection button: select it to enter the **Select Bed** menu.

information, see *4.5.1 Entering the Remote View Screen*.

4.5.7.2 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** menu.
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**.

4.5.8 Auto Displaying the New 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 the setup icon to enter the **Remote View** setup menu.
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 and 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 reminding 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. Besides, 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
- BoA Dashboard screen
- EWS screen
- CQI waveform in the Resus Mode

4.6.2 Viewing Frozen Waveforms

To view the frozen waveforms, follow this procedure:

- Select the < or > button in the **Freeze** menu.
- Slide the frozen waveform leftward or rightward.

At the lower right corner of the bottommost 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.**
- **The frozen time is not displayed when the waveforms are frozen in the Resus Mode.**

4.6.3 Unfreezing Waveforms

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

4.6.4 Printing Frozen Waveforms

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

5 Managing Patients

5.1 Discharging a Patient

Before monitoring a new patient, discharge the previous patient. After the patient is discharged, the technical alarms is reset, and monitor settings return to their defaults. For more information, see *6.4 Setting Default Configuration*.

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

CAUTION

- **Discharge the previous patient before starting monitoring a new patient. Otherwise there may be risk of mixing patient data.**

5.1.1 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. The configuration of this function is password protected. For more information, see *23.3.3 The Discharge Tab*.

5.1.2 Manually Discharging a Patient

To manually discharge a patient, follow this procedure:

1. Enter the **Discharge Patient** window using any of the following methods:
   - Swipe down the touchscreen with two fingers.
   - Select the patient information area at the top left corner of the screen, and then select **Discharge Patient**.
   - Select the **Main Menu** quick key → from the **Patient Management** column select **Discharge**.
2. Select the desired item from the popup box:
   - **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.

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, you will be prompted whether to start monitoring a new patient if any of the above vital signs are detected again.

Always inputs patient information as soon as the patient is admitted. For more information, see*5.3.2 Editing Patient Information* for details.

WARNING

- **The settings of patient category and paced status always contain a default value, regardless of whether the patient is admitted or not. Check if the setting is correct for your patient.**

- **For paced patients, set Paced to Yes. Otherwise the monitor could mistake a pace pulse for a QRS complex and fail to generate alarms when the ECG signal is too weak.**
- **For non-paced patients, you must set Paced to No.**

5.3 Managing Patient Information

5.3.1 Entering the Patient Management Menu

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

- Select the patient information area at the top left corner of the screen.
- Select the **Main Menu** quick key → from the **Patient Management** column select **Patient Management**.

5.3.2 Editing Patient Information

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

To edit patient information, follow this procedure:

1. Enter the **Patient Management** menu. For more information, see*5.3.1 Entering the Patient Management Menu*.
2. Edit patient information as required.

If you connect a barcode reader with your monitor, you can scan the patient's barcode to enter patient information.

NOTE

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

5.3.3 Loading Patient Information from the CMS

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** menu in either of the following ways:
   - Select the **Main Menu** quick key → from the **Patient Management** column select **Find Patient**.
   - From the **Patient Management** menu select **Find Patient**.
2. Input query criteria. If your monitor is connected with the ADT server, input query criteria from the **Discharged Patients** page.
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 **Import**. Corresponding patient information in the monitor will be updated.

Patients that can be searched for are configurable based on location. For more information, see *23.3.2 The Find Patient Tab*.

5.3.4 Loading Patient Information from the ADT Server

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** menu 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** menu.
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 **Import**. Corresponding patient information in the monitor will be updated.

NOTE

- **You can load patient information from the ADT server only when ADT Query is enabled. For more information, see *7.5 MLDAP*.**
- **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.**

5.4 Transferring Patient

You can transfer the patient data between N1 and the host monitor without re-entering the patient demographic information or changing the settings. Transferring of patient data enables you to understand the patient's history condition. The patient data that can be transferred includes: patient demographics, trend data, event data, full disclosure waveform and parameters settings. The trends data and event data from the parameter modules of the host monitor can also be transferred.

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*.

You can transfer a patient via the MRV Pod to N1 without re-entering the patient demographic information or changing the parameter settings. Transferring of patient data enables you to understand the patient's history condition.

CAUTION

- **Do not discharge a patient before the patient is successfully transferred.**
- **Do not remove the MRV Pod from the monitor before parameter settings are synchronized between MRV Pod and the monitor. Otherwise, patient information saved in the MRV Pod may not be consistent with those in the monitor.**
- **Removing the MRV Pod when transferring historical patient data to the monitor will cause historical data saved in the monitor incomplete.**
- **After a patient is successfully transferred, check if the patient settings (especially patient category, paced status, alarm limits settings, and etc) on the monitor are appropriate for this patient.**

NOTE

- **The system automatically switches on the HR alarm and lethal arrhythmia alarm after transferring the patient data.**

5.4.1 Data Storage Introduction

Understanding the data respectively stored in this monitor and MRV Pod helps you understand the effects incurred by transferring patients with MRV Pod.

Type of storage		Can be stored in the monitor?	Can be transferred via MRV Pod?
Data	Patient demographics	Yes	Yes
	Trend data	Yes	No
	Calculation data	Yes	No
	Event data	Yes	No
	Full disclosure	Yes	No

Type of storage		Can be stored in the monitor?	Can be transferred via MRV Pod?
Settings	Monitor settings (Alarm pause, alarm volume, etc.)	Yes	No
	Parameter settings (Alarm limits, measurement setting, etc.)	Yes	Yes

5.4.2 Transferring Patient Data

To transfer the patient data via MRV Pod, connect the MRV Pod with the monitor.

- If the patient demographics in the monitor are consistent with those of in the MRV Pod, the MRV Pod automatically uploads the data to the monitor.
- If the patient demographics in the monitor are not consistent with those of in the MRV Pod, and **Data Transfer Strategy** is set to **Always Ask**, the monitor prompts the **Select Patient** menu automatically. In this case, you need to select an operation (see the following table) according to the actual situation.

Operations	Operation Description
Continue Patient in Monitor	Continue to use the patient data in the monitor. This deletes all patient data in the MRV Pod and copies all data in the monitor to the MRV Pod.
Continue Patient in MRV Pod	Continue to use the patient data in MRV Pod. The monitor discharges the patient, and automatically admits a new patient and copies all data from MRV Pod.
New Patient	Select this option if you will not use either the information in the monitor or that in the MRV Pod. This deletes all data in the monitor and MRV Pod and lets you admit a new patient on the monitor. In this case, you need to re-enter the patient demographics. The monitor will restore the settings according to the patient category.
Same Patient	Select this option if the patient information in the monitor and MRV Pod are different but you are sure that it is the same patient.

5.5 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 *23.7.4 The Export Tab*.

5.6 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**.

6 Managing Configurations

6.1 Configuration Introduction

When continuously monitoring 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. System configuration items can be classified as: parameter configuration, alarm configuration, and user maintenance. Allowing you to configure the monitor more efficiently, the monitor provides different sets of configurations to accommodate various 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 any of the following department:

- General
- OR
- ICU
- Neonatology
- CCU

WARNING

- **The configuration management function is password protected. The configuration management tasks must be performed by clinical professionals.**

6.2 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.**

6.3 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**.

6.4 Setting Default Configuration

The monitor will load the preset 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 *6.5 Defining Age Segments*.

6.5 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**, and **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.

6.6 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.

6.7 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** menu, selecting **Local** tab shows the existing user configurations on the monitor.
   - In the **Delete Configuration** menu, selecting **USB Drive** tab shows the existing user configurations on the USB drive.
4. Select **Delete**.
5. Select **OK**.

6.8 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.

6.8.1 Exporting a Configuration

To export the current monitor's configuration, follow this procedure:

1. Connect the monitor 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**.

6.8.2 Importing a Configuration

To import the configuration from the USB drive to the monitor, follow this procedure:

1. Connect the monitor 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**.

6.9 Printing Configurations

To print 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**.

6.10 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.**

6.11 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**.

7 Networked Monitoring

7.1 Network Introduction

You can connect the monitor to the central monitoring system (CMS), and eGateway through wired LAN or wireless LAN.

7.2 Network Safety Information

CAUTION

- **Wireless network design, deployment, debugging, and maintenance should be executed by Mindray service personnel or authorized technicians.**
- **Always deploy 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.**
- **To ensure network security and stability, data communication must be performed within a closed network or within a virtually isolated hospital network. 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 leaked. WPA2-Enterprise and a long password are recommended.**
- **Keep network authentication information, for example password, 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 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 data loss and function failure. Check the patient in case of network disconnection and reconnect the network 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 you have any problems on setting the IP address.**

7.3 Connecting the Monitor to 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, alarm settings, and events to the CMS. From the CMS, you can check the patient's monitoring data and alarms.
- 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 network is reconnected.

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

Connect the monitor to the CMS through either of the following methods:

- Admit the monitor on the 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. For more information, see *23.16.2 The Central Station Setup Tab*.

NOTE

- **You can select CMS only when the Select CMS switch is on. For more information, refer to *23.16.2 The Central Station Setup Tab*.**

7.4 Connecting the eGateway

You can connect the monitor to the eGateway 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 getting from the connected external devices to the eGateway.
- Clock can be synchronized between the monitor and the eGateway.

7.5 MLDAP

MLDAP refers to Mindray LDAP (Lightweight Directory Access Protocol). It is an independent process which can be installed on 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** menu

For more information on setting the MLDAP server, see *23.16.8 The MLDAP Tab*. For more information on selecting or changing the passwords, see *23.12 The Authorization Setup Settings*

7.6 Connecting the Wireless Network

You can add up to five wireless networks for the monitor. 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.

7.7 Disconnecting the Wireless Network

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 .

8 Alarms

8.1 Alarm Introduction

This chapter describes alarm functions and alarm settings.

8.2 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 your 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 of the CMS and the other monitors.**
- **The monitors in the care area may have different alarm settings to suit different patients. Before starting monitoring, check that alarm settings are appropriate for the patient. 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, high oxygen level may predispose a premature infant to retrolental fibroplasia. Setting the SpO_2 high alarm limit to 100% is equivalent to switching off the SpO_2 alarm.**
- **When the alarm sound is switched off, the monitor gives no alarm tones even if a new alarm occurs. Be careful about whether to switch off the alarm sound or not. 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 exclusively rely on audible alarms for patient monitoring. Adjusting alarm volume to a low level or turning off alarm sound may result in patient hazards. Always make sure that the audio alarm volume level is adequate in your care environment. Always keep the patient under close surveillance.**

8.3 Understanding the Alarms

8.3.1 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, or other monitor failure, or by failure of sensors or components. 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 some messages telling the system status or patient status.

8.3.2 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 prompt response.
- Low priority alarms: indicates a discomfort condition, a device malfunction, or an improper operation. Low priority alarms require you to be aware of this condition.
- Prompts: provide additional information on the patient or the equipment.

8.3.3 Alarm Priority Escalation

Priority of some alarms can escalate to higher priority. An escalating alarm starts at a preset priority and will escalate to the next higher priority after a certain period of time if the alarm condition has not been resolved or certain alarms occurs at the same time.

- The priority of IBP-S Low alarm escalates from medium to high if any of the following alarms also present: HR Low, Brady, Tachy, ST-XX High, ST-XX Low, A-Fib, Vent Rhythm, Bigeminy, and Trigeminy.
- The priority of SpO2 Low escalates from medium to high if RR High or RR Low also presents and lasts for 0 to 10 minutes (configurable).
- The alarm message of SpO2 Desat changes to SpO2 Desat (with RR High) or SpO2 Desat (with RR Low) if RR High or RR Low also presents.

The following table lists alarm messages of escalated alarms.

Original Alarm Message	Alarm Messages after Escalation
IBP-S Low	IBP-S Low (with HR Low) IBP-S Low (with Tachy) IBP-S Low (with Brady) IBP-S Low (with A-Fib) IBP-S Low (with Vent Rhythm) IBP-S Low (with Bigeminy) IBP-S Low (with Trigeminy) IBP-S Low (with ST Low) IBP-S Low (with ST High)
SpO2 Low	SpO2 Low (with RR High) SpO2 Low (with RR Low)
SpO2 Desat	SpO2 Desat (with RR High) SpO2 Desat (with RR Low)

NOTE

- **The IBP-S low alarm escalates to IBP-S low (with XX) only when any of the following alarms presents before IBP-S Low occurs: Tachy, ST High, ST Low, A-Fib, Vent Rhythm, Bigeminy, or Trigeminy. XX refers to any of these alarms.**
- **The alarm priority escalation function only affects the currently active alarms. Future alarms of the same type will not be affected. New alarms of the same type will be generated at preset priority rather than at the escalated priority.**

8.3.4 Alarm Indicators

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

Alarm Indicator		High Priority Alarm	Medium Priority Alarm	Low Priority Alarm	Prompt
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 alarm of the highest priority to light the alarm lamp and issue the alarm tone.**
- **When multiple alarms of different priority levels occur simultaneously and should be displayed in the same area, the monitor only displays the messages of the highest priority alarm.**
- **When multiple alarms of the same priority levels occur simultaneously, alarm messages are displayed circularly.**
- **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.**

8.3.5 Alarm Status Symbols

Apart from the alarm indicators as described in ***8.3.4 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.

8.3.6 Highlighted Display of Alarm Messages (only available for the independent external display)

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

Alarm messages of the following alarms can be highlighted:

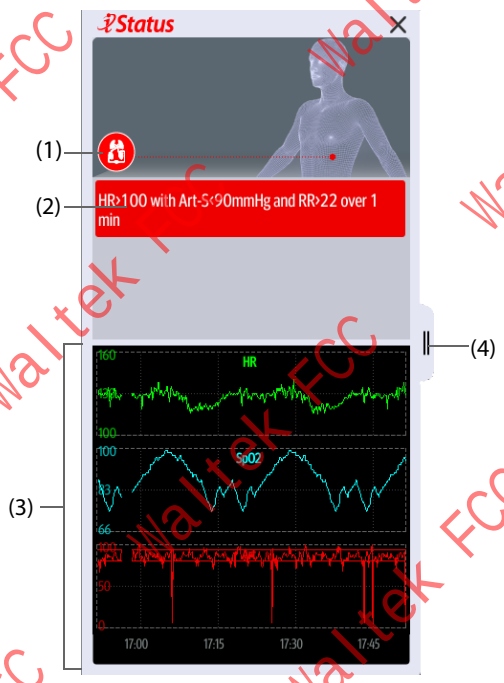
- Lethal arrhythmia alarms, including Asystole, V-Fib/V-Tach, V-Tach, Vent Brady, Extreme Tachy, and Extreme Brady.
- SpO2 Desat
- Apnea
- HR>XX with IBP-S<XX and RR>XX over YY min, in which "XX" represents a parameter threshold and "YY" represents the alarm duration threshold.

8.4 *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 *23.4.5 The Combined Alarm Tab*.

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 ✕ 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.

8.5 Checking Physiological Alarm List

To check the physiological alarm list, follow this procedure:

1. Select the physiological alarm information area to enter the **Alarms** window.
2. Select the **Physiological Alarms** tab.

8.6 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 the technical alarm information area to enter the **Alarms** window.
2. Select the **Technical Alarms** tab.
3. From the alarm list select the desired alarm.

8.7 Alarm Limits

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

8.7.1 Auto Alarm Limits

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

The monitor calculates auto limits basing 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
Resp	RR (rpm)	Adult/ Pediatric	RR × 0.5 or 6 (whichever is greater, no greater than 12)	(RR × 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 85or guard limit (whichever is smaller, no less than 70)	10 to 90
SpO_2	SpO_2 (%)	All	Same as the default alarm limit	Same as the default alarm limit	Same as the measurement range

Module	Parameter	Patient Category	Lower Limit	Upper Limit	Auto Limit Range
NIBP	NIBP-S (mmHg)	Adult	(SYS × 0.68 + 10) or guard limit (whichever is greater, no greater than 110)	(SYS × 0.86 + 38), or guard limit (whichever is smaller, no less than 140)	45 to 270
		Pediatric	(SYS × 0.68 + 10 or guard limit (whichever is greater, no greater than 90)	(SYS × 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 × 0.68 + 8) or guard limit (whichever is greater, no greater than 80)	(Mean × 0.86 + 35), or guard limit (whichever is smaller, no less than 100)	30 to 245
		Pediatric	(Mean × 0.68 + 8) or guard limit (whichever is greater, no greater than 60)	(Mean × 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 to105
	NIBP-D (mmHg)	Adult	(Dia × 0.68 + 6) or guard limit (whichever is greater, no greater than 60)	(Dia × 0.86 + 32), or guard limit (whichever is smaller, no less than 80)	25 to 225
		Pediatric	(Dia × 0.68 + 6) or guard limit (whichever is greater, no greater than 50)	(Dia × 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 the measurement range
IBP/PiCCO	IBP-S (mmHg)	Adult	SYS × 0.68 + 10 or guard limit (whichever is greater, no greater than 110)	SYS × 0.86 + 38 or guard limit (whichever is smaller, no less than 140)	45 to 270
		Pediatric	SYS × 0.68 + 10 or guard limit (whichever is greater, no greater than 90)	SYS × 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 × 0.68 + 8 or guard limit (whichever is greater, no greater than 80)	Mean × 0.86 + 35 or guard limit (whichever is smaller, no less than 100)	30 to 245
		Pediatric	Mean × 0.68 + 8 or guard limit (whichever is greater, no greater than 60)	Mean × 0.86 + 35 or guard limit (whichever is smaller, no less than 80)	30 to180
		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 × 0.68 + 6) or guard limit (whichever is greater, no greater than 60)	(Dia × 0.86 + 32) or guard limit (whichever is smaller, no less than 80)	25 to 225
		Pediatric	(Dia × 0.68 + 6) or guard limit (whichever is greater, no greater than 50)	(Dia × 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/pArt, Ao, UAP, BAP, FAP, LV, P1, P2, P3, P4. pArt is applied to adult and pediatric patients.				

Module	Parameter	Patient Category	Lower Limit	Upper Limit	Auto Limit Range
IBP	PA-S (mmHg)	All	SYS × 0.75, no less than guard limit and no greater than 15	SYS × 1.25, no greater than guard limit and no less than 25	3 to 120
	PA-M (mmHg)	All	Mean × 0.75, no less than guard limit and no greater than 5	Mean × 1.25, no greater than guard limit and no less than 10	3 to 120
	PA-D (mmHg	All	Dia × 0.75, no less than guard limit and no greater than 5	Dia × 1.25, no greater than guard limit and no less than 6	3 to 120
	IBP-M	All	Mean × 0.75, no less than guard limit and no greater than 5	Mean × 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 × 0.68 + 8, no less than 60	CPP × 0.86 + 35, no greater than 90	20 to 235
		Pediatric	CPP × 0.68 + 8, no less than 50	CPP × 0.86 + 35, no greater than 70	25 to175
		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
PiCCO	pCVP (mmHg)	Adult/ Pediatric	Mean × 0.75	Mean × 1.25	3 to 40
CO_2	$EtCO_2$ (mmHg)	All	0 to 32: remains the same 33 to 35: 29 36 to 45: (EtCO2 - 6) 46 to 48: 39 >48: remains the same	0 to 32: remains the same 33 to 35: 41 36 to 45: (EtCO2 + 6) 46 to 48: 51 >48: remains the same	Same as the measurement range
	$FiCO_2$	All	None	Same as the default alarm limit	Same as the measurement range
CO_2	awRR (rpm)	Adult/ Pediatric	awRR × 0.5 or 6 (whichever is greater)	awRR × 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

8.7.2 Initiating Auto Alarm Limits

The monitor provides the auto alarm limits function to automatically adjust alarm limits according to the patient's vital signs using. When auto limits are selected, the monitor calculates safe auto limits based on the latest measured values. To get accurate auto alarm limits, you need to 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.

8.7.3 Guard Limit

You can set guard limits for some parameters to prevent alarm limits from being set too high or too low. Setting guard limits is password protected. For more information, see *23.4.4 The Guard Limits Tab*.

8.7.4 Alarm Limit Recommendations (only available for the independent external display)

If the base values of the patient's vital signs are abnormal or the patient's status has a tendency change, using the current alarm limits may continuously or frequently trigger alarms. When monitoring HR, PR, SpO_2, RR, and arterial pressure, the monitor has a function of recommending alarm limits. If the alarm counts or the ratio of accumulated alarm duration reaches the preset value, or a parameter measurement frequently approaches the alarm limit, the monitor can recommend an alarm limit.

The alarm limit recommendation function is intended for adult and pediatric patients.

NOTE

- **The alarm limit recommendation function is not applied to the Resus mode, intubation mode and CPB mode.**
- **The alarm limit recommendation function is not applied to the operating room.**
- **The alarm limit recommendation function is not intended for neonatal patients.**

8.7.4.1 Viewing Alarm Limit Recommendations

When an alarm limit recommendation is triggered, the alarm limit recommendation icon *Alarm* is displayed above the quick key area. To view the alarm limit recommendation, select the **Alarm Setup** quick key.

The following figure is an example of the Alarm Limit Recommendation window:

(1) Prompt and recommendation

(2) Parameter trend of the last one hour

(3) Recommended alarm limit

(4) Select here to set alarm high limit

(5) The current alarm high limit

(6) The current alarm low limit

(7) Select here to set alarm low limit

The value in green and followed by a green pentagram is the recommended alarm limit.

- Select **Apply** to apply the recommended alarm limit. You can also set an alarm limit as needed, and then select **Apply** to apply the new alarm limit.
- Select **Reject** to ignore the recommended alarm limit.

If an recommended alarm limit is accepted or rejected, the monitor starts a new alarm limit analysis window.

8.7.4.2 Configuring Alarm Limit Recommendation

The alarm limit recommendation function is enabled by default. However, you can switch it off. The monitor gives alarm limit recommendation only when this function is switched on.

To configure alarm limit recommendation, follow this procedure:

1. Select the **Main Menu** quick key → from the **Alarms** column select **Setup** to enter the *Alarm* menu.
2. Verify that **Alarm Limits Recommendation** is switched on.
3. Set the criteria for providing alarm limit recommendation.
   - **Analysis Window**: sets the duration of alarm limit analysis.
   - **Alarm Count in Analysis Window**: the monitor recommends an alarm limit when the alarm count reaches the threshold within the analysis window.
   - **Alarm Duration Ratio in Analysis Window**: the monitor recommends an alarm limit when the ratio of accumulated alarm duration reaches the preset value within the analysis window.

NOTE

- **The monitor recommends an alarm limit when either the alarm count or alarm duration ration reaches the preset value within the analysis window.**

8.7.5 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. Select **Defaults** at the bottom.

8.8 Changing Alarm Settings

From the **Alarm** column of the main menu select desired buttons to set alarm properties.

8.8.1 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. Select a parameter tab and set alarm properties as desired. Enter the password if required. For more information, refer to *23.12 The Authorization Setup Settings*.

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

8.8.2 Setting Alarm Tone Properties

8.8.2.1 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 optional alarm volume is between X to 10, in which X is the minimum volume, depending on the setting of minimum alarm volume, 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.**

8.8.2.2 Password Protected Audio Alarm Settings

The following alarm settings are password protected:

- Minimum alarm volume
- Alarm sound pattern
- Alarm interval
- Alarm sound escalation switch and delay

For more information, see *23.4.1 The Audio Tab*.

8.8.3 Enabling Special Alarm Sound

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

- Lethal 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 Special Advanced Alarm Sound in *23.4.1 The Audio Tab*.

NOTE

- **The special alarm sound is available only when Alarm Sound is set to ISO2. See Alarm Sound from *23.4.1 The Audio Tab*.**

8.8.4 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.

This setting is password protected. For more information, see *23.4.7 The Other Tab*.

The setting of **Alarm Delay** is not applied to the apnea alarms and the ST alarms. You can set **Apnea Delay** and **ST Alarm Delay** separately.

WARNING

- **The alarm delay time can be set to a maximum of 15 seconds. Changing this setting to an inappropriate level could result in a hazard to the patient.**

8.8.5 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.

8.8.6 Adjusting the Alarm Light Brightness

This setting is password protected. For more information, see *23.4.7 The Other Tab*.

NOTE

- **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.**

8.8.7 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.

The monitor has predefined some combined alarms. You can modify the settings of these alarms. You can also add up to 10 custom combined alarms.

The following operations 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.

NOTE

- **The predefined combined alarm function is not intended for pediatric and neonatal patients.**
- **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, selected icon type is used to indicate the alarmed system or organ.**
- **You can only delete custom combined alarms.**

8.8.8 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**.

8.8.9 Setting the Delay of SpO2 Low Alarm Escalation

To set the delay time of SpO2 Low Alarm escalation, follow this procedure:

1. Select the **Main Menu** quick key → from the **Alarm** column select **Setup.**
2. Set **SpO2 Low Escalation Time**.

8.9 Pausing Alarms/Pausing Alarm Tones

8.9.1 Defining the Pause Function

You can either pause alarms or pause alarm tones. This depends on the pause setting. This setting is password protected. For more information, see *23.4.2 The Pause/Reset Tab*.

8.9.2 Pausing Alarms

If the pause function is designated as pausing alarms, pressing the **Alarm Pause** quick key can temporarily disable alarm indicators. 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 remain 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 status is automatically deactivated. You can also cancel the alarm paused status by pressing the **Alarm Pause** quick key.

The following alarm pause and alarm reset settings are password protected.

- Alarm pause time
- Priorities of paused alarms
- Alarm reset setting
- Reminder tone settings

For more information, see *23.4.2 The Pause/Reset Tab*.

8.9.3 Switching Off All Alarms

If **Pause Time** is set to **Permanent** (see *23.4.2 The Pause/Reset Tab*), pressing the **Alarm Pause** quick key permanently switches off all alarms. The alarm off status 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 status, press the **Alarm Pause** quick key again.

WARNING

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

8.9.4 Pausing Alarm Sound

If the pause function is defined as **Audio Pause**, pressing the **Audio Pause** key pauses alarm tone. 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 paused status is automatically deactivated. You can also cancel the audio paused status by pressing the **Audio Pause** quick key.

8.9.4.1 Setting the Alarm Tone Pause Time

The alarm tone pause time can be set to **1 min**, **2 min**, **3 min**, or **Permanent**. The default audio pause time is two minutes.

This function is password protected. For more information, see *23.4.2 The Pause/Reset Tab*.

8.9.4.2 Prolonging the Alarm Tone Pause Time

You can temporarily prolong the alarm tone pause time after the monitor enters the alarm tone paused status. This function is password protected. For more information, see *23.4.2 The Pause/Reset Tab*.

NOTE

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

8.9.4.3 Setting the Priority of Audio Paused Alarms

You can select alarm sound of what priority can be paused. This function is password protected. For more information, see *23.4.2 The Pause/Reset Tab*.

8.9.4.4 Switching Off Alarm Sound

If **Pause Time** is set to **Permanent** (see *23.4.2 The Pause/Reset Tab*), pressing the **Audio Pause** quick key permanently switches off all alarm sound. The audio off status 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 status, press the **Audio Pause** quick key again.

WARNING

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

8.10 Resetting Alarms

Pressing 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.**

8.10.1 Resetting Physiological Alarms

Physiological alarms give different alarm indicators when the alarm system is reset:

- 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.

8.10.2 Resetting Technical Alarms

Technical alarms give different alarm indicators when the alarm system is reset:

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

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

8.11 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 until you reset the alarms. For latched alarms the time when the alarm is last triggered is displayed behind the alarm message.

You can 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 issues alarm sounds when the alarm condition ends.

The alarm latch settings is password protected. For more information, see *23.4.3 The Latching Tab*.

NOTE

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

8.12 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 in order to inactivate unnecessary alarms.

8.12.1 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

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

8.12.2 Exiting the CPB Mode

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

8.13 Intubation Mode

Intubation mode is available for Resp and CO_2 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 CO_2 related physiological alarms are switched off.

8.13.1 Entering the Intubation Mode

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

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

8.13.2 Exiting the Intubation Mode

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

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

8.14 Testing Alarms

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

8.15 Actions When an Alarm Occurs

When an alarm occurs, observe the following steps and take proper actions:

1. Check the patient's condition.
2. Confirm the alarming parameter or alarm category.
3. Identify the source of the alarm.
4. Take proper action to eliminate the alarm condition.
5. Make sure the alarm condition is corrected.

For more information, see *E Alarm Messages*.

9 Using with MRV Pod (BeneVision VP10)

9.1 Introduction

The MRV Pod can be used with BeneVision N1 to provide ECG, Resp, SpO_2, PR, NIBP, IBP and Temp monitoring for a patient. BeneVision VP10 is the model of the MRV Pod.

The MRV Pod consists of the following parts:

- MRV Pod:
  - Wireless MRV Pod: to be used with an MRV Pod Pocket, and can be connected to the monitor wirelessly or with cable.
  - Wired MRV Pod: to be used with an MRV Pod Rack, and can be connected to the monitor with cable.
- Monitoring accessories: including ECG cables (with SpO_2 sensor connector), TEMP/IBP cables, and NIBP cuffs.
- Clamps: used to secure an MRV Pod to a bed, infusion pole or operation table.

MRVpod is the registered trademark owned by Mindray in China and other countries.

NOTE

- **Check if your monitor has an "Ultimate" label on the right. If not, you can upgrade the software to support using with an MRV Pod with a cable. Contact the service personnel.**
- **After the monitor without "Ultimate" label is upgraded the software, it does not support 12-lead ECG measurement and analog output when connected to an MRV Pod.**

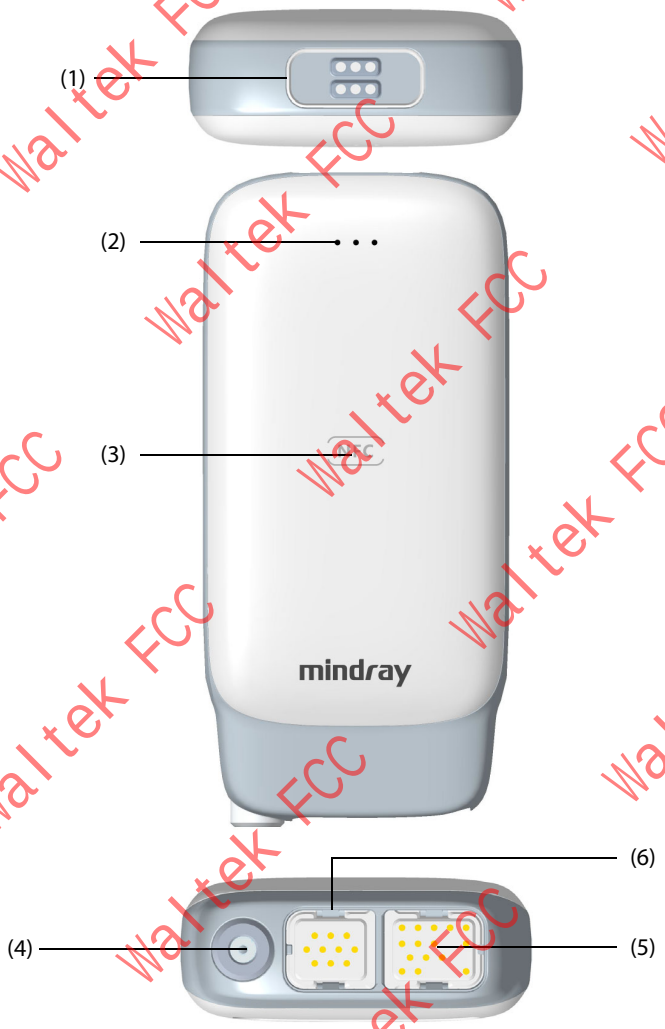
9.2 Overview of MRV Pod

9.2.1 Overview of Wireless MRV Pod

Top view

Front view

Bottom view



(1) Multifunctional connector: connects the MRV Pod Pocket.

(2) Battery indicator:

When in use, the indicator indicates the current charge and working status of the battery:

- Three lights illuminated in white: the battery charge is sufficient.
- Two lights illuminated in white: the battery charge is at medium level.
- One light illuminated in white: the battery charge is low.
- The light on the left illuminated in yellow: the battery is depleted and needs to be charged immediately.
- All lights illuminated in yellow: a self-test error occurred, and the MRV Pod needs to be checked.

When charging, the indicator indicates the charging and working status of the battery:

- Flashing white: the battery is being charged.
- White: the battery is fully charged.
- All lights illuminated in yellow: a self-test or charging error occurred, and the MRV Pod needs to be checked.

(3) NFC label: used to pair an NFC device for data transmission

(4) NIBP cuff connector

(5) ECG cable connector: an ECG cable connects ECG leadwire and SpO_2 sensor. For details, refer to *9.2.5 Overview of ECG Cable (with SpO_2 Sensor Connector)*.

(6) IBP cable connector: an IBP cable connects IBP transducers, and Temp probes if configured. For details, refer to *9.2.6 Overview of IBP and TEMP/IBP Cable*.

9.2.2 Overview of MRV Pod Pocket

(1) MRV Pod cavity: used to hold and connect a wireless MRV Pod.

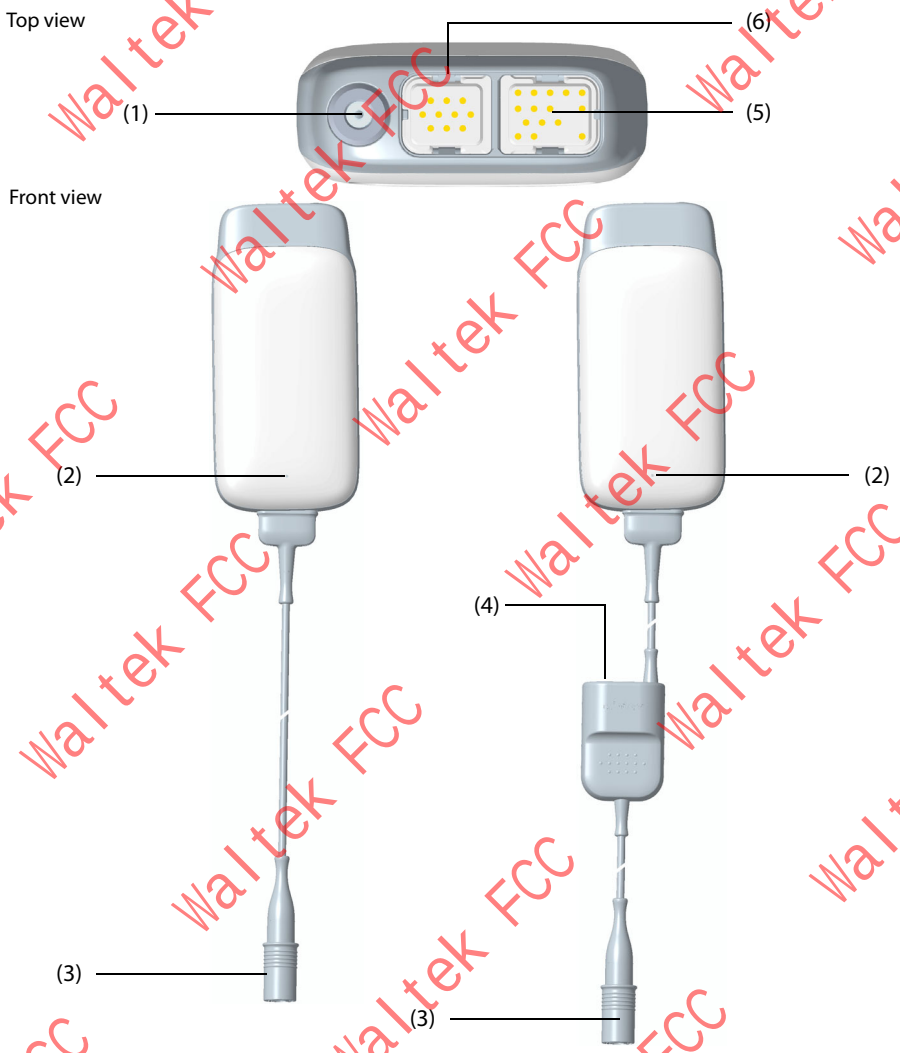
(2) Release button: press to unlock the MRV Pod from the MRV Pod Pocket.

(3) Multifunctional connector: connects BeneVision N1 for data transmission and power supply.

(4) Analog out connector: outputs defibrillation synchronization pulse, ECG, and IBP analog signal.

(5) Guiding slot: used to engage with a clamp. The base is 180-degree rotatable, facilitating cable routing for the patient.

9.2.3 Overview of Wired MRV Pod



(1) NIBP cuff connector

(2) Working status indicator:

- White: the MRV Pod works normally.
- Yellow: a self-test error occurred, and the MRV Pod needs to be checked.

(3) Multifunctional connector: connects BeneVision N1 for data transmission and power supply.

(4) Analog out connector: outputs defibrillation synchronization pulse, ECG, and IBP analog signal.

(5) ECG cable connector: an ECG cable connects ECG leadwire and SpO_2 sensor. For details, refer to *9.2.5 Overview of ECG Cable (with SpO_2 Sensor Connector)*.

(6) IBP cable connector: an IBP cable connects IBP transducers, and Temp probes if configured. For details, refer to *9.2.6 Overview of IBP and TEMP/IBP Cable*.

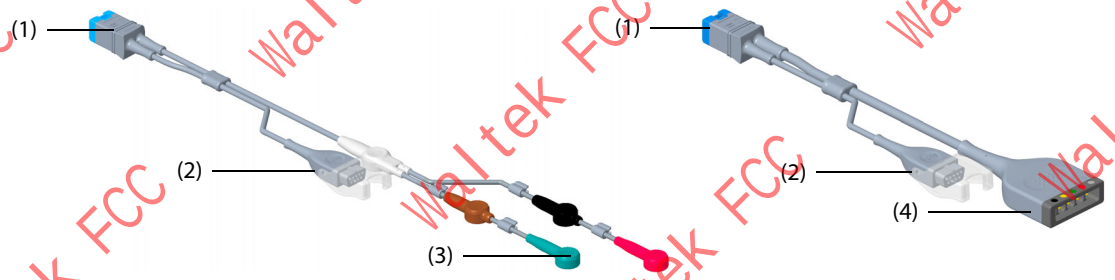
9.2.4 Overview of MRV Pod Rack

(1) Guiding slot: used to engage with a clamp

(2) Auto-centering block: used to secure an MRV pod. Rotate it 90 degrees if you need to take the MRV pod out.

(3) MRV Pod cavity: used to hold and connect a wired MRV Pod

9.2.5 Overview of ECG Cable (with SpO_2 Sensor Connector)



Single-wire ECG cable

Multi-wire ECG cable

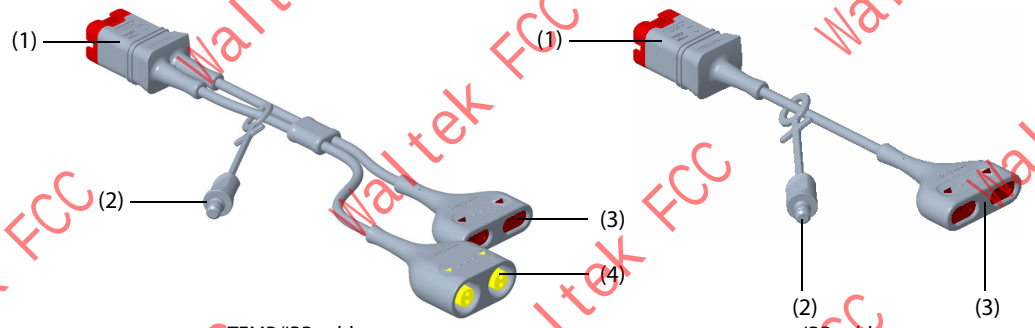
(1) MRV Pod connector: connects the MRV Pod.

(2) SpO_2 trunk cable: connects an SpO_2 sensor.

(3) ECG electrode

(4) ECG leadwire connector: connects ECG leadwires

9.2.6 Overview of IBP and TEMP/IBP Cable



TEMP/IBP cable

IBP cable

(1) MRV Pod connector: connects the MRV Pod.

(2) Rubber plug: placed into the NIBP cuff connector on the MRV Pod for waterproofing during cleaning and disinfection.

(3) IBP cable connectors: connects IBP extension cables or adapter cables, which can be connected to IBP transducers.

(4) Temp probe connectors

9.3 Connecting MRV Pod

A wireless MRV Pod can be connected to BeneVision N1 wirelessly or with cable, while wired MRV Pod can only be connected to BeneVision N1 with cable.

An MRV Pod can be connected to BeneVision V series monitor via BeneVision N1. For connection between BeneVision N1 and BeneVision V series monitor, refer to the operator's manual of BeneVision V series monitor.

An MRV Pod can also be connected to BeneVision N series monitor via BeneVision N1 with cable. For connection between BeneVision N1 and BeneVision N series monitor, refer to the operator's manual of BeneVision N series monitor.

WARNING

- **When using MRV Pod on a patient, always make sure the MRV Pod is firmly secured. Otherwise, it may fall off, pulling cables attached to the patient, which could cause serious or life-threatening injury to the patient, especially for neonates.**
- **Do not place the MRV Pod into incubators.**
- **To ensure proper heat dissipation, do not cover the MRV Pod with any object.**

CAUTION

- **To prevent battery depletion, connect MRV Pod to the monitor via cable during prolonged bedside use.**
- **During in-ward activities, when monitoring the patient with MRV Pod, if the distance between MRV Pod and monitor exceeds operational range, or wireless interference exists in the environment, data transmission may be unstable. It is recommended to connect MRV Pod to the BeneVision N1 via cable.**
- **When monitoring the patient with MRV Pod, if you need to transfer the patient, or the patient is moving outside the ward, carry the BeneVision N1 with the patient. The wireless interference may exist in the transferring environment or outside the ward, if the MRV Pod is connected to BeneVision N1 wirelessly, data transmission may be unstable.**
- **Use caution when handling the clamps. Applying excessive force, such as striking and dropping, would deform or even damage the clamps.**

NOTE

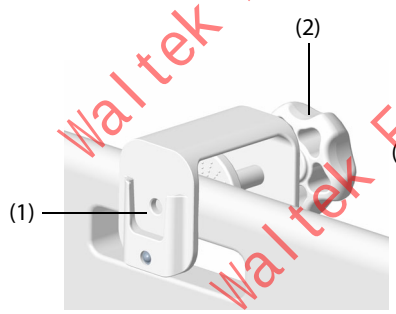
- **When used in combination with the BeneVision N1, the MRV Pod does not support wireless connectivity to the BeneVision N series monitor.**
- **When the MRV Pod is connected to BeneVision N series monitor via BeneVision N1, the monitor does not support the function of IBP waveforms overlap and the Patient Data Transfer function of the MRV Pod.**

9.3.1 Connecting Wireless MRV Pod with Cable

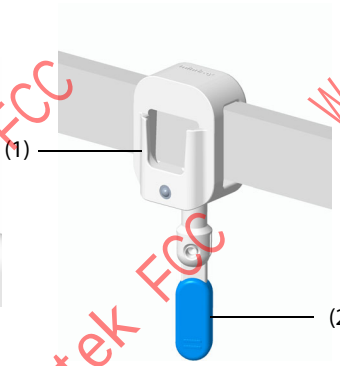
Follow this procedure:

1. Turn on the monitor.
2. Select a clamp based on the intended installation position.

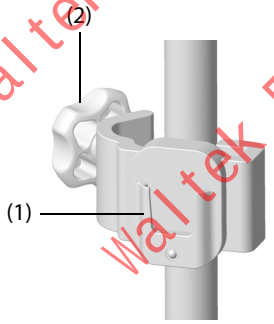
To bedrail



To guide rails



To infusion poles



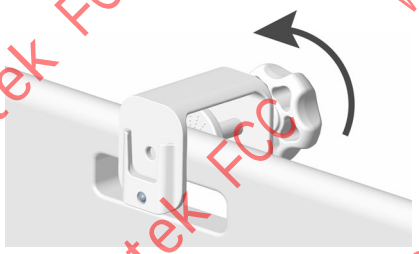
(1) Guiding slot: used to engage with an MRV Pod Pocket or MRV Pod Rack.

(2) Knob:

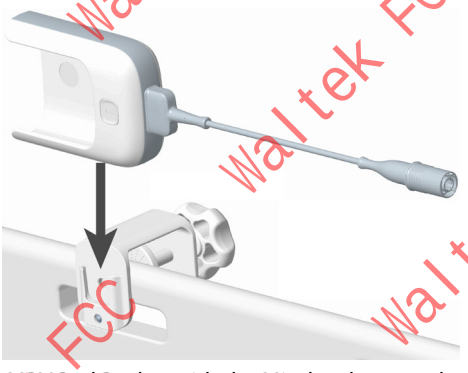
- Rotate clockwise to secure the clamp to a bed, operation table or infusion pole.
- Rotate counterclockwise to loose the clamp.

3. Fix an MRV Pod Pocket onto the patient bed, operation table or infusion pole with a clamp (taking bedrail clamp for example).

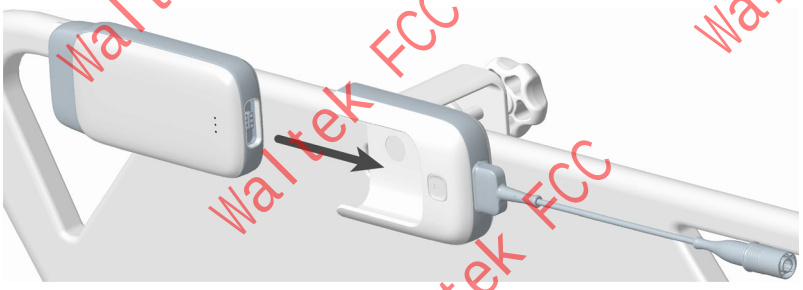
   a Rotate the knob to fix the clamp to a patient bed, operation table or infusion pole. Make sure the opening of the guiding slot is upward.



   b Engage the MRV Pod Pocket to the clamp.



   c Fit the MRV Pod to the MRV Pod Pocket with the Mindray logo on the MRV Pod facing out. Make sure you can hear a click, which means the MRV Pod is fit in place.



   d Rotate the MRV Pod Pocket to better route the cables.

4. Connect the multifunctional cable on the MRV Pod Pocket to the multifunctional connector on the monitor.

Then the wireless MRV Pod automatically pairs with the monitor.

9.3.2 Connecting Wireless MRV Pod Wirelessly

Follow this procedure:

1. Connect the wireless MRV Pod to the monitor with cable as instructed in *9.3.1 Connecting Wireless MRV Pod with Cable*.
2. Press the release button and take the MRV Pod out from the MRV Pod Pocket.

WARNING

- **If the MRV pod beeps or a message indicating poor MRV Pod connection is prompted on the monitor, the patient may be leaving the network-accessible area. If the patient moves further, the MRV Pod is likely to lose connection with the monitor and patient monitoring might be interrupted. Ask the patient to move back or keep the patient under close observation.**
- **After the wireless MRV Pod is disconnected from the monitor, the beeps will last for 10 minutes. Please reconnect to the monitor in time.**

9.3.3 Switching a Connected Wireless MRV Pod to Another Monitor

A wireless MRV Pod connected to a monitor can be switched to another monitor seamlessly via NFC. Follow this procedure:

1. Connect a wireless MRV Pod to a monitor wirelessly as described in *9.3.2 Connecting Wireless MRV Pod Wirelessly*.
2. Turn the second monitor on.
3. Place the MRV Pod close to the NFC tag on the second monitor until you hear a beep.

CAUTION

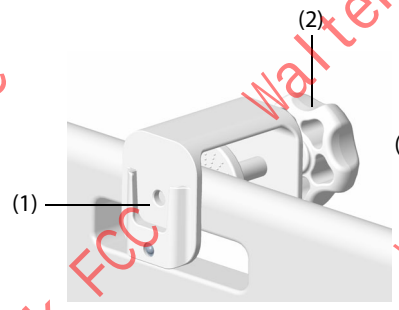
- **Data loss could occur if the MRV Pod is away from the monitor further than the distinct vision distance.**
- **After pairing an MRV Pod with the monitor, connect the MRV Pod to the correct patient.**
- **Keep the metal contacts on the MRV Pod clean and dry. Otherwise, poor connection would result.**
- **Do not cover the MRV Pod with anything that could prevent ventilation.**

9.3.4 Connecting Wired MRV Pod

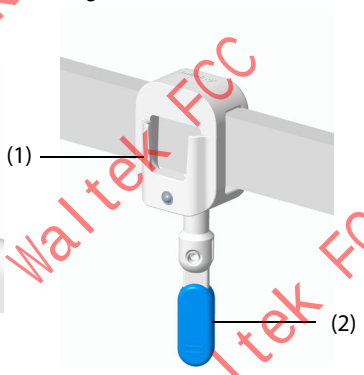
A wired MRV Pod connects the monitor with cable. Follow this procedure:

1. Turn on the monitor.
2. Select a clamp based on the intended installation position.

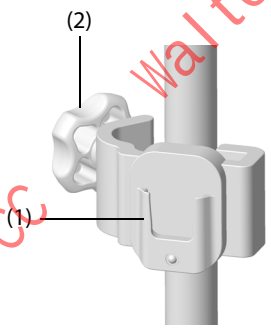
To bedrail



To guide rails



To infusion poles

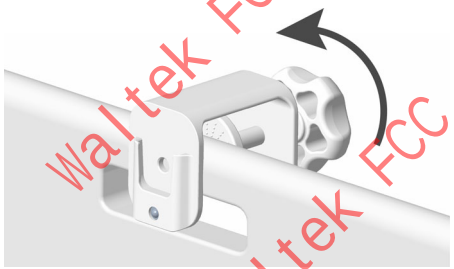


(1) Guiding slot: used to engage with an MRV Pod Pocket or MRV Pod Rack.

(2) Knob:
- Rotate clockwise to secure the clamp to a bed, operation table or infusion pole.
- Rotate counterclockwise to loose the clamp.

3. Fix an MRV Pod Rack onto the patient bed, operation table or infusion pole with a clamp (taking bedrail clamp for example).

   a Rotate the knob to fix the clamp to the patient bed, operation table or infusion pole.



   b Engage the MRV Pod Rack to the clamp.

c Fit the MRV Pod to the MRV Pod Rack in a way that better routes the cable. Make sure you can hear a click, which means the MRV Pod is fit in place.

4. Connect the multifunctional connector on the wired MRV Pod to the multifunctional connector on the monitor.

9.4 Disconnecting MRV Pod from the Monitor

9.4.1 Disconnecting a Wired MRV Pod

To disconnect a wired MRV Pod from the monitor, hold the connector of the multifunctional cable of the MRV Pod, press the tip slightly and then pull it out from the monitor.

CAUTION

- **Always hold the connector part other than the cable when disconnecting the multifunctional cable. Otherwise, the cable may be damaged.**

9.4.2 Disconnecting a Wireless MRV Pod

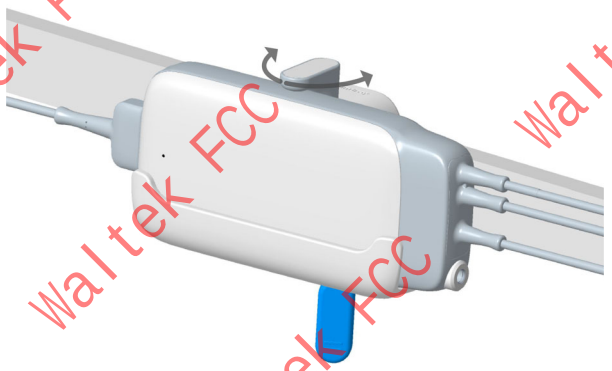
To disconnect a wireless MRV Pod from the monitor, follow this procedure:

1. If the MRV Pod is connected to the monitor with cable, you can choose either of the following ways:
   - Take the MRV pod out from the MRV Pod Pocket;
   - Disconnect the multifunctional cable from the monitor as described in *9.4.1 Disconnecting a Wired MRV Pod*.
2. On the monitor, select the **Main Menu** quick key → from the **Parameter** column select **Bedside Devices**.
3. Select the MRV Pod and then select **UnPair**.

9.4.3 Removing a Wired MRV Pod from the MRV Pod Rack

If you need to remove a wired MRV Pod from the MRV Pod Rack, follow this procedure:

1. Turn the auto-centering block 90 degrees to the left or the right.



2. Take out the MRV Pod.

10 Monitoring ECG, Arrhythmia, ST and QT

10.1 ECG Introduction

The electrocardiogram (ECG) measures and records the electrical activity of the heart. ECG monitoring provides 3-, 5-, 6-, and 12-lead ECG monitoring, ST-segment analysis, arrhythmia analysis, and QT/QTc measurements.

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

10.2 ECG Safety Information

WARNING

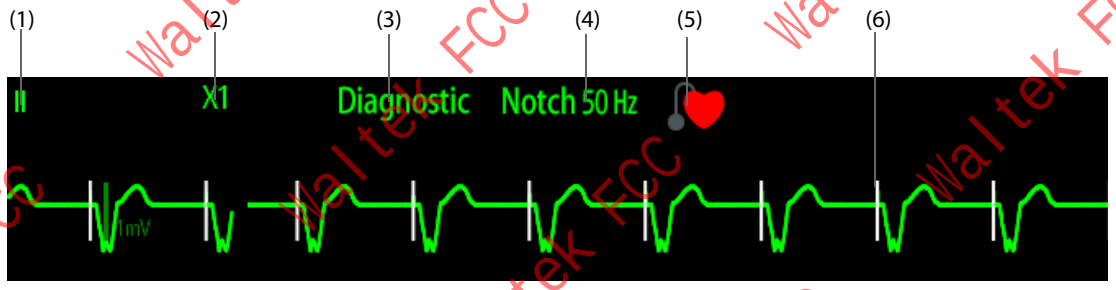
- **This equipment is not intended for direct cardiac application.**
- **Make sure the conductive parts of electrodes and associated connectors, including the neutral electrode, do not contact any other conductive parts including earth.**
- **Use defibrillation-proof ECG cables during defibrillation.**
- **Do not touch the patient or metal devices connected to the patient during 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 electrosurgery unit (ESU).**
- **To reduce 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 site to ensure skin integrity. If the skin quality changes, replace the electrodes or change the application site.**
- **Interference from ungrounded instrument near the patient and electrosurgery interference can induce noise and artifact into the waveforms.**

10.3 ECG Display

The following figures show the ECG waveform and numeric areas:



(1) ECG lead label of the displayed waveform. When 6-lead placement is used to derive 12-lead ECG (D12L), all derived leads are marked with a "d" in front of the lead label, for example "dV1".

(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 mark: If **Paced** is set to **Yes**, the pace pulse markers "|" are displayed corresponding to detected pace pulse on each ECG waveform.

(1) Parameter label (2) HR unit

(3) HR alarm limits (4) HR value

NOTE

- **The ECG numeric area and waveform area are configured to be different for different lead type and ECG settings.**

10.4 Preparing for ECG Monitoring

10.4.1 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, follow this procedure:

1. 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.
4. Dry the skin completely before applying electrodes.

10.4.2 Applying Electrodes

To connect ECG cables, follow this procedure:

1. Check that electrode packages are intact and the electrodes are not past the expiry date. Make sure 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. Make sure 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.

NOTE

- **Store the electrodes at room temperature.**
- **Only open the electrode package immediately prior to use.**
- **Never mix patient electrode types or brands. This may lead to problem due to impedance mismatch.**
- **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.**

10.4.3 Lead Wire Color Code

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

Lead	IEC		AHA	
	Label	Color	Label	Color
Right arm	R	Red	RA	White
Left arm	L	Yellow	LA	Black
Right leg (neutral)	N	Black	RL	Green
Left leg	F	Green	LL	Red
Chest 1	C1	White/Red	V1	Brown/Red
Chest 2	C2	White/Yellow	V2	Brown/Yellow
Chest 3	C3	White/Green	V3	Brown/Green
Chest 4	C4	White/Brown	V4	Brown/Blue
Chest 5	C5	White/Black	V5	Brown/Orange
Chest 6	C6	White/Violet	V6	Brown/Violet

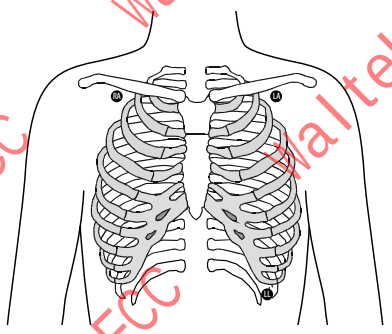
10.4.4 ECG Electrode Placement

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

10.4.4.1 3-lead Electrode Placement

3-lead electrode placement is as follows::

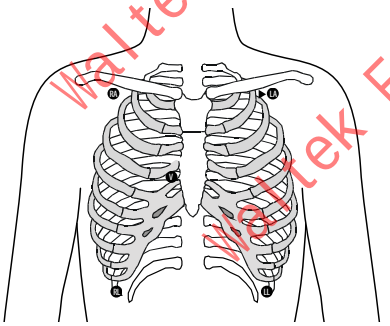
- RA: just below the clavicle and near the right shoulder.
- LA: just below the clavicle and near the left shoulder.
- LL: below the lower left edge of the rib cage.



10.4.4.2 5-lead Electrode Placement

5-lead electrode placement is as follows:

- RA: just below the clavicle and near the right shoulder.
- LA: just below the clavicle and near the left shoulder.
- RL: below the lower right edge of the rib cage.
- LL: below the lower left edge of the rib cage.
- V: on the chest.



10.4.4.3 6-lead Electrode Placement

For 6-lead electrode placement, you can use the position for the 5 -lead placement but with two chest leads. Chest leads Va and Vb can be positioned at any two of the V1 to V6 positions. For more information, see *10.4.4.4 Chest Electrode Placement*. The Va and Vb lead positions are configurable. For more information, see *10.6.4.4 Changing Va and Vb Labels*.

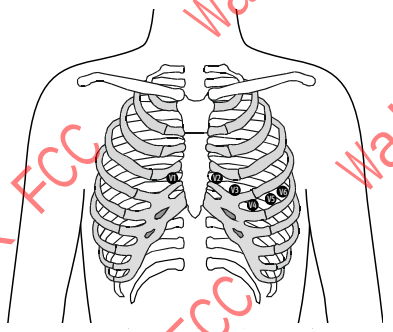
When 6-lead placement is used to derive 12-lead ECG, Va and Vb shall use any of the following combinations.

- V1 and V3, V1 and V4, V1 and V5
- V2 and V4, V2 and V5
- V3 and V5, V3 and V6

10.4.4.4 Chest Electrode Placement

The chest electrode can be placed at the following positions:

- V1: on the fourth intercostal space at the right border of sternal.
- V2: on the fourth intercostal space at the left border of sternal.
- V3: midway between V2 and V4.
- V4: on the fifth intercostal space on the left midclavicular line.
- V5: on the left anterior axillary line at the same horizontal level as V4.
- V6: on the left midaxillary line at the same horizontal level as V4 and V5.

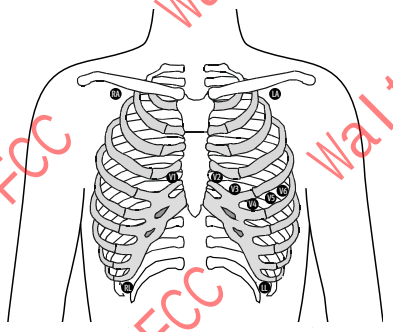


NOTE

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

10.4.4.5 12-lead Electrode Placement

12-lead ECG monitoring uses 10 electrodes. The chest electrodes can be placed according to the physician's preference. The picture at the right side shows the conventional 12-lead electrode placement. For the placement of RA, RL, LA, and LL, see *10.4.4.2 5-lead Electrode Placement*. For the placement of chest electrodes, see*10.4.4.4 Chest Electrode Placement*.



10.4.4.6 Lead Placement for Pacemaker Patients

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

Do not place an ECG electrode directly over the pacemaker generator. Place the electrodes 5 cm to 7 cm 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.

10.4.4.7 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.**
- **If the ESU is used, do not place ECG electrodes near the grounding plate of the ESU. Otherwise interference on ECG signals may occur.**

10.4.5 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** menu.
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.

10.4.6 Checking Paced Status

You should check the patient's paced status before monitoring ECG. The paced symbol is displayed when **Paced** is set to **Yes**. The pace pulse markers "|" are shown on each ECG waveform when the patient has a paced signal. If **Paced** is set to **No** or if the patient's paced status is not selected, 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** menu.
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 menu. For more information, see *5.3.1 Entering the Patient Management Menu*.

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, set Paced to Yes. Otherwise the monitor could mistake a pace pulse for a QRS complex and fail to generate alarms 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 heart 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 or neonatal patients.**
- **For non-paced patients, you must set Paced to No.**

10.4.7 Enabling Pacer Rejection

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** menu.
2. Select the **Pacer** tab.
3. Switch on **Pacer Reject**.

NOTE

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

10.5 Using 6-lead Placement to Derive 12-lead ECG (D12L)

The monitor supports using the 6-lead placement to derive 12-lead ECG. This function is called D12L. When D12L is enabled, the monitor can derive four additional chest leads according to directly acquired ECG signals. D12L provides a non-diagnostic 12-lead view, including ECG waveforms and ST/QT measurements. D12L is intended for adult patients only.

The available Va and Vb combinations supporting D12L are:

- V1 and V3, V1 and V4, V1 and V5
- V2 and V4, V2 and V5
- V3 and V5, V3 and V6

D12L is disabled by default. To enable D12L, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.
3. Select the positions of Va and Vb. You shall use an available Va and Vb combination.
4. Switch on **D12L**.

WARNING

- **D12L is not intended for pediatric and neonatal patients.**
- **The positions of Va and Vb shall be consistent with the settings of Va and Vb. Otherwise D12L does not work properly.**
- **The derived leads cannot be used for heart rate calculation and arrhythmia analysis.**
- **The derived 12-lead ECGs should not be used for diagnostic interpretations.**

NOTE

- **You shall use the available Va and Vb combination supporting D12L. If you choose other combinations, D12L does not work and the message "D12L not available" is prompted.**

10.6 Changing ECG Settings

10.6.1 Choosing an ECG Screen

When monitoring ECG, you can choose the screen as desired.

- For 3-lead ECG monitoring, only normal screen is available.
- For 5-lead or 6-lead ECG monitoring, besides the normal screen, you can also choose the full screen.
- For 12-lead ECG monitoring, besides the normal screen, you can also choose the full screen, and 12-lead full screen.

To choose the desired screen configuration, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. From the bottom of the menu, select **Full-Screen** or **12-Lead** (for 12-lead ECG monitoring).

10.6.2 Setting ECG Alarm Properties

To set ECG alarm properties, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Alarm** tab.
3. Enter the password if required.
4. Set alarm properties as desired.

10.6.3 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** menu.
2. Select the **Setup** tab.
3. Set the **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 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 Single Lead analysis mode.**
- **When a 3-lead ECG cable is used, the monitor always uses a single lead as the calculation lead and the Analysis Mode option is not available.**

10.6.4 Changing ECG Wave Settings

10.6.4.1 Selecting the Leads of Displayed ECG Waveforms

To select the leads of displayed ECG waveforms, follow this procedure:

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

The waveform of selected lead should have the following characteristics:

- The QRS complex is tall and narrow.
- The QRS complex is completely above or below the baseline. It should not be biphasic.
- The amplitudes of P waves and T waves are less than 0.2 mV.

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.**

NOTE

- **If D12L is enabled, you cannot select the derived leads as ECG1 or ECG2.**

10.6.4.2 Setting the ECG Waveform Layout

To set the ECG waveform layout, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
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.

10.6.4.3 Changing ECG Waveform Size

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

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
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.

10.6.4.4 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** menu.
2. Select the **Setup** tab.
3. Set **Va** and **Vb** according to the Va and Vb electrode sites. Default settings are **Va** and **Vb**.

10.6.4.5 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** menu.
2. Select the **Setup** tab.
3. Set **Speed**.

10.6.4.6 Setting the ECG Filter

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

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.
3. Set **Filter**.
   - **Diagnostic**: is used when ECG waveforms of diagnostic quality is required.
   - **Monitor**: is used in routine ECG monitoring.
   - **Surgery**: is used if ECG signals are distorted by high or low frequency noise. In the operating room, setting **Filter** to **Surgery** can reduce ESU interference. However, during normal ECG monitoring, selecting **Surgery** may suppress certain features or details of the QRS complexes.
   - **ST**: is recommended for ST monitoring.

10.6.4.7 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** menu.
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.**

10.6.5 Disabling the Smart Lead Off Function

The monitor provides the smart lead off function. When the lead of the first ECG wave is 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** menu.
2. Select the **Setup** tab.
3. Switch off **Smart Lead**.

10.6.6 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** menu.
2. Select the **Setup** tab.
3. Set **QRS Volume**.

When valid SpO_2 measurements are available, the monitor adjusts the pitch of QRS tone based on the SpO_2 value.

10.6.7 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** menu.
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 QRS amplitude is low, the monitor might not be able to calculate heart rate and false asystole calls may occur.**

NOTE

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

10.7 CrozFusion™

The monitor provides the CrozFusion™ function when the MPM module is used to monitor the patient's ECG, SpO2, and IBP.

The CrozFusion function analyzes ECG signals, SpO2 signals, and IBP signals together to achieve more accurate arrhythmia analysis results and improve the accuracy of HR/PR parameter measurement.

The CrozFusion™ function is intended for adult patients only.

10.7.1 CrozFusion™ Display

The ECG parameter area displays CrozFusion symbol and signal fusion status when the CrozFusion™ function is enabled, see the figure below:

(1) CrozFusion symbol and signal fusion status

The following table lists indications of different signal fusion status:

CrozFusion ECG Pleth IBP	The quality of ECG signal, Pleth signal, and IBP signal are good. ECG signal, Pleth signal, and IBP signal are independently analyzed.
CrozFusion ECG Pleth IBP	PR values may be inaccurate. ECG signal quality is better than Pleth and IBP signal quality. PR comes from HR.
CrozFusion ECG Pleth IBP	HR parameter or arrhythmia may be inaccurate. Pleth signal quality is better than ECG signal quality. ECG and Pleth signal fusion to correct HR or suppress false arrhythmia result.
CrozFusion ECG Pleth IBP	HR parameter or arrhythmia may be inaccurate. IBP signal quality is better than ECG signal quality. ECG and IBP signal fusion to correct HR or suppress false arrhythmia results.

NOTE

- **The CrozFusion function is not intended for pediatric and neonatal patients.**
- **The CrozFusion function is not applied to pacer not pacing and pacer not capture.**
- **The CrozFusion™ function uses ECG arrhythmia analysis leads according to the Analysis Mode setting. So the ECG signal quality indicates the signal quality of the ECG analysis leads. For more information, see *10.6.3 Setting the Analysis Mode*.**

- **The CrozFusion™ function is available only when the MPM module or N1 is configured with Mindray SpO_2.**
- **The CrozFusion™ function is available only when the MPM module is used to monitor IBP. If the pulse pressure difference is too small, ECG and IBP pulse signal fusion will not happen.**
- **The CrozFusion™ function is not recommended for patients in unstable hemodynamic status, such as low perfusion**
- **If the CrozFusion™ function is enabled, do not rely entirely on it. Always keep the patient under close surveillance for the vital parameter changes.**

10.7.2 Disabling the CrozFusion™ Function

The CrozFusion™ function is enabled by default. However, in some situations the CrozFusion™ function may not be able to work properly, so you should disable the CrozFusion™ function.

The CrozFusion function is not intended for the following situations:

- Performing CPR
- Using an artificial heart-lung machine for extracorporeal circulation surgery or using V-A ECMO
- Using IABP
- Patients with persistent regular restlessness

To disable the CrozFusion™ function, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the ECG menu.
2. Select the **CrozFusion** tab.
3. Switch off **CrozFusion**.

WARNING

- **The monitor is used for one patient at a time.**
- **ECG, Pleth, or IBP signals from different patients may result in incorrect signal fusion.**
- **When the CrozFusion function is enabled, arrhythmia may be wrongly suppressed or interference may be ignored . In above situations, you may disable the CrozFusion function according to patient condition.**

10.8 Monitoring Arrhythmia

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

10.8.1 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 arrhythmia. 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.**
- **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%, sometimes there may be some false arrhythmias detected and also some true arrhythmia events may not be detected. This is especially true when the signal is noisy.**
- **The ECG size and minimum QRS detection threshold settings affect arrhythmia detection and heart rate calculation sensitivity.**

- **If QRS amplitude is low, the monitor might not be able to calculate heart rate and false asystole calls may occur.During the learning phase of the algorithm, arrhythmia detection may not be available. So you should closely monitor patient condition during and for several minutes after the learning phase to allow the algorithm to reach optimal detection performance.**

10.8.2 Arrhythmia Events

This section lists all arrhythmia events and their criteria.

10.8.2.1 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.
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.

10.8.2.2 Nonlethal Arrhythmia Events

Arrhythmia message	Description
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, N, V, N, 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.

Arrhythmia message	Description
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 time threshold of pause.
Irr Rhythm	Consistently irregular rhythm (N, irregular RR interval change is greater than 12.5%)
A-Fib	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 within the irregular rhythm end delay time.
A-Fib End	Atrial fibrillation no longer detected within the Afib 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

10.8.3 Displaying Arrhythmia Information

You can display the arrhythmia information in the numeric 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. Click the numeric area where you want to display the arrhythmia information, and then select ECG → **Arrhythmia**.

10.8.4 Changing Arrhythmia Settings

10.8.4.1 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** menu.
2. Select the **Arrhythmia** tab→ **Alarm** tab.
3. Enter the password if required.
4. 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 *23.4.4 The Guard Limits Tab*.**
- **The priority of lethal arrhythmia alarms is always high. It cannot be altered.**

10.8.4.2 Changing Arrhythmia Alarm Threshold Settings

You can change threshold settings for some arrhythmia alarms. When an arrhythmia violates 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** menu.
2. Select the **Arrhythmia** tab → select the **Threshold** tab.
3. Enter the password if required.
4. Set the threshold of 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.**

10.8.4.3 Arrhythmia Threshold Range

Arrhythmia	Threshold Range
Asystole Delay	3 sec to 10 sec
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	15bpm 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	1.5sec, 2.0sec, 2.5sec, 3.0sec
AF/Irr Rhy End Time	0, 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

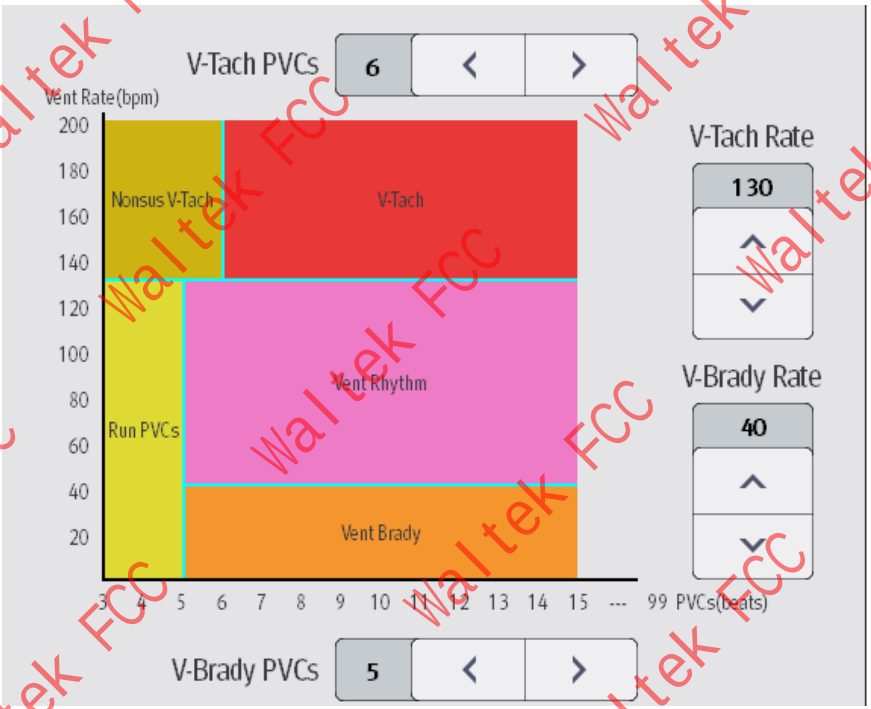
10.8.4.4 Setting Thresholds for PVC-Related Alarms

The monitor detects PVC-related alarms basing on 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** menu.
2. Select the **Arrhythmia** tab → select the **More Threshold** tab.
3. Enter the password if required.
4. Adjust **V-Tach PVCs**, **V-Tach Rate**, V-Brady PVCs, and V-Brady Rate to set the threshold of 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.

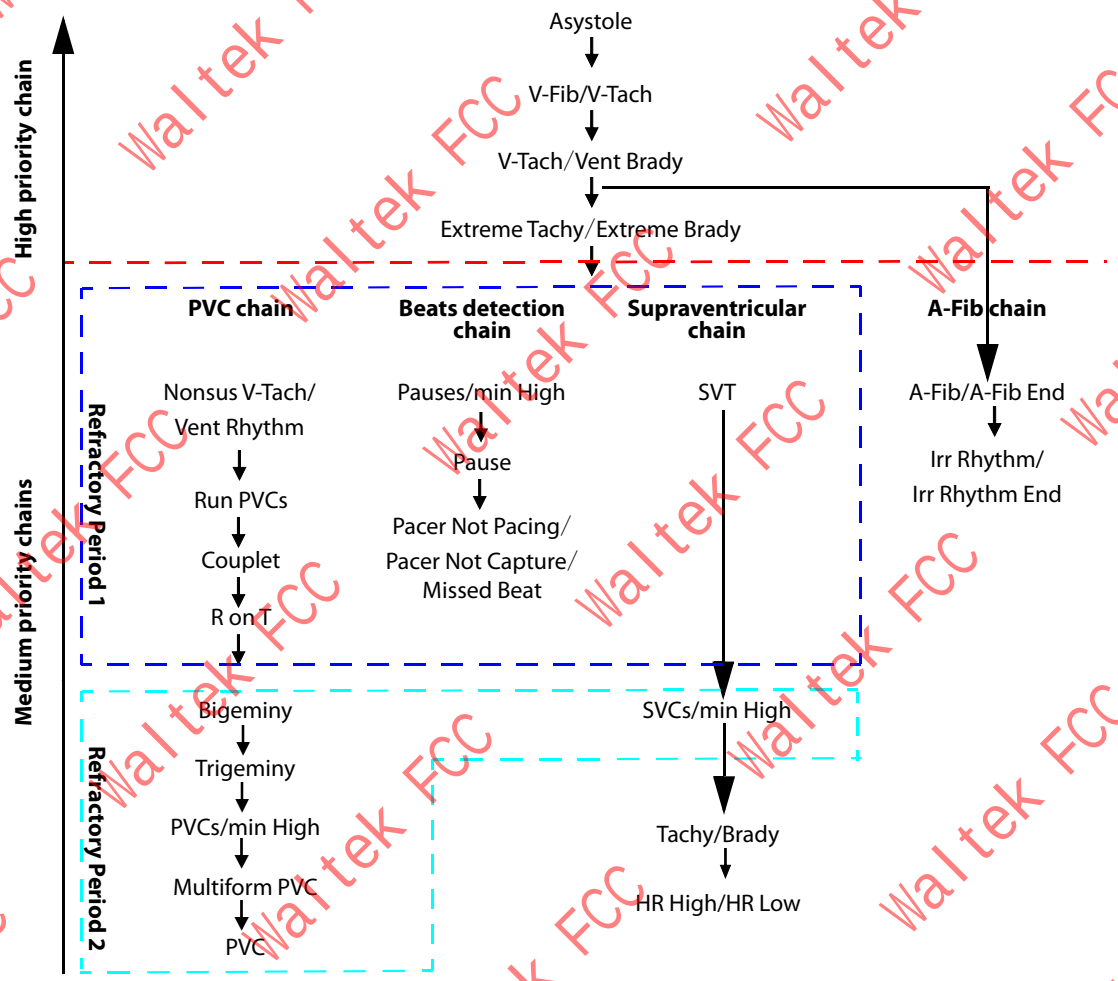
10.8.5 Deactivated Arrhythmia Alarms

The monitor generally issues an alarm once an arrhythmia 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 *10.8.5.2 Arrhythmia Shielding Period* and *10.8.5.4 Setting Arrhythmia Refractory Periods*.

10.8.5.1 Arrhythmia Alarm Chains

If multiple arrhythmia conditions occur simultaneously, announcing all detected alarm conditions may be confusing. This may result in serious conditions being overlooked. So arrhythmia alarms are prioritized through alarm chains.

There are five arrhythmia alarm chains: one high priority chain and four medium priority chains, including PVC chain, beats detection chain, supraventricular chain, and A-Fib chain.



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

10.8.5.2 Arrhythmia Shielding Period

The arrhythmia algorithm can disable alarm light and alarm tone for designated period of time when certain arrhythmia alarms are detected. This period is called arrhythmia shielding period.

This function is password protected. For more information, see **Arrhy Shield Time** in *23.4.7 The Other Tab*.

NOTE

- **The arrhythmia shielding period is only applicable to arrhythmias in the medium priority chains. For arrhythmias in the high priority chain, alarm tone and alarm light are generated as soon as an alarm condition is detected.**
- **The arrhythmia shielding period has no impact on HR High, HR Low, Tachy, Brady, A-Fib End, Irr Rhythm End.**

10.8.5.3 Arrhythmia Alarm Shielding Rules

The following table explains how auidble and visual alarm indicate during the arrhythmia 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

10.8.5.4 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 in a designated period of time. This period is called 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** menu → 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 *10.8.5.1 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.**

10.9 ST Segment Monitoring

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

10.9.1 ST Safety Information

WARNING

- **ST values may be affected by such factors as some 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 the ST segment changes must be decided by the physician.**

10.9.2 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** menu.
2. Select the **ST** tab→ select the **Setup** tab.
3. Switch on **ST Analysis**.

ST analysis may not be reliable under the following situations. Consider switching off ST analysis in these cases:

- The patient is implanted with a ventricular pacemaker.
- The patient has left bundle branch block.
- Arrhythmias such as atrial fibrillation or flutter occur, which may cause irregular baseline.
- All ECG leads are noisy.

10.9.3 Displaying ST Numerics

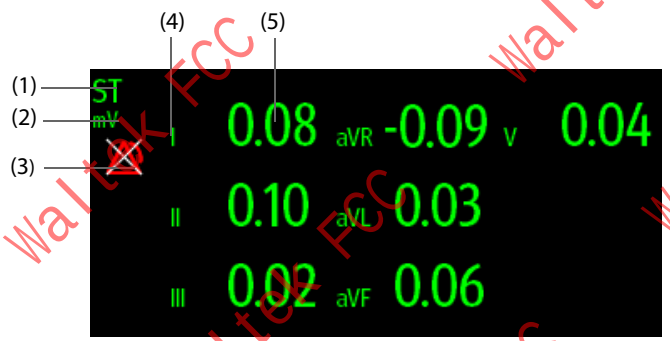
To display ST numerics and Segments, follow this procedure:

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 numeric area where you want to display the ST numerics, and then select **ECG** → **ST**.

The display of ST parameters area is different according to the lead type:

- When you are using the 3-lead ECG leadwires, the ST numeric area does not display. A ST value displays in the ECG numeric area.
- When you are using the 5-lead ECG leadwires, the ST numeric area displays 7 ST 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 values: ST-I, ST-II, ST-III, ST-aVR, ST-aVL, ST-aVF, ST-Va, ST-Vb.
- When you are using the 6-lead ECG placement to derive 12-lead ECG (D12L), the ST numeric area displays 12 ST 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, in which two chest leads are directly measured and four are derived. The derived leads are marked with a "d" in front of the lead label, for example “dV1”.
- When you are using the 12-lead ECG leadwires, the ST numeric area displays12 ST 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:



(1) Parameter label. When 6-lead placement is used to derive 12-lead ECG (D12L), all derived leads are marked with a "d" in front of the lead label, for example “dV1”.

(2) ST unit (3) ST alarm off symbol (4) Lead labels

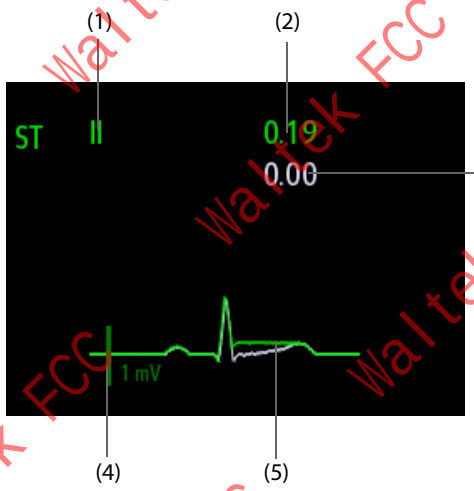
(5) ST numerics: a positive value indicates ST segment elevation, and a negative value indicates ST segment depression.

10.9.4 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 Segment**.

The waveform area displays the current and baseline ST segments. It also displays the current and baseline ST values. In the following picture, the current ST segment and value are in green, while the baseline ST segment and value are in white.



(1) ST lead (2) Current ST value

(3) Baseline ST value (4) 1 mV scale

(5) Current ST segment (green) and baseline ST segment (white)

10.9.5 Entering the ST View

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

You can enter the ST view either by selecting the ST segment in the waveform area or by the following ways:

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

NOTE

- **In the ST view, the derived leads are marked with a "d" in front of the lead label, for example "dV1".**

10.9.6 Saving the Current ST as Baseline

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

1. From the **ST View** window, 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** window, 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

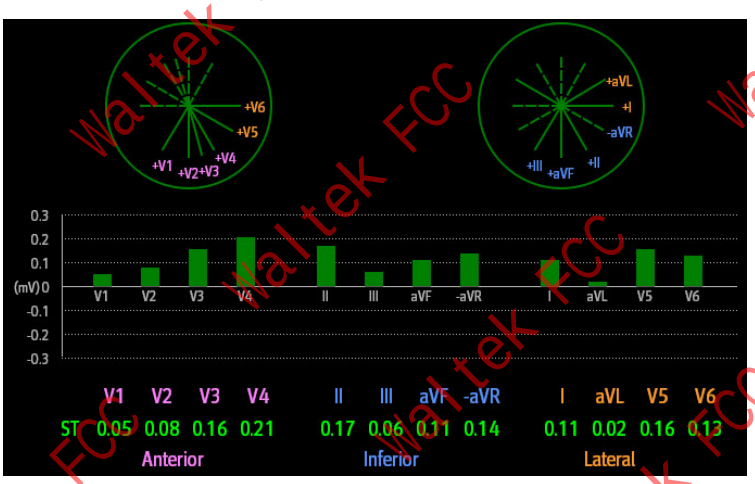
- **If you set the ST baseline with D12L enabled, the baseline time is followed by "(D12L)", for example "Baseline 2017-04-06 20:30 (D12L) ".**

10.9.7 Entering the ST Graphic Window (only available for the independent external display)

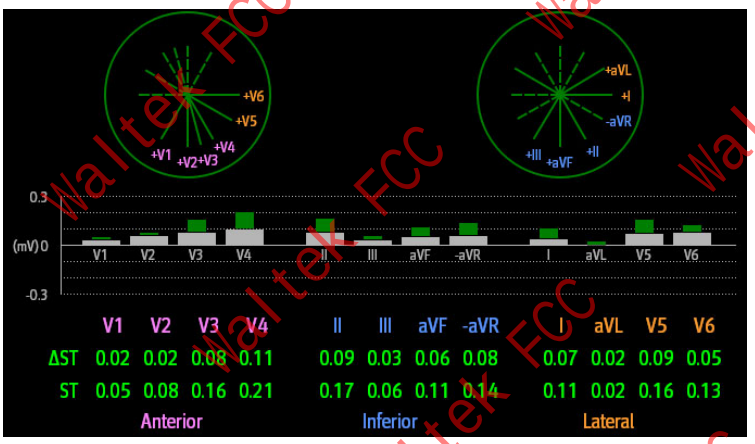
To display **ST Graphic** window, follow this procedure:

1. Select ST numeric area, ECG numeric area, or ECG waveform area to enter the **ECG** menu.
2. Select the **ST** tab.
3. From the bottom of the menu, 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 value of corresponding ST lead. The color of the bar indicates ST alarm status: green indicates that corresponding ST value is within alarm limits; cyan, yellow and red indicate that the ST 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 value and the green bar (cyan, yellow or red if an alarm occurs) indicates ΔST.



NOTE

- **In the ST Graphic, the derived leads are marked with a "d" in front of the lead label, for example "dV1".**

10.9.8 Changing ST Settings

10.9.8.1 Setting ST Alarm Properties

To set ST alarm properties, follow this procedure:

1. Select the ST numeric area, ECG numeric area, or ECG waveform area to enter the **ECG** menu.
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.
   - **Relative**: you can set the alarm properties for **ST Single** and **ST Dual** alarms.
4. Set ST alarm properties.

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

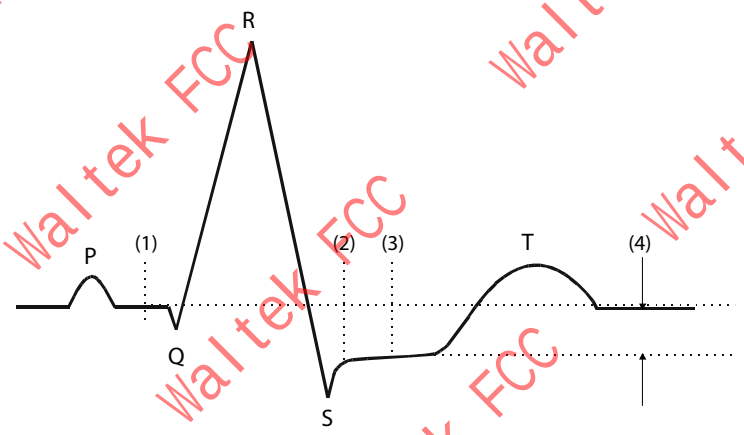
10.9.8.3 Showing ISO Point, J Point, and ST Point Marks

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

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

10.9.9 ST Point, ISO Point, and J Point

The following figure shows the position of ST point, isoelectric (ISO) point, and J point:



(1) ISO point: is located between the end of the P-wave and the onset of the QRS complex. The ISO point provides the baseline for ST deviation measurement.

(2) J point: is located at the end of the QRS complex. The distance between the J point and ST point is fixed. So it helps correctly position the ST point.

(3) ST point: is located at the midpoint of the ST segment.

(4) ST deviation (ST elevation or depression): is the potential difference between the ISO point and the ST point.

10.9.10 Setting ST Point, ISO Point, and J Point

Make sure that the position of the ST point is correctly set for the patient. Incorrect setting of ST point may result in artifactual ST deviation. Adjust the ST point before starting monitoring, or if the patient's heart rate or ECG morphology changes dramatically.

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

1. Select the ST numeric area, ECG numeric area, or ECG waveform area to enter the **ECG** menu.
2. Select the **ST** tab→ select the **Adjust** tab.
3. Set **ST Point**. The ST point is positioned at a fixed distance from the J point. When **J+60/80ms** is selected, the ST point is positioned either 80 ms (HR≤120 bpm) or 60 ms (HR>120 bpm) from the J point.

The setting of **Auto Adjust** defines the method of adjusting the ISO point and J point. **Auto Adjust** is enabled by default. In this case, positions of ISO point and J point are automatically adjusted accordingly. If you disable when **Auto Adjust**, you need to manually adjust the position of ISO point and J point by selecting the arrows at the right sides of **ISO** and **J**.

- Put the ISO point in the middle of the flattest part between the P and Q waves.
- Put the J point at the end of the QRS complex and the beginning of the ST segment.

10.10 QT/QTc Interval Monitoring

The QT interval is from the beginning of the Q wave to the end of the T wave. QTc is the HR corrected QT interval. Monitoring QT interval helps detect the long QT syndrome.

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

10.10.1 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
- Unstable RR intervals
- 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, and ECG lead off

For these cases you should select a 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 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 150bpm for adults and over 180bpm 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.

10.10.2 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 QT numerics area, ECG numeric area, or waveform area to enter the **ECG** menu.
2. Select the **QT** tab→ select the **Setup** tab.
3. Switch on **QT Analysis**.

10.10.3 Displaying QT/QTc Numerics and Segments

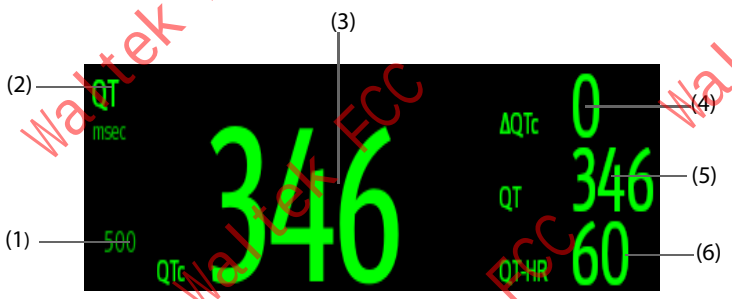
To display QT/QTc numerics and Segments, follow this procedure:

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. For more information, see *10.10.4 Entering the QT View*.**

The following picture shows the QT numeric area:



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

(2) Parameter label

(3) QTc value

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

(5) QT value

(6) QT-HR value

NOTE

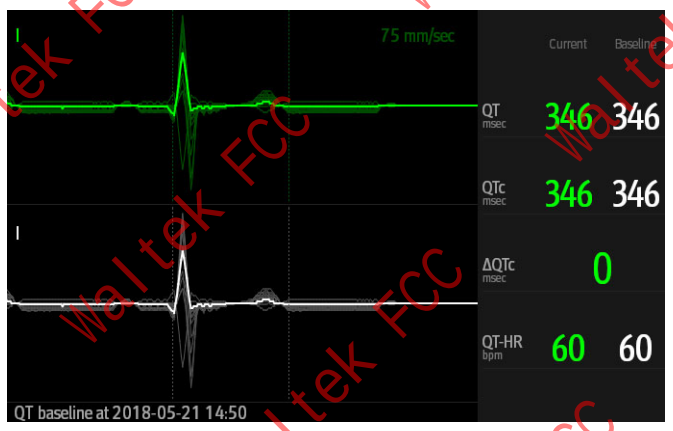
- **The display of the QT numeric area differs as related settings change.**

10.10.4 Entering the QT View

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

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

The following picture shows the QT view.



- The current waveform is shown in the upper half in green.
- The baseline waveform is shown below in white.
- The start of QRS complex and the end of the T wave are marked with a vertical line.
- In some conditions, no QT measurement can be calculated. 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. Corresponding waveform will be highlighted.

NOTE

- **In the QT view, the derived leads are marked with a "d" in front of the lead label, for example "dV1".**

10.10.5 Saving the Current QTc as Baseline

In order to quantify differences in the QTc value, you can set a QTc baseline. If you do not set a baseline within the first five minutes after getting valid QT values, the monitor will automatically set a baseline for this patient.

To set the current values as baseline, follow this procedure:

1. From the **QT View** window, select **Set Baseline**.
2. From the pop-up dialog box, select **OK**.

This baseline will then be used to calculate ΔQTc. and the old baseline will be discarded.

From the **QT View** window, 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 baseline waveform.

CAUTION

- **Updating QTc baseline affects ΔQTc value and alarm.**

10.10.6 Changing QT Settings

10.10.6.1 Setting QT Alarm Properties

To set QT alarm properties, follow this procedure:

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

10.10.6.2 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 QT numerics area, ECG numeric area, or ECG waveform area to enter the **ECG** menu.
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.

10.11 ECG Relearning

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

10.11.1 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.

10.11.2 Manually Initiating an ECG Relearning

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

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select **Relearn** at the bottom left corner of the menu.

CAUTION

- **Initiate ECG relearning only during periods of predominantly normal rhythm and when ECG signal is relatively free of noise. If ECG relearning occurs during arrhythmia, abnormal QRS complex may be incorrectly learned as normal QRS complex, resulting in missed detection of subsequent arrhythmia.**

10.12 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. For more information, see *23.6.1 The ECG Tab*.

10.13 Defibrillation Synchronization Pulse Output

The monitor provides a multifuncational connector to output defibrillation synchronization pulse. If a defibrillator is connected, it receives a synchronization pulse (100 ms, +5 V) through the analog out connector each time an R-wave is detected.

WARNING

- **Improper use of a defibrillator may cause injury to the patient. The operator should determine whether to perform defibrillation or not according to the patient's condition.**
- **Before defibrillation, the user must ensure both defibrillator and monitor have passed the system test and can be safely used together.**

10.14 ECG Troubleshooting

This section lists the problems that might occur. 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 your service personnel.

Problem	Corrective Actions
Do not see ECG numeric area or waveform area on the main screen	1. Check that ECG is set to display in the **Screen Setup** menu. For more information, see *3.11.2 Displaying Parameter Numerics and Waveforms*. 2. Check that if the ECG parameter switch is enabled. If not, enable the ECG measurement. For more information, see *3.11.1 Switching On or Off a Parameter*. 3. Check that the cable connections of ECG electrode and the lead set are tight. Replace the ECG electrode or the lead set if needed.
Noisy ECG traces	1. Check that 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 patient cable or leadwires are routed too close to other electrical devices. Move the patient cable or leadwires away from electrical devices.
Excessive electrosurgical Interference	Use ESU-proof ECG cables. For more information, see *27.1 ECG Accessories*.
Muscle Noise	Inadequate skin preparation, tremors, tense subject, and/or poor electrode placement. 1. Perform skin preparation again and re-place the electrodes. For more information, see *10.4.1 Preparing the Patient Skin* and *10.4.2 Applying Electrodes*. 2. Apply fresh, moist electrodes. Avoid muscular areas.
Intermittent Signal	1. Check that cables are properly connected. 2. Check that electrodes are not detached or dry. Perform skin preparation again as described in *10.4.1 Preparing the Patient Skin* 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	1. Check that electrodes are not dry. Perform skin preparation again and re-place the electrodes. For more information, see *10.4.1 Preparing the Patient Skin* and *10.4.2 Applying Electrodes*. 2. Check for excessive patient movement or muscle tremor. Reposition the electrodes. Replace with fresh and moist electrodes if necessary.
Low Amplitude ECG Signal	1. Check that the ECG gain is not set too low. Adjust the gain as required. For more information, see *10.6 Changing ECG Settings*. 2. Perform skin preparation again and re-place the electrodes. For more information, see *10.4.1 Preparing the Patient Skin* and *10.4.2 Applying Electrodes*. 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	1. Check that the ECG gain is not set too low. Adjust the gain as required. For more information, see *10.6.3 Setting the Analysis Mode*. 2. Check that the leadwires and patient cables are properly connected. 3. Change cable and lead wires. 4. Check that the patient cable or leadwires are not damaged. Change them if necessary.
Base Line Wander	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 *10.4.1 Preparing the Patient Skin* and *10.4.2 Applying Electrodes*. 3. Check for ECG filter setting. Set ECG Filter mode to **Monitor** to reduce baseline wander on the display.

11 Resting 12-Lead ECG Analysis

11.1 Resting 12-Lead ECG Analysis Introduction

The monitor can be configured with either Glasgow 12-lead ECG analysis algorithm or Mindray 12-lead ECG analysis algorithm. The 12-lead ECG analysis function is intended for adult, pediatric, and neonatal patients.

The monitor providing the 12-lead ECG analysis function has a 12-lead label. The monitor incorporating the Glasgow algorithm is labeled with the logo of Glasgow.

For more information on the Mindray algorithm, refer to *Mindray Physician's Guide* for detail.

For more information on the Glasgow algorithm, refer to *Glasgow Physician's Guide* for detail.

11.2 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** menu.
2. Select the **Setup** tab.
3. Set the **Lead Set** to **12-Lead**.
4. From the bottom of the **ECG** menu, select **12-Lead**.

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

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

11.3 Initiating Resting 12-Lead ECG Analysis

Before 12-lead ECG interpretation, 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 left bottom of the 12-Lead screen.

11.4 Changing 12-Lead ECG Analysis Settings

11.4.1 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 taking an ECG measurement.

To enter patient information, follow this procedure:

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

NOTE

- **Check that patient information is correct before resting 12-lead analysis.**
- **We recommend using pediatric lead placement V4R, V1, V2, V4 - V6 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.**

11.4.2 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 **Setup** to enter the **12-Lead Setup** menu.
2. Select the **Setup** tab → Set **High Freq Cut-off**.

The high frequency filter is a low-pass filter. That is to say signal that exceeds the set frequency is filtered out. For example, if you set **High Freq Cut-off** to **35 Hz**, only signal at 35 Hz or less displays. Signal exceeding 35 Hz is attenuated.

11.4.3 Setting the Baseline Drift Removal

The baseline drift removal (BDR) 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 **Setup** to enter the **12-Lead Setup** menu.
2. Select the **Setup** tab → Switch on or off **Baseline Drift Removal**. If BDR is switched off, the 0.05 Hz high pass filter is used.

NOTE

- **BDR introduces around 1-second delay. We recommend using BDR except when the delay is unacceptable.**

11.4.4 Setting Tachycardia and Bradycardia Thresholds

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

To set tachycardia and bradycardia thresholds, follow this procedure:

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

11.4.5 Setting the ECG Waveform Layout

1. On the ECG 12-Lead screen, select **Setup** to enter the **12-Lead Setup** menu.
2. Select the **Setup** tab → 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.

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.

11.4.6 Setting the 12-Lead Interpretation Report

You can change the format and items included in the 12-lead interpretation report. To set the report, follow this procedure:

1. On the ECG 12-Lead screen, select **Setup** to enter the **12-Lead Setup** menu.
2. Select the **Report** tab → Set the format and items.

11.5 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 *19.2.10 12-Lead ECG Review Page*.

11.6 Printing the 12-Lead Interpretation Report

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

11.7 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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12 Monitoring Respiration (Resp)

12.1 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. Respiration rate (RR) is calculated from these impedance changes, and a respiration waveform appears on the patient monitor screen.

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

12.2 Resp Safety Information

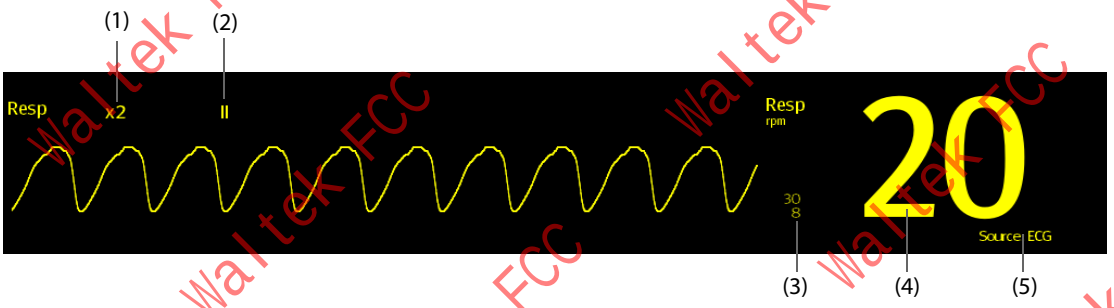
WARNING

- **When monitoring the patient's respiration, do not use ESU-proof ECG cables.**
- **The respiration measurement does not recognize the cause of apneas. It only indicates an alarm if no breath is detected when a pre-adjusted time has elapsed since the last detected breath. Therefore, it cannot be used for diagnostic purpose.**
- **When using the electrosurgery unit, 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.**

CAUTION

- **Only use parts and accessories specified in this manual.**
- **The impedance respiration measurement may cause rate changes in Minute Ventilation Rate Responsive Pacemakers. Set the pacemaker rate responsive mode off or disable the impedance respiration measurement on the monitor.**
- **Respiration monitoring is not for use on the patients who are very active, as this will cause false alarms.**

12.3 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.**

12.4 Preparing for Resp Monitoring

12.4.1 Preparing the Patient

Follow this procedure to prepare the patient:

1. 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.

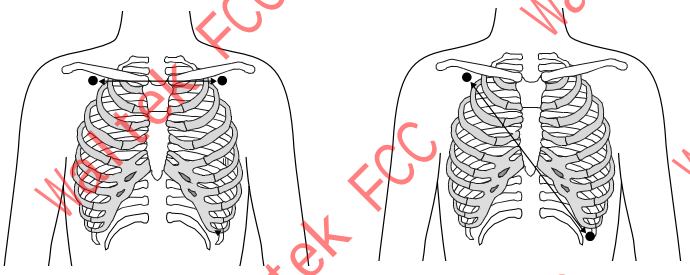
CAUTION

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

12.4.2 Placing the Electrodes

As the Respiration measurement adopts the standard ECG electrode placement, you can use different ECG cables. Since the respiration signal is measured between two ECG electrodes, if a standard ECG electrode placement is applied, the two electrodes should be RA and LA of ECG Lead I, or RA and LL of ECG Lead II.

For more information, see *10.4.4 ECG Electrode Placement*.



(1) (2)

(1) Lead I (2) Lead II

CAUTION

- **To reduce cardiovascular artifact, apply the respiration electrodes so that the liver area and the ventricles of the heart are not in the line between the respiratory electrodes. This is especially important for neonatal patients.**
- **To optimize the 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.**
- **To optimize respiratory waveforms for patients breathing mainly abdominally, apply the LL electrode on the left abdomen at the point of maximum abdominal expansion.**
- **For patients expand chests laterally (normally neonatal patients), to avoid negative intrathoracic pressure and optimize respiratory waveforms, respectively apply the electrodes in the right midaxillary and the left lateral chest areas at the maximum point of the breathing movement.**
- **Periodically inspect the electrode application site to ensure skin quality. 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 not expired. Make sure the electrode gel is moist.**

12.5 Changing Resp Settings

12.5.1 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** menu.
2. Select the **Alarm** tab.
3. Enter the password if required.
4. Set alarm properties as desired.

NOTE

- **You can switch off the apnea alarm only when Apnea Alarm Off is enabled.**

12.5.2 Setting the RR Source

To set the RR source, follow this procedure:

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

When you select **Auto**, the system automatically selects the RR source according to the priority. The priority of RR source is first CO_2, and then ECG. When the current RR source does not have valid measurement, the system automatically switches the **RR Source** to **Auto**.

12.5.3 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** menu.
2. Select the **Setup** tab.
3. Set **Resp Lead**.

If you cannot get optimal Resp waveform or you suspect the Resp value after choosing the Resp lead, you may need to optimize the electrode placement.

12.5.4 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** menu.
2. Select the **Setup** tab.
3. Set **Gain**.

12.5.5 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** menu.
2. Select the **Setup** tab.
3. Set **Speed**.

12.5.6 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** menu.
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 adjusts the Resp waveform threshold. For more information, see *12.5.7 Manually Adjusting the Resp Waveform Detection Threshold*.

In the auto detection mode, if ECG is switched off when you are monitoring respiration, the monitor cannot compare ECG and RR to detect cardiovascular artifact. To avoid cardiovascular artifact being interpreted as respiration, the respiration threshold is automatically set higher.

12.5.7 Manually Adjusting the Resp Waveform Detection Threshold

It is recommended to use the manual detection mode in the following situations:

- The patient has intermittent mandatory ventilation.
- The patient's respiration is weak.
- The patient's RR is close to HR.

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** menu.
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 you set the Resp waveform threshold, it will not automatically adapt to different respiration depths.In the manual detection mode, cardiovascular artifact can be mistakenly interpreted as respiration in certain situations. This results in higher respiration rate or undetected apnea. If you suspect the RR reading, adjust the Resp waveform threshold to raise the detection level. If you cannot adjust threshold because the Resp waveform is too small, consider optimize the electrode placement.

CAUTION

- **Always remember that if the depth of breathing changes, you may need to change the detection level.**
- **In the manual detection mode, if the respiration threshold is not correctly set, an apnea may not be detected. When the respiration threshold is set too low, the monitor may falsely interpreted cardiac activity as respiratory activity in the case of apnea.**

12.6 Resp Troubleshooting

For more information, see *E Alarm Messages*.

13 Monitoring Pulse Oxygen Saturation (SpO_2)

13.1 SpO_2 Introduction

Pulse Oxygen Saturation (SpO_2) monitoring is a non-invasive technique used to measure the amount of oxygenated haemoglobin 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 haemoglobin is measured and the pulse oxygen saturation can be calculated. This device is calibrated to display functional oxygen saturation.

SpO_2 monitoring is intended for adult, pediatric and neonatal patients.

The following types of SpO_2 can be configured for the N1 monitor:

- Mindray SpO_2: the connector is blue and no logo is on the monitor.
- Nellcor SpO_2: the connector is grey and the logo of Nellcor is on the monitor.
- Masimo SpO_2: the connector is purple and the logo of Masimo SET is on the monitor.

NOTE

- **The SpO_2 extension cable should be compatible with the SpO_2 connectors. For example, you can only connect the Mindray SpO_2 extension cable to the Mindray SpO_2 connectors.**
- **Measurement accuracy verification: The SpO_2 accuracy has been verified in human experiments by comparing with arterial blood sample reference measured with a CO-oximeter. Pulse oximeter measurements 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 SpO_2 simulator can be used to determine the pulse rate accuracy.**
- **A functional tester or SpO_2 simulator cannot be used to assess the SpO_2 accuracy.**

13.2 SpO_2 Safety Information

WARNING

- **Do not use the monitor or SpO_2 sensors during MRI scanning or in an MRI environment. Induced current could potentially causes burns. The monitor may affect the MRI image, and the MRI device may affect the accuracy of the SpO_2 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.**
- **Setting alarm limits to extreme values may cause the alarm system to become ineffective. For example, high oxygen level may predispose a premature infant to retrolental fibroplasia. Setting the SpO_2 high alarm limit to 100% is equivalent to switching off the SpO_2 alarm.**
- **SpO_2 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.**
- **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.**
- **Use only SpO_2 sensors specified in this manual. Follow the instructions for use delivered with the SpO_2 sensor.**
- **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).**
- **If the patient has a trend of deoxygenation, analyze the blood samples with a laboratory CO-oximeter to completely understand the patient's condition.**
- **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.**

13.3 SpO_2 Measurement Limitations

The following factors may influence the accuracy of SpO_2 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 SpO_2 sensor, or use of incorrect SpO_2 sensor
- Cuff or arterial blood pressure measurement device on the same limb as the SpO_2 sensor.

13.4 SpO_2 Display

(1) Pleth waveform (Pleth): indicates the blood pulsation at the measurement site. The waveform is not normalized.

(2) Arterial oxygen saturation (SpO_2): indicates the percentage of oxygenated hemoglobin relative to total hemoglobin.

(3) Perfusion indicator: the pulsatile portion of the measured signal caused by arterial pulsation. The higher the bar, the better the perfusion quality.

(4) Perfusion index (PI): indicates the percentage of pulsatile signal to non pulsatile signal. PI is an indicator of the pulsatile strength. You can also use it to assess the SpO_2 signal strength.

For Mindray SpO_2 module,

- Above 1 is optimal.
- Between 0.3 and 1 is acceptable.
- Below 0.3 indicates low perfusion. Reposition the SpO_2 sensor or find a better site. If low perfusion persists, choose another method to measure oxygen saturation if possible.

(5) Pulse rate: indicates the number of pulsations per minute.

NOTE

- **PI is only available for Mindray SpO_2 and Masimo SpO_2.**

13.5 Preparing for SpO_2 Monitoring

To prepare to monitor SpO_2, follow this procedure:

1. Select an appropriate sensor according to the module type, application site, patient category and weight.
2. Clean the contact surface of the reusable sensor.

3. Apply the sensor to the patient according to the instruction for use of the sensor.
4. Select an appropriate extension cable according to the connector type and plug the cable into the SpO_2 connector.
5. Connect the sensor to the extension cable.

CAUTION

- **Select proper SpO2 sensor according to application site. Applying sensor too tight may severely obstruct circulation and lead inaccurate measurements. Loose application may result in measurement site exposing to ambient light.**
- **Avoid placing the SpO_2 sensor on the same extremity with an NIBP cuff, arterial catheter, or intravascular line.**
- **When monitoring SpO_2 at high ambient temperature, to avoid burns at the application site that is not well perfused, pay attention to prolonged SpO_2 sensor application.**

13.6 Changing the SpO_2 Settings

NOTE

- **The settings of in the SpO_2 module and SpO_2b module are linked.**

13.6.1 Changing the SpO_2 Alarm Settings

To change the SpO_2 alarm settings, follow this procedure:

1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** menu.
2. Select the **Alarm** tab.
3. Enter the password if required.
4. Set the alarm properties of SpO_2 and SpO_2 Desat.

NOTE

- **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 *23.4.4 The Guard Limits Tab*.**

13.6.2 Monitoring SpO_2 and NIBP Simultaneously

When monitoring SpO_2 and NIBP on the same limb simultaneously, you can switch on **NIBP Simul** to lock the SpO_2 alarm status until the NIBP measurement ends. If you switch off **NIBP Simul**, low perfusion caused by NIBP measurement may lead to inaccurate SpO_2 readings and therefore cause false physiological alarms.

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

1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** menu.
2. Select the **Alarm** tab.
3. Set **NIBP Simul**.

13.6.3 Sat-Seconds Alarm Management (for Nellcor SpO_2)

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 SpO_2 fluctuates near an alarm limit, the alarm sounds each time the limit is violated. Such frequent alarms can be distracting. Nellcor's Sat-Seconds alarm management technique is used to reduce these nuisance alarms.

The Sat-Seconds feature is available with the Nellcor SpO_2 to decrease the likelihood of false alarms caused by motion artifacts. With Sat-Seconds alarm management, high and low alarm limits are set in the same way as those with traditional alarm management. A Sat-Seconds limit is also set. The Sat-Seconds limit controls the amount of time that SpO_2 saturation may be outside the set limits before an alarm sounds.

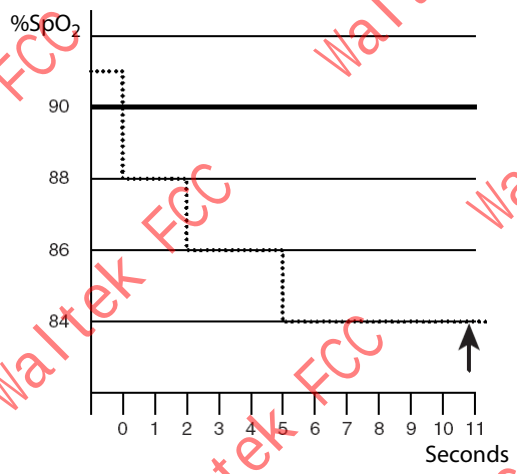
The method of calculation is as follows: the percentage points of the SpO_2 saturation falling outside the alarm limit is multiplied by the number of seconds remaining outside the limit. This can be stated as the equation:

Sat-Seconds = Points × Seconds

Only when the Sat-Seconds limit is reached, the monitor gives a Sat-Seconds alarm. For example, the figure below demonstrates the alarm response time with a Sat-Seconds limit set at 50 and a low SpO_2 limit set at 90%. In this example, the patient SpO_2 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 Sat-Seconds are:

% SpO_2	Seconds	Sat-Seconds
2×	2=	4
4×	3=	12
6×	6=	36
Total Sat-Seconds=		52

After approximately 10.9 seconds, a Sat-Second alarm would sound, because the limit of 50 Sat-Seconds 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 Sat-Seconds 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 for 3 times within one minute even if the setting of Sat-Seconds is not reached.**

13.6.4 Setting the SpO_2 Sat-Seconds (for Nellcor SpO_2)

To set the Sat-Seconds, follow this procedure:

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

13.6.5 Setting SpO_2 Sensitivity (for Masimo SpO_2)

For Masimo SpO_2, selects 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** menu.
2. 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 SpO_2 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 6.4 Setting Default Configuration* for managing configuration.**

13.6.6 Enabling Smart Tone (for Masimo SpO_2)

SmartTone is the intelligent sound function, which can generate pulse tone in case of motion interference. To enable Smart Tone, follow this procedure:

1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** menu.
2. Select the **Setup** tab.
3. Switch on **Smart Tone**.

13.6.7 Enabling FastSAT (for Masimo SpO_2)

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 SpO_2 values and provides an averaged SpO_2 value that is a better representation of the patient's current oxygen saturation status.

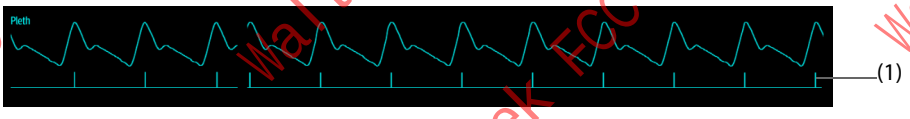
The reliability of FastSAT is dependent on the setting for the averaging time and the input signal. FastSAT is disabled by default. To enable FastSAT, follow this procedure:

1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** menu.
2. Select the **Setup** tab.
3. Switch on **Fast SAT**.

13.6.8 Displaying SIQ (for Masimo SpO_2)

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 SpO_2 value. The SpO_2 SIQ can also be used to identify the occurrence of a patient 's pulse.

The following picture shows the SpO_2 SIQ:



(1) Signal quality indicator (SIQ)

To show SpO_2 SIQ, follow this procedure:

1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** menu.
2. Select the **Setup** tab.
3. Switch on **Display SIQ**.

13.6.9 Changing Averaging Time (for Masimo SpO_2)

The SpO_2 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 SpO_2 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 SpO_2 numeric area or waveform area to enter the **SpO2** menu.
2. Set **Averaging**.

13.6.10 Changing the Sensitivity (for Mindray SpO_2)

The SpO_2 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 SpO_2 measurement is more stable. For critically ill patients, selecting shorter averaging time will help understanding the patient's state.

To set the averaging time, follow this procedure:

1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** menu.
2. Select **Sensitivity**.

13.6.11 Showing/Hiding PI

You can set whether to display PI in the SpO_2 parameter area. To do so, follow this procedure:

1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** menu.
2. Switch on or off **Display PI.**

13.6.12 Changing the Sweep Speed of the Pleth Wave

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

1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** menu.
2. Set **Speed**.

13.7 Changing the PR Settings

13.7.1 Changing the PR Alarm Settings

To change the PR alarm settings, follow this procedure:

1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** menu.
2. Select the **PR Alarm** tab.
3. Enter the password if required.
4. Set the alarm properties as desired.

13.7.2 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 SpO_2 numeric area or waveform area to enter the **SpO2** menu.

2. Select the **PR** tab.
3. Select the **Setup** tab.
4. Set **QRS Volume**.

If the SpO_2 value is effective, the monitor also adjusts the QRS tone (pitch tone) according to the SpO_2 value.

13.7.3 Setting the PR Source

You can select the source of PR. The current PR source is displayed in the PR numeric area. PR from the current source is monitored as system pulse and generates alarms when you select PR as alarm source.

To set which pulse rate as PR source, follow this procedure:

1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** menu.
2. Select the **PR** tab.
3. Select the **Setup** tab.
4. Set **PR Source**.

The **PR Source** menu 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.

13.7.4 Showing/Hiding PR

You can set whether to display the PR value in the SpO_2 parameter area. To do so, follow this procedure:

1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** menu.
2. Select the **PR** tab.
3. Select the **Setup** tab.
4. Switch on or off **Display PR.**

13.8 SpO_2 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 *E Alarm Messages*.**

Problem	Solution
Do not see SpO_2 numeric area or waveform area on the main screen	1. Check that the SpO_2 is set to display in the **Screen Setup** menu. For more information, see *3.11.2 Displaying Parameter Numerics and Waveforms*. 2. Check that if the SpO_2 parameter switch is enabled. If not, enable the SpO_2 measurement. For more information, see *3.11.1 Switching On or Off a Parameter*. 3. Check that the cable connections of SpO_2 sensor and the extension cable are tight. Replace the SpO_2 sensor or the extension cable if needed.

Problem	Solution
Dashes "- -" display in place of numerics.	1. Check that the cable connections of SpO_2 sensor and the extension cable are tight. Replace the SpO_2 sensor or the extension cable if needed. 2. Reconnect the SpO_2 sensor if the alarm **SpO2 Sensor Off** appears. 3. Check the PI value. If the PI value is too low, adjust the SpO_2 sensor, or apply the sensor to the site with better perfusion. 4. Move the sensor to the place with weaker light, or cover the sensor with shade cloth if the alarm **SpO2 Excess Light** appears.
Low amplitude SpO_2 signal	1. The SpO_2 sensor and NIBP cuff are placed on the same limb. Change a monitoring site if necessary. 2. Check the PI value. If the PI value is too low. Adjust the SpO_2 sensor, or apply the sensor to the site with better perfusion. 3. Check the sensor and its application site.
SpO2 value is inaccurate	1. Check the patient's vital signs. 2. Check for conditions that may cause inaccurate SpO_2 readings. For more information, see *13.3 SpO_2 Measurement Limitations*. 3. Check the monitor, the SpO_2 module or the MPM for proper functioning.

13.9 Nellcor Information

■ Nellcor Patents

This device may be covered by one or more of the following US patents and foreign equivalents: 5,485,847, 5,676,141, 5,743,263, 6,035,223, 6,226,539, 6,411,833, 6,463,310, 6,591,123, 6,708,049, 7,016,715, 7,039,538, 7,120,479, 7,120,480, 7,142,142, 7,162,288, 7,190,985, 7,194,293, 7,209,774, 7,212,847, 7,400,919.

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14 Monitoring Temperature (Temp)

14.1 Temperature Introduction

You can continuously monitor the patient's skin temperature and core temperature by the monitor. Thermally sensitive resistors (thermistors) are used. They are based on the principle that electrical resistance of the thermistor changes as temperature changes. Thermistors measure the resistance change and use it to calculate the temperature.

You can simultaneously monitor two temperature sites and calculate the difference between the two sites.

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

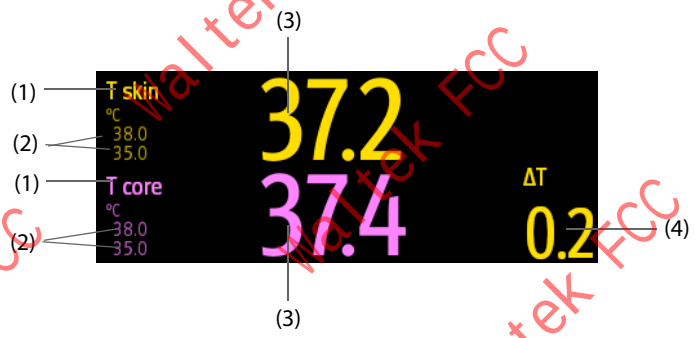
14.2 Displaying the Temp Numerics Area

To display the Temp 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 a parameter numeric area or waveform area, and then from the popup list select **Temp**.

14.3 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) Alarm limits (3) Temperature value

(4) Temperature difference (ΔT): Difference between two temperature sites. It displays only when ΔT is switched on.

14.4 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 you are using a disposable temperature probe, connect it to the temperature cable.
3. Follow the probe manufacturer's instructions to connect the probe to the patient.

14.5 Changing Temperature Settings

14.5.1 Setting the Temperature Alarm Properties

To set the temperature alarm properties, follow this procedure:

1. Select the temperature numeric area to enter the **Temp** menu.
2. Select the **Alarm** tab.
3. Enter the password if required.
4. Set the alarm properties.

14.5.2 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** menu.
2. Select the **Setup** tab.
3. Set the temperature label.

14.5.3 Displaying the Temperature Difference

To display the temperature difference between two measurement sites monitored by the same temperature module, switch on corresponding ΔT. To do so, follow this procedure:

1. Select the temperature numeric area to enter the **Temp** menu.
2. Select the **Setup** tab.
3. Switch on **ΔT**.

14.6 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 for services. If the problem persists, contact your service personnel.

NOTE

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

Problem	Solution
Do not see Temp numeric area on the main screen	1. Check that the Temp is set to display in the **Screen Setup** menu. For more information, see *3.11.2 Displaying Parameter Numerics and Waveforms*. 2. Check that if the Temp parameter switch is enabled. If not, enable the Temp measurement. For more information, see *3.11.1 Switching On or Off a Parameter*. 3. Check that the connections of the temperature probe and the temperature cable are tight.
Measurement fails/'--' is displayed in the Temp numeric area	1. If you are 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.

15 Monitoring Noninvasive Blood Pressure (NIBP)

15.1 NIBP Introduction

The monitor uses the oscillometric method for measuring the 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.

Two algorithms can be used on the monitor:

- Inflation (optional): the device measures blood pressure during cuff inflation. If affected by patient condition or environment factors, the measurement fails at the inflation stage, the device automatically continues the measurement at deflation stage.
- Deflation: the device measures blood pressure during cuff deflation.

The oscillometric method measures the mean pressure and determines the systolic and diastolic pressures.

NIBP measurement adopting inflation algorithm is intended for adult and pediatric patients, and NIBP measurement adopting deflation algorithm is intended for adult, pediatric, and neonatal patients.

NIBP monitoring is intended for use with pregnant, including pre-eclamptic 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 measurements can be performed during electro-surgery and discharge of defibrillator.**

15.2 NIBP Safety Information

WARNING

- **Be sure to select the correct patient category setting for your patient before NIBP measurements. Do not apply the higher adult settings for pediatric or neonatal patients. Otherwise, it may present a safety hazard.**
- **Do not perform NIBP measurements on patients with sickle-cell disease.**
- **To avoid further injury, do not apply the NIBP cuff on the limb with a wound.**
- **Use only cuffs with the *TrueBP*™ symbol. Using other cuffs may lead to incorrect or failed measurements.**
- **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.**
- **To avoid the risk of patient injury, do not apply the NIBP cuff on a limb that has an intravenous infusion or catheter in place. Apply the cuff on another limb if possible.**
- **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 resulting 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.**
- **Taking NIBP measurements exert pressure on the patient's tissue. This can cause skin purpura, ischemia, and neuropathy. Periodically check the cuff site and the limb distal to the cuff for normal color, warmth and sensitivity. If there is a sign of skin change or poor distal circulation, move the cuff**

to another limb or stop NIBP measurements. Check more frequently when using the STAT mode or using the auto mode at short intervals. Auto NIBP measurements with one and two minute intervals are not recommended for extended periods of time.

- **As MRV Pod uses an alternative small-bore connector design different from those specified in the ISO 80369 series, there is a possibility that a misconnection can occur between this medical device and a medical device using a different alternative small-bore connector, which can result in a hazardous situation causing harm to the patient. Special measures need be taken by the user to mitigate these reasonable foreseeable risks.**
- **NIBP diagnostic significance must be decided by the physician.**

CAUTION

- **Using IABP may cause NIBP, including PR, measurements inaccurate or failed.**
- **Only use parts and accessories specified in this manual. Follow the instructions for use and adhere to all warnings and cautions.**
- **Accuracy of NIBP measurements depends on using a cuff of proper size. It is essential to measure limb circumference and choose a cuff with proper size.**

15.3 NIBP Measurement Limitations

NIBP measurements may be inaccurate or impossible in the following situations:

- The patient is connected to a heart lung machine.
- Regular arterial pressure pulses are hard to detect.
- The patient has cardiac arrhythmias.
- The patient's blood pressure changes dramatically.
- The patient has poor circulation due to severe shock or hypothermia.
- NIBP cuff is applied on an limb with edematous extremity.
- The NIBP cuff is compressed by excessive movement such as shivering, seizures, or convulsions.
- The patient's blood pressure is out of measurement range.

If you are using inflation algorithm on the monitor, affected by measurement factors or patient's physiological conditions, NIBP measurement might fail, be incorrect, or unavailable. The measurement factors or patient's physiological conditions include:

- Excessive patient movement
- Using cuffs with no *TrueBP*™ symbol
- Using cuffs of inappropriate size
- Cuffs being too tight or loose
- Using well-worn cuffs
- Patient blood pressure being too low
- Patient pulse rate being too low
- Patient having frequent arrhythmia
- Weak patient pulse

NOTE

- **The monitor always performs NIBP measurement at deflation stage if Patient Category is Neo.**

15.4 Measurement Modes

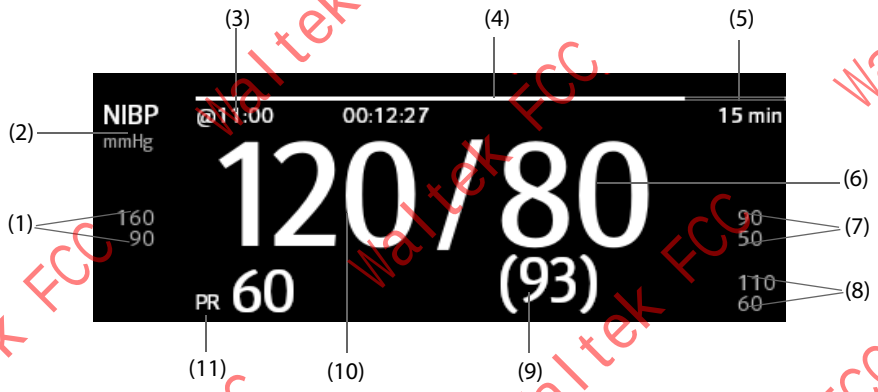
There are three NIBP measurement modes:

- Manual mode: measurement is taken on demand.
- Auto mode: repeated measurements are taken at set interval.
- STAT mode: continually rapid series of measurements are taken over a five-minute period.

- Sequence mode: continually automatic measurements are taken at set durations and intervals.

15.5 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, "--" is displayed.**
- **Outlined NIBP numerics indicate that the measurement is old and exceeds the set time. So these NIBP values are not recommended for reference.**

15.6 Preparing for NIBP Measurements

15.6.1 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

- **It is recommended that the patient calms down and relaxes as much as possible before performing the measurement and that the patient do not talk during the measurement.**
- **It is recommended to have the patient sit quietly for several minutes before taking the measurement.**
- **Other factors that have been shown to result in an overestimation of blood pressure are labored breathing, full bladder, pain etc.**

15.6.2 Placing the NIBP Cuff

To place the NIBP cuff, follow this procedure:

1. Verify that the patient category setting is correct. If not, enter the **Patient Management** menu to change patient category. For more information, see *5.3.2 Editing Patient Information*.
2. Connect the air tubing to the NIBP connector on the monitor.
3. Apply the cuff around the patient's limb directly over the patient's skin as follows:
   a Use only cuffs with the ***TrueBP***™ symbol. Using other cuffs may lead to incorrect or failed measurements.
   b Determine the patient's limb circumference.
   c 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 cover at least 50% to 80% of the limb.
   d 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. Excessive tightness may cause discoloration and ischemia of the limb distal. Make sure that the cuff index line falls within the range markings on the cuff.
   e Make sure that the middle of the cuff is at the level of the heart. Otherwise correct the measurement by referring the measurement correction formula. For more information, see *15.8.10 Correcting the NIBP Measurements*.
4. Connect the cuff to the air tubing. Check that the air tubing are not kinked or compressed, and air can pass unrestrictedly through the tubing.

CAUTION

- **Using a cuff of wrong size, or a cuff with twisted bladder and kinked air tubing, can cause inaccurate measurements.**
- **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.**

15.7 Starting and Stopping NIBP Measurements

Start and stop NIBP measurement by selecting the NIBP quick keys or from the NIBP menu.

Task	By Quick Key	From NIBP menu
Start a manual measurement	**NIBP Start/Stop** quick key	**Start NIBP** button
Start auto NIBP series	**NIBP Start/Stop** quick key Make sure to set **Interval** before starting auto NIBP.	**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
End auto NIBP series or NIBP Sequence	/	**NIBP Stop All** button

Task	By Quick Key	From NIBP menu
Stop STAT measurement and end series	**NIBP Start/Stop** quick key	**Stop NIBP** or **NIBP Stop All** button

15.8 Changing NIBP Settings

15.8.1 Setting the NIBP Alarm Properties

To set the NIBP alarm properties, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** menu.
2. Select the **Alarm** tab.
3. Enter the password if required.
4. Set alarm properties as desired.

15.8.2 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** menu.
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.**

15.8.3 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** menu.
2. Set Interval. Selecting **Manual** switches to manual mode.

15.8.4 Selecting NIBP Start Mode

Start mode defines how NIBP auto mode works. To set the start mode, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** menu.
2. Set **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 you start NIBP auto measurement 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 you start NIBP auto measurement at 14:03, the next measurement will be taken at 14:23, and then at 14:43, 15:03, and so on.

15.8.5 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** menu.
2. Switch on **NIBP End Tone**.

15.8.6 Setting NIBP Sequence

NIBP sequence measurement can have up to five phases: A, B, C, D, and E. You can individually set the duration and interval of each phase.

To set NIBP sequence, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** menu.
2. Select the **Sequence** tab.
3. Set **Duration** and Interval of each phase.

15.8.7 Setting the NIBP Display Format

To set the NIBP display format, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** menu.
2. Select the **Setup** tab.
3. Set **Display Format**.

15.8.8 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** menu.
2. Select the **Setup** tab.
3. Switch on or off **Display Alarm Limits.**

15.8.9 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** menu.
2. Select the **Setup** tab.
3. Switch on or off **Display PR.**

15.8.10 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, you need to correct the measurement:

- 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.

15.9 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 menu.
4. Puncture vein and draw blood sample.
5. Select the **NIBP Start/Stop** quick key to deflate the cuff. If you do not deflate the cuff, the cuff automatically deflates after a 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.

15.10 NIBP Maintenance

15.10.1 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.

15.10.2 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.

15.11 NIBP Troubleshooting

For more information, see *E Alarm Messages*.

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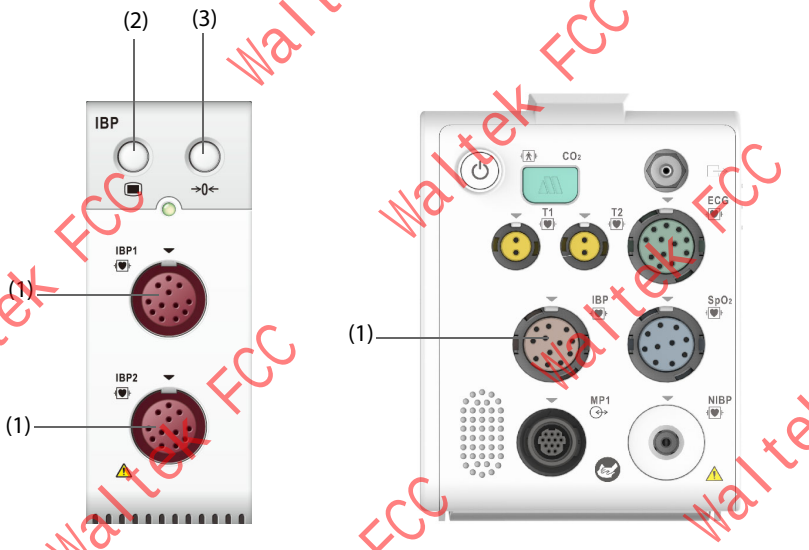
16 Monitoring Invasive Blood Pressure (IBP)

16.1 IBP Introduction

This patient monitor can monitor four invasive blood pressures.

IBP monitoring is intended for adult, pediatric, and neonatal patients. PAWP monitoring is only intended for adult and pediatric patients. PAWP monitoring is available only for the external display.



(1) IBP cable connector (2) IBP menu hard key (3) Zero IBP hard key

NOTE

- **In order for the N1 to connect to the external IBP module and perform IBP monitoring, the N1system software V02.25 and above is required.**
- **If your monitor configures the PiCCO module, you can also measure IBP with the PiCCO module. For more information, see *18 Monitoring Continuous Cardiac Output (CCO from PiCCO Module)*.**

16.2 IBP Safety Information

WARNING

- **Use only pressure transducers specified in this manual. Never reuse disposable pressure transducers.**
- **Make sure that the applied parts never contact other conductive parts.**
- **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 high-frequency surgical units.**

CAUTION

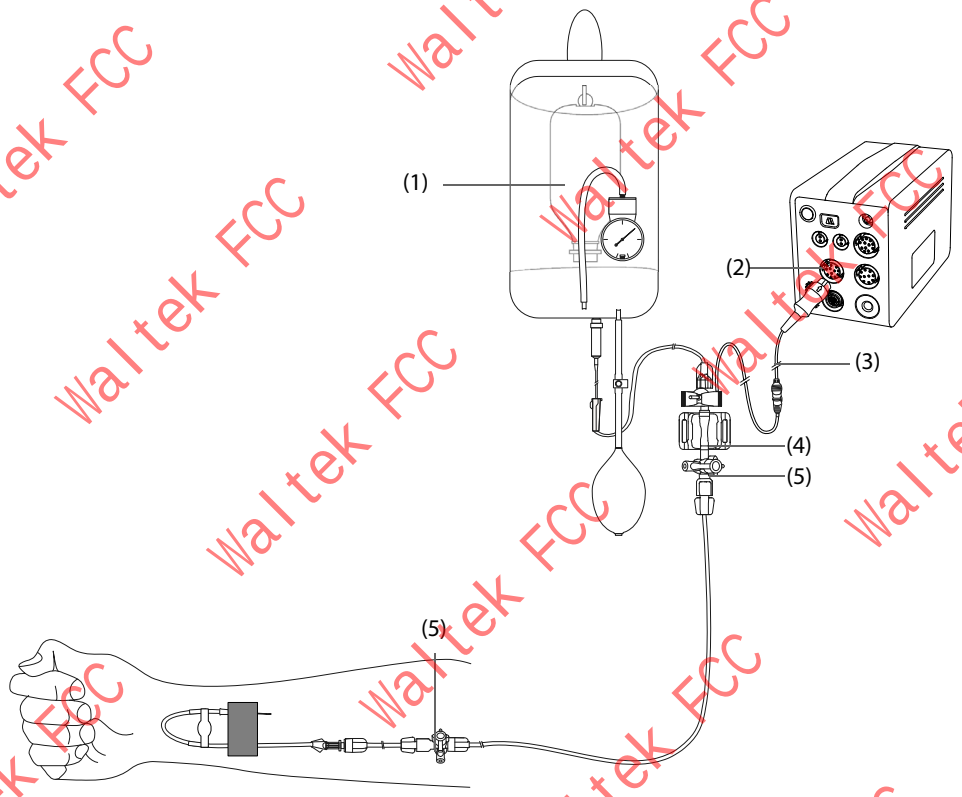
- **Using IABP may cause IBP, including PR, measurements inaccurate or failed.**
- **Mechanical shock to the invasive blood pressure transducer may cause severe shifts in zero balance and calibration, and cause erroneous readings.**

NOTE

- **When using accessories, their operating temperature should be taken into consideration. For more information, see instructions for use of accessories.**
- **Invasive procedures involve risks to the patient. Use aseptic technique and follow catheter manufacturer's instructions.**

16.3 Preparing for IBP Monitoring

16.3.1 IBP Equipment to Patient Connection



(1) Pressure bag
(2) IBP connector
(3) IBP cable
(4) IBP transducer
(5) Three-way valve

16.3.2 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 *16.6.2 Changing the Pressure Label*.
5. Zero the IBP transducer. For more information, see *16.3.3 Zeroing the IBP transducer*. After a successful zeroing, turn off the stopcock to the air and turn on the stopcock to the patient.

CAUTION

- **Make sure that all the transducers are zeroed correctly before the IBP measure.**
- **Make sure that no air bubble exists in the IBP transducer system before the IBP measure.**
- **When measuring ICP on a sitting patient, place the ICP transducer at the same level with the top of the patient's ear. Incorrect leveling may give incorrect values (not applicable if measuring ICP with the Codman ICP transducer).**

16.3.3 Zeroing the IBP transducer

To avoid inaccurate pressure readings, the IBP transducer should be zeroed in accordance with the hospital policy. The IBP transducer should be zeroed in the following conditions:

- The IBP transducer or adapter cable is reconnected.
- The monitor restarts.
- You doubt the readings.
- 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. zero hard key →0←After the zero calibration is completed, close the stopcock to the air and open the stopcock 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.

16.4 Measuring ICP Using the Codman ICP Transducer

16.4.1 Zeroing the Codman ICP transducer

You shall zero the Codman ICP transducer (Model: 82-6653) 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 you see the message **Zero Reference** in the ICP numeric area, select the ICP waveform area or numeric area to enter the **ICP** menu → select the **Zero** tab → select the **Zero** button.
4. Record the zero reference value on the blank area of the ICP transducer for further reference.

If the ICP transducer zero calibration failed or you doubt the zero reference value, perform a zero calibration again.

16.4.2 Measuring ICP

To perform the ICP measurement, follow this procedure:

1. Zero the Codman ICP transducer. For more information, see section *16.4.1 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 you have to transfer the patient who is taking ICP measurement, check that the target monitor supports the Codman ICP transducer. For more information, see *16.4.1 Zeroing the Codman ICP transducer*. If the target monitor does not support the Codman ICP transducer, do not use it for ICP monitoring.

Follow this procedure to transfer the patient:

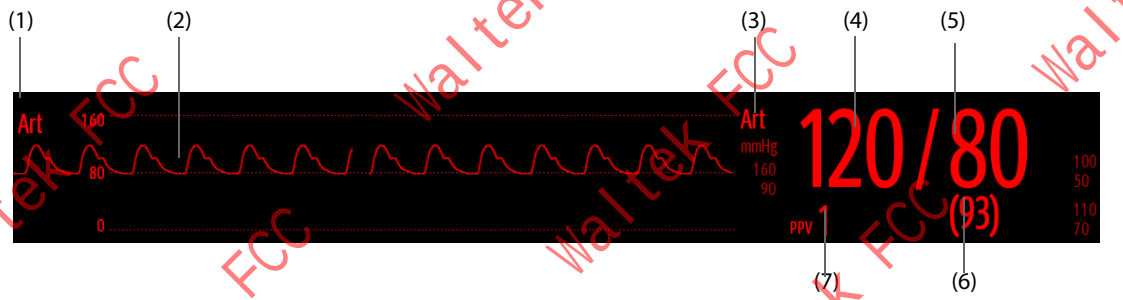
1. Disconnect the ICP adapter cable from the measurement module, or remove the module from the monitor.
2. Connect the ICP adapter cable, measurement module, and the target monitor, or insert the measurement module into the target monitor.
3. Check that the zero reference value displayed on the monitor 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 can be inaccurate.**

16.5 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

NOTE

- **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.**

16.6 Changing IBP Settings

16.6.1 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 menu.
2. Select the **Alarm** tab.
3. Enter the password if required.
4. Set the alarm properties.

16.6.2 Changing the Pressure Label

A pressure label is used to define each type of pressure. Therefore, you should select a proper pressure label for the source of the pressure you want to monitor.

If the host monitor does not support the IAP label, after N1 is connected to the host monitor, the IAP label of N1 will automatically switch to the custom extension label. If all custom extension labels are occupied, the host monitor will generate the "Host Monitor does not support IAP" alarm. In this case, change the IAP label of N1 to another label manually, and then connect to the host monitor.

To select the pressure label, follow this procedure:

1. Select the IBP numeric area or waveform area to enter the corresponding pressure menu.
2. Select the **Setup** tab.
3. Set **IBP1 Label** or **IBP2 Label**.

Label	Description	Label	Description
PA	Pulmonary artery pressure	CVP	Central venous pressure
Ao	Aortic pressure	LAP	Left atrial pressure
UAP	Umbilical arterial pressure	RAP	Right atrial pressure
BAP	Brachial arterial pressure	ICP	Intracranial pressure
FAP	Femoral arterial pressure	UVP	Umbilical venous pressure
Art	Arterial blood pressure	LV	Left ventricular pressure
IAP (optional)	Intra abdominal pressure	APP (optional)	Abdominal (intra) perfusion pressure
CPP	Cerebral perfusion pressure	P1 to P4	Custom expansion pressure

NOTE

- **It is not allowed to select the same label for different pressures.**

16.6.3 Setting the Pressure Type for Display

For the custom expansion 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 custom expansion pressure to enter the corresponding pressure menu.
2. Select the **Setup** tab.
3. Set **Measure**:
   - If this custom expansion pressure is artery pressure, set the **Measure** to **All**. In this case, its corresponding numeric area displays systolic pressure, diastolic pressure and mean pressure.
   - If this custom expansion pressure is venous pressure, set the **Measure** to **Mean Only**. In this case, its corresponding numeric area displays only the mean pressure.

16.6.4 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 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 menu.
2. Select the **Setup** tab.
3. Set **Sensitivity**.

16.6.5 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 menu.
2. Select the **Setup** tab.
3. Set the **Speed**.
4. Set the scale.
   - Enable **Auto Scale**: the size of the pressure's waveform will be adjusted automatically. Or,
   - Set **Upper Scale** and **Lower Scale** separately.

16.6.6 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 menu.
2. Select the **Setup** tab.
3. Set **Display Format**.

16.6.7 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 menu.
2. Select the **Setup** tab.
3. Switch on or off **Display Alarm Limits.**

16.6.8 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 menu.
2. Select the **PPV Setup** tab.
3. Switch on **PPV Measure**.

You can select PPV source after enabling the PPV measurement.

WARNING

- **PPV measurement is reliable only for mechanically ventilated patients with no arrhythmias.**
- **PPV measurements may be inaccurate for patients with a very low respiration rates, low tidal volumes during ventilation, and with acute cor pulmonale.**
- **The PPV measurement is validated only on adult patients.**

- **The clinical value of the PPV must be determined by the physician.**

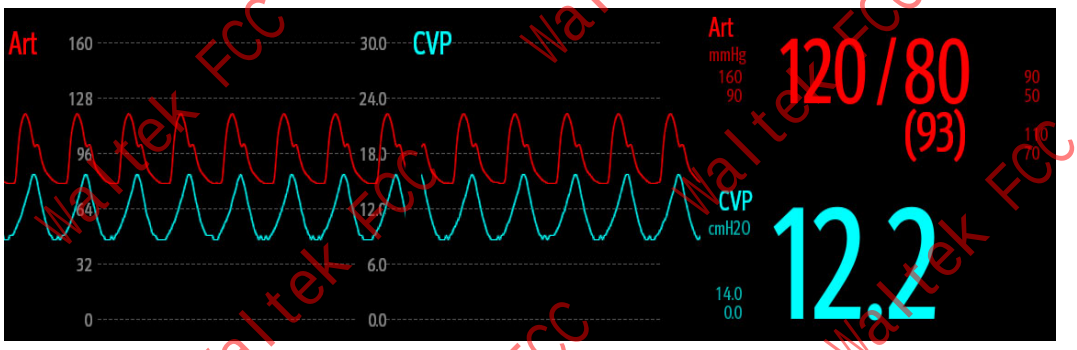
NOTE

- **The PPV measurement from IBP will automatically be switched off if PiCCO module is working. The monitor will measure PPV through PiCCO module.**

16.6.9 Overlapping IBP Waveforms

The IBP waveforms can be displayed together. To combine IBP waveforms, follow this procedure:

1. Select the **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 window. The main screen will display the overlapped IBP waves.



Selecting the overlapped IBP waveforms on the main screen opens the **Overlapping Waveform Setup** menu, 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 CVP parameter unit.**

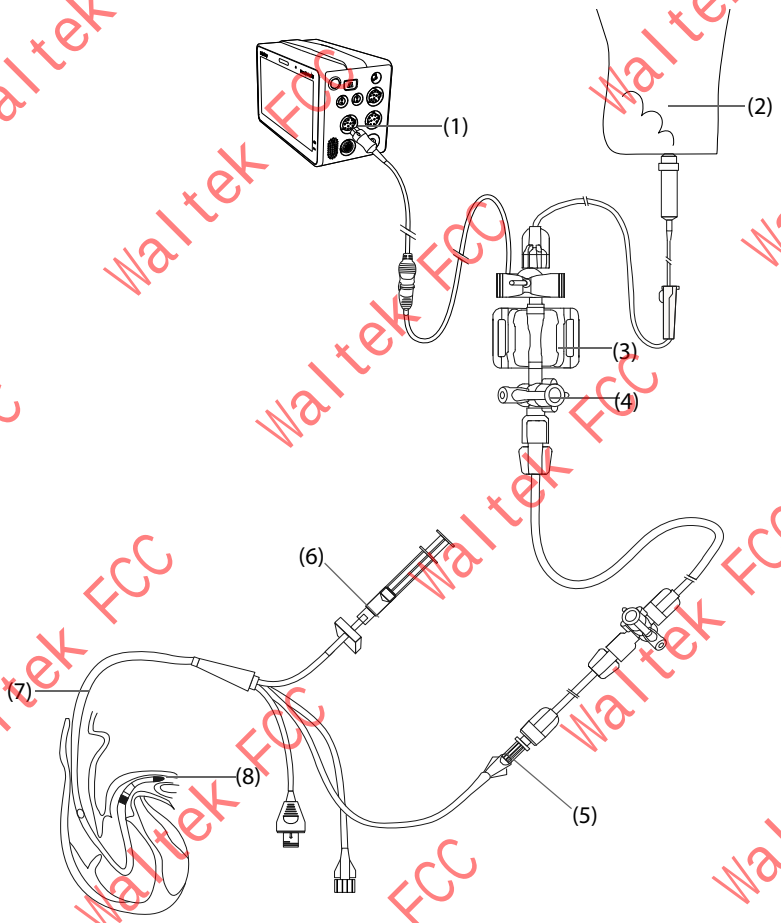
16.7 Measuring PAWP (Only Available for the Independent External Display)

PAWP reflects the pressure in the left ventricle at end-diastole. PAWP is derived from a pulmonary artery catheter when the pulmonary artery distal balloon is inflated and the catheter advances and occludes a distal pulmonary artery. PAWP values obtained at the end of the respiration cycle are the most accurate. At this time, the intrathoracic pressure is relatively constant and the respiration artifact is minimal.

WARNING

- **PAWP monitoring is not intended for neonatal patients.**

16.7.1 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 valve
(7) Thermodilution catheter	(8) Balloon

16.7.2 Preparing to Measure PAWP

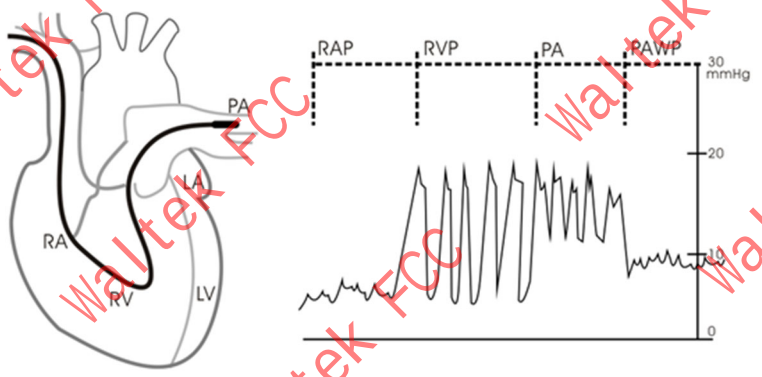
To prepare to monitor PAWP, follow this procedure:

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 *16.3.2 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 *16.3.3 Zeroing the IBP transducer*.
4. Set the IBP label to **PA** since the PAWP is measured on PA. For more information, see *16.6.2 Changing the Pressure Label*.

16.7.3 Measuring PAWP

To measure the PAWP, follow this procedure:

1. Select the PA numeric area or waveform area to enter the **PA** menu, 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 yet the monitor still not show the prompt message **Ready For Balloon Deflation**, select the **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 the 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

- **Follow manufacturer's suggested procedures and hospital policy for PAWP balloon inflation. Inflating the balloon for an extra long time could result in pulmonary hemorrhage or infarction, or both.**
- **A PAWP value greater than the systolic PA may indicate rupture of the pulmonary artery. Deflate the balloon immediately and report this event according to hospital policy.**

NOTE

- **The PA alarm is turned off automatically when the monitor enters the PAWP screen.**

16.7.4 Setting the Waveforms of the PAWP Screen

On the **PAWP** screen, select **Setup** to enter the **PAWP Setup** menu. In the **PAWP Setup** menu, 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.

16.7.5 Setting the Use PA-D as PAWP Switch

You can set whether PA-D value is used to replace PAWP value for hemodynamic calculation. To do so, follow this procedure:

1. Select the PA numeric area or waveform area to enter the **PA** menu.
2. Select the **Setup** tab.

3. Switch on or off **Use PA-D as PAWP**.

For more information on hemodynamic calculation, see *21.4 Hemodynamic Calculations*.

16.7.6 Performing Hemodynamic Calculation

On the **PAWP** screen, select **Hemo Calcs** to enter the **Hemo Calcs** menu. For more information, see *21.4 Hemodynamic Calculations*.

16.8 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 for services. If the problem persists, contact your service personnel.

NOTE

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

Problem	Solution
Cannot see IBP numeric area or waveform area on the main screen	1. Check that the IBP is set to display from the **Screen Setup** menu. For more information, see *3.11.2 Displaying Parameter Numerics and Waveforms*. 2. Check that if the IBP parameter switch is on. If not, enable the IBP measurement. For more information, see *3.11.1 Switching On or Off a Parameter*. 3. Check the connection of IBP cable, IBP transducer and monitor. 4. Check that the stopcock is turned to the correct position. 5. Check that the IBP transducer has been zeroed. For more information, see *16.3.3 Zeroing the IBP transducer*.
Cannot see systolic pressure and diastolic pressure for P1/P2/P3/P4	Set **Measure** to **All** in the P1/P2/P3/P4 setup menu. For more information, see *16.6.3 Setting the Pressure Type for Display*.
IBP readings seem unstable	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 a transducer.
Zeroing of IBP channel(s) fails.	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 *16.3.3 Zeroing the IBP transducer*. 3. If zero calibration still fails, replace the transducer.

17 Monitoring Carbon Dioxide (CO_2)

17.1 CO_2 Introduction

CO_2 monitoring is a continuous, non-invasive technique for determining the concentration of CO_2 in the patient's airway by measuring the absorption of infrared (IR) light of specific wavelengths. CO_2 has its own absorption characteristic and the amount of light passing the gas probe depends on the concentration of the measured CO_2. When a specific band of IR light passes through respiratory gas samples, some of IR light will be absorbed by the CO_2 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 CO_2 is calculated.

The following two methods are used for CO_2 monitoring:

- Mainstream CO_2 method: the CO_2 sensor is inserted on the airway adapter which is directly connected to the patient's airway. The mainstream CO_2 measurement can be used, with specified accessories, with intubated patients.
- Sidestream/Microstream™ CO_2 method: a sample line is used to take the respiratory gas from the patient's airway. The CO_2 sensor is built into the CO_2 module. The sidestream and Microstream™ CO_2 modules can be used with intubated and non-intubated patients. With intubated patients, the respiratory gas is sampled from the patient's breathing circuit through an airway adapter and a airway sampling line. With non-intubated patients, the gas is sampled through a nasal simple line.

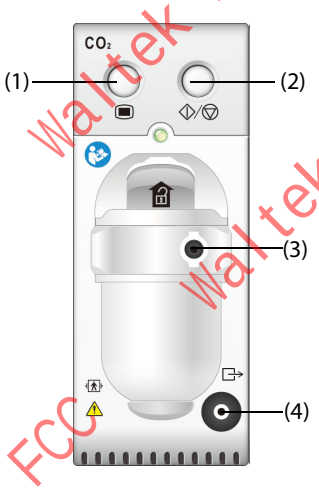
The sidestream CO_2 module can be configured with a paramagnetic oxygen sensor. The paramagnetic oxygen sensor measures oxygen relying on its paramagnetic properties.

CO_2 monitoring is intended for adult, pediatric and neonatal patients.

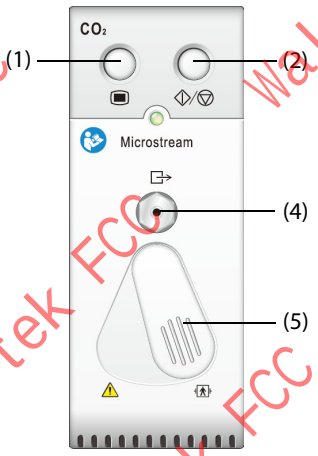
WARNING

- **N1 monitor does not support the CO_2 measurement when it is used for transporting patient through the rotary or fixed-wing ambulance.**
- **It is recommended not to measure O_2 when you're transferring patient with the N1 monitor. Shaking the CO_2 module during O_2 measurement may lead to distorted O_2 waveform or inaccurate O_2 measurement.**

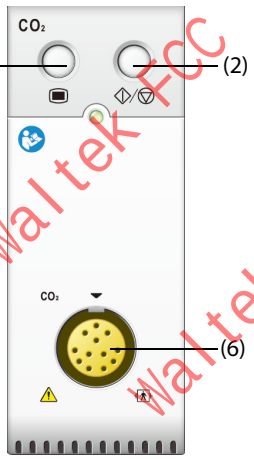
To measure CO_2, you can use either the internal CO_2 module or the external CO_2 module. The external CO_2 module is connected to the N1 through the Modular Rack. For the connection of the N1 and the external CO_2 module, see section *2.8.1 Installing the N1 or External Parameter Module into the Modular Rack*.



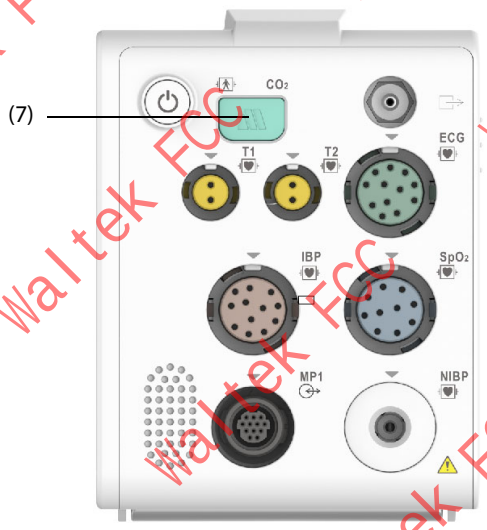
Sidestream CO_2 module



Microstream™ CO_2 module



Mainstream CO_2 module



(1) CO_2 menu hard key

(2) CO_2 Measure/standby hard key

(3) CO_2 watertrap seat

(4) Gas outlet

(5) Sample line connector

(6) CO_2 sensor connector

(7) CO_2 adapter connector

17.2 CO_2 Safety Information

WARNING

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

CAUTION

- **If the N1 is configured with the CO_2 module, only the N1 with the label  can be used with Transport Dock with DC input.**
- **CO_2 readings and respiratory rate can be affected by certain ambient environmental conditions, and certain patient conditions.**
- **In high-altitude environments, etCO_2 values may be lower than values observed at sea level, as described by Dalton's law of partial pressures. When using the monitor in high-altitude environments, it is advisable to take this into account and to consider adjusting etCO_2 alarm settings accordingly.**
- **Remove the airway sample line from the patient's airway while nebulized medications are being delivered.**
- **EtCO_2 values measured from the CO_2 module may differ from those of from the blood gas analysis.**
- **Avoid mechanical shock to the sidestream CO_2 module configuring the paramagnetic oxygen sensor.**

NOTE

- **The CO_2 module automatically suppresses physiological alarms until breathing waves have been detected. Make sure that a patient is properly connected when monitoring with the CO_2 module.**

17.3 CO_2 Measurement Limitations

The following factors may influence the measurement accuracy:

- Leaks or internal venting of sampled gas
- Mechanical shock