ePM 12M Vet

Portable Multi-Parameter Veterinary Monitor

Operator's Manual

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- the electrical installation of the relevant room complies with the applicable national and local requirements;
- 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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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

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.**
- **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.**
- **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 rely exclusively on the audible alarm system for patient monitoring. Turning the alarm volume to a low level or off may result in a hazard to the patient. Remember that alarm settings should be customized according to patient situations. Always keep the patient under close surveillance.**
- **Alarm settings should be customized according to patient situations.**
- **Do not place the equipment or accessories in any position that might cause it to fall on the patient.**
- **Do not start or operate the equipment unless the setup was verified to be correct.**

- **To avoid inadvertent disconnection, route all cables in a way to prevent a stumbling hazard. Wrap and secure excess cabling to reduce risk of entanglement by patients or personnel.**
- **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 sole basis for diagnosis or therapy decisions. They must be used in conjunction with clinical signs and symptoms. Misinterpretation of the measured values or other parameters can endanger the patient.**
- **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 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 use a mains plug as isolation means to the mains power. Do not locate the equipment in a place difficult to operate the mains plug.**
- **The typical operator's position is in front of the monitor.**
- **The software was developed in compliance with IEC62304.**
- **This manual describes all features and options. Your equipment may not have all of them.**
- **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
	General warning sign		Refer to instruction manual/booklet
	Serial number		Catalogue number
	Date of manufacture		Manufacturer
	USB connector		Unlocking
	Battery indicator		Computer network
	Equipotentiality		Alternating current
	DEFIBRILLATION-PROOF TYPE CF APPLIED PART		DEFIBRILLATION-PROOF TYPE BF APPLIED PART
	Stop USB		Zero key
	NIBP start/stop		Calibration
	Stand-by		Menu
IPX1	Protected against vertically falling water drops per IEC 60529		Plastic identification symbol
	Unlocking		Locking
	Graphical record		Non-ionizing electromagnetic radiation
	Gas outlet		Gas inlet

Symbol	Description	Symbol	Description
	Output		Input/output
	Humidity limitations		Atmospheric pressure limitations
	Temperature limitations		Pushing prohibited (wheels locked, no pushing)
	Stacking limit by number		Keep dry
	This way up		Fragile; handle with care
EC REP	Authorised representative in the European Community		Dispose of in accordance to your country's requirements
CE	The product bears CE mark indicating its conformity with the provisions of the Council Directive 93/42/EEC concerning medical devices and fulfills the essential requirements of Annex I of this directive. Note: The product complies with the Council Directive 2011/65/EU.		

2 Equipment Introduction

2.1 Intended Use

The ePM 12M Vet portable multi-parameter veterinary patient monitor, hereafter called the monitor, is intended to be used for monitoring, displaying, reviewing, storing, alarming and transferring of multiple physiological parameters including ECG (arrhythmia detection, ST segment analysis, QT/QTc monitoring, and heart rate (HR)), respiration (Resp), temperature (Temp), pulse oxygen saturation (SpO_2), pulse rate (PR), non-invasive blood pressure (NIBP), invasive blood pressure (IBP), cardiac output (C.O.), carbon dioxide (CO_2), oxygen (O_2) and anesthetic gas (AG).

The monitor is to be used in animal hospitals by clinical professionals or under their guidance.

WARNING

- **This monitor is intended for use only by clinical professionals or under their guidance. It must only be used by persons who have received adequate training in its use. Anyone unauthorized or untrained must not perform any operation on it.**

2.2 Applied Parts

The applied parts of the monitor are:

- ECG electrode and leadwire
- SpO_2 sensor
- Temp probe
- NIBP cuff
- IBP transducer
- C.O. sensor
- CO_2 sampling line/nasal sampling cannula and water trapk
- AG sampling line, water trap, and airway adapter

2.3 System Components

The monitor consists of the main unit, display, external modules, input devices, and output devices.

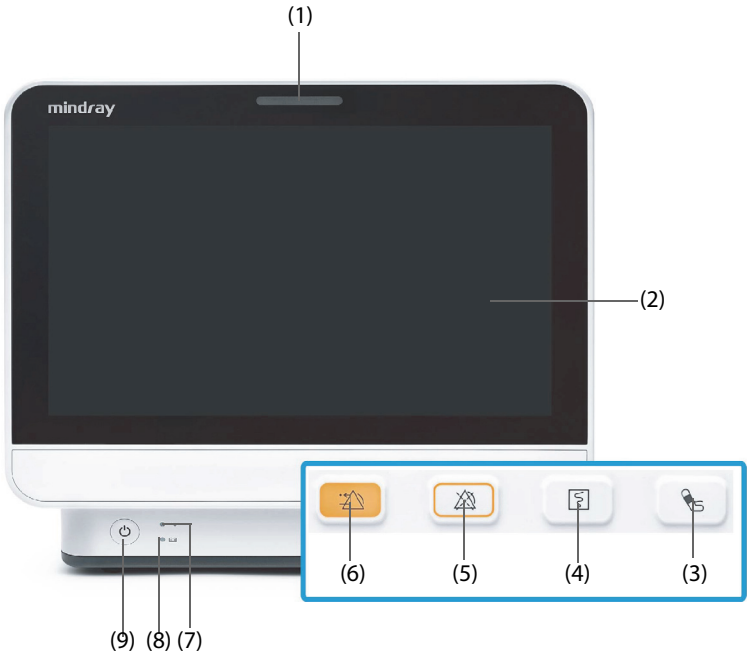
NOTE

- **Your monitor may not include all these components. Contact your local service personnel for the available components.**

2.3.1 Main Unit

The main unit processes data from modules.

2.3.1.1 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) Display

(3) NIBP Start/Stop hard key

Press to start an NIBP measurement or stop the current NIBP measurement.

(4) Record Start/Stop key

Press to start a recording or stop the current recording.

(5) Alarm Pause hard key

Press to pause the physiological alarm system.

(6) Alarm Reset hard key

Press to reset the alarm system.

(7) Power indicator

- On: when the power is connected.
- Off: when the power is not connected.

(8) Battery indicator

- Yellow: the battery is being charged.
- Green: the battery is fully charged.
- Flashing green: the monitor operates on battery power.
- Off: no battery is installed, or the battery is malfunctioning, or the monitor is powered off and no power is connected.

(9) Power switch

- Pressing this switch turns on the monitor.
- When the monitor is on, pressing and holding this switch turns off the monitor.

2.3.1.2 Left View

(1) Temperature probe connector

(2) SpO_2 probe connector

(3)IBP cable connector

(4) ECG cable connector

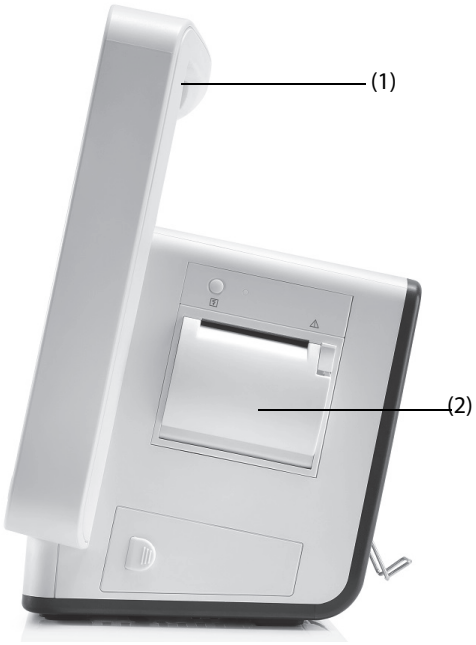
(5) CO_2 watertrap seat

(6) NIBP cuff connector

(7) Gas outlet

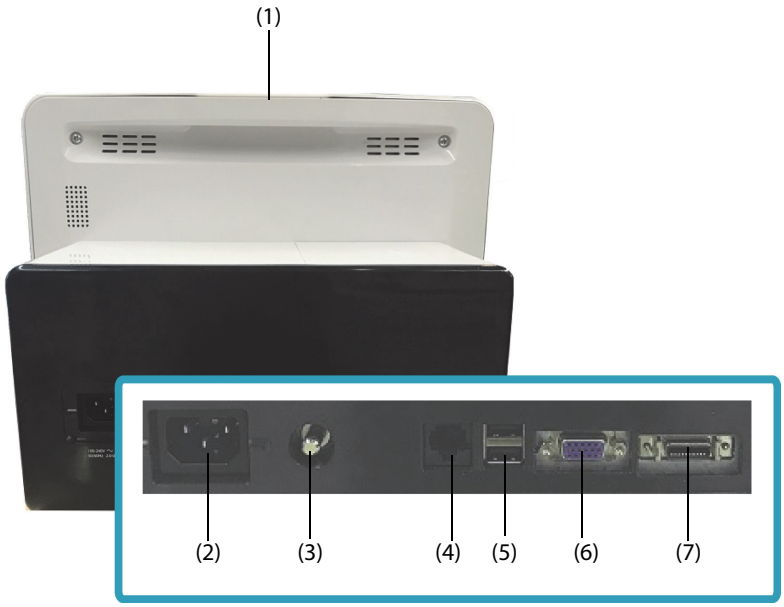
(8) C.O. cable connector

2.3.1.3 Right View



(1) Handle (2) Recorder

2.3.1.4 Rear 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) AC Power input

(3) Equipotential Grounding Terminal

When using the monitor together with other devices, connect their equipotential grounding terminals together to eliminate the potential difference between them.

(4) Network Connector

It is a standard RJ45 connector which connects the monitor to other network devices.

(5) USB connectors

It connects USB devices, for example the barcode reader.

(6) VGA Connector

It connects an external display, which extends the display capability of your monitor. The contents displayed on the external display screen accords with those displayed on the monitor screen.

(7) Multifunctional Connector

It outputs defibrillator synchronization signals, nurse call signals and analogy output signals.

2.3.2 External Modules

The external modules are used to monitor the patient's physiological parameters, record patient information and data The monitor provides the following modules:

- Parameter modules: acquires and processes the patient's data and sends the data to the main unit. For details, see the relevant parameter chapters.

2.3.2.1 Available Modules

The following table lists available modules

Module label	Comments
C.O.	Supports C.O. monitoring
IBP	Supports IBP monitoring
CO_2	Supports CO_2 monitoring. The sidestream CO_2 module can integrate O_2 (paramagnetic) monitoring.
AG	Supports AG monitoring. The AG module can integrate O_2 monitoring.

You can simultaneously use maximum two IBP modules (built-in IBP not included) . The other modules can only be used one at a time. Otherwise, the monitor will issue a module conflict prompt.

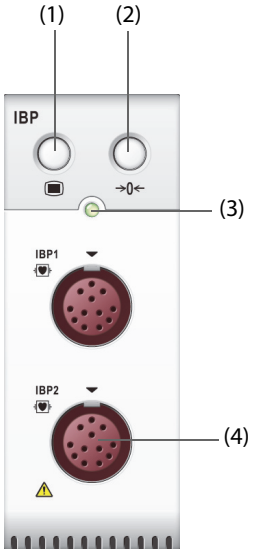
For example, if a CO_2 module is already loaded and then another CO_2 module is inserted, the monitor will then prompt module conflict. To solve the problem of module conflict, just remove a module.

2.3.2.2 Example Module

The parameter modules have similar structure:

- The parameter label is marked at the upper left corner.
- Hard keys are located on the upper part.
- Patient cable connectors are located at the lower part.

We take the IBP module as an example.



(1) Setup hard key: enters or exits the IBP Setup menu.

(2) Zero hard key: enters the **Zero IBP** menu.

(3) Module status indicator

- On: the module works properly.
- Flashing: the module is initializing.
- Off: the module is not connected or the module fails.

(4) Patient cable connectors

2.3.3 Input Devices

The monitor allows data entry through touchscreen, remote controller, hardkey and barcode reader.

You can only use Mindray specified input devices.

2.3.4 Printing Devices

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

The monitor is configured with a build-in recorder.

The printer can be connected to the monitor through the network to output patient reports.

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, please contact Mindray.**
- **The monitor and parameter monitoring accessories are suitable for use within the patient environment. For other equipment and accessories connected to the monitor, consult corresponding manufacturers for the suitability within the patient environment.**
- **If it is not evident from the equipment specifications whether a particular combination with other devices is hazardous, for example, due to summation of leakage currents, please consult the manufacturer or an expert in the field. A determination must be made that the proposed combination will not negatively affect the devices themselves or the patient's safety.**
- **If the accuracy of any value displayed on the monitor, 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.**
- **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 the packing case and packaging material as they can be used if the equipment must be reshipped.**

3.2 Monitor Installation

The monitor can be installed in various ways as required.

- Wall mount
- Placed on desk
- Trolley tray
- Bedrail clamp
- Bedrail hook

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.

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. If the equipment is installed in a cabinet, sufficient space in front and behind shall be left for convenient operation, maintenance and repair. 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 is powered by AC power supply. 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 besides the AC power input.

To use the AC power source, follow this procedure:

1. Connect the female end of the power cord with the AC power input.
2. Connect the male end of the power cord with a wall AC outlet.
3. Check that the power indicator is on.

The AC indicator is off if the AC mains is not connected. When AC mains is connected, the AC indicator is illuminated in green.

WARNING

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

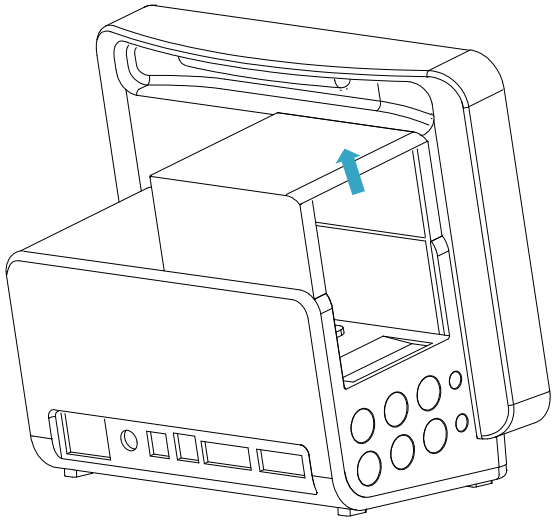
3.3.2 Connecting the Input Devices

Connect the barcode reader if necessary.

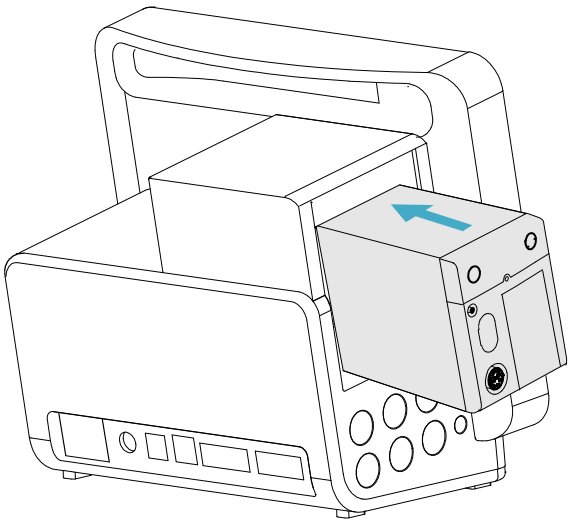
3.3.3 Connecting the Parameter Module

To connect the parameter module, follow this procedure:

1. Push the module rack door open, and then push it until you hear a click.



2. With the module properly oriented, align the module insertion guide slot with the module rack insertion guide. Push the module into the module rack until you hear a click.
3. Push the lock at the bottom of the module inwards to lock the module.



3.3.4 Removing the Parameter Module

To remove the parameter module, follow this procedure:

1. Pull outwards the lock at the bottom of the module to release the module.
2. Lift the latches at the bottom of the module and slide the module out of the module rack. Hold on the module to make sure it does not drop when it comes out.

CAUTION

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

3.4 Turning on the Monitor

Before turn on the monitor, perform the following inspections:

1. Check the monitor and modules for any mechanical damage. Make sure that all external cables, plug-ins and accessories are properly connected.
2. Connect the power cord to the power supply.

To turn on the monitor, press the power switch.

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.**

3.5 Operation and Navigation

Everything you need to operate the monitor is on its screen. Almost every element on the screen is interactive. Screen elements include parameter values, waveforms, quick keys, information fields, alarms fields and menus. Often you can access the same element in different ways. For example, you can access a parameter menu by selecting corresponding numeric area or waveform area, through the Menu hard key on the parameter module, or through the **Parameters Setup** quick key.

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 or Swiping across the Screen

- Tapping the screen
  - To select an item from menus or lists, or select a quick key, tap on it with your finger.
  - To enter a parameter menu, tap corresponding numeric area or waveform area. For example, select the ECG numeric area or waveform area to enter the **ECG** menu.
- Swiping across the screen with a single finger
  - To scroll through a list and a menu, swipe up and down.
  - To show or expand the Minitrends screen, swipe right across the corresponding screen.
  - To contract or hide the Minitrends screen, swipe left across the corresponding screen.
- Swiping across the screen with two fingers
  - To switch screens among the normal screen, the big numeric screen, and the minitrends screen, swipe left or right across the screen.
  - To discharge a patient, swipe from top to bottom.

3.5.1.2 Locking the Touchscreen

To avoid misuse, you can temporarily disable the touchscreen. To do so, hold and press the **Main Menu** quick key and slide as directed by the arrow. A padlock symbol displays at the top of the main menu quick key if the touchscreen is disabled.

The touchscreen lock period is configurable. To do so, 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 **Screen Lock Duration**.

The touchscreen is enabled when the preset time is reached. If you need to manually enable the touchsceen, hold and press the **Main Menu** quick key and slide as directed by the arrow.

CAUTION

- **Check that the touchscreen is not damaged or broken. If there is any sign of damage, stop using the monitor and contact the service personnel.**
- **If the touchscreen is loose, stop using the monitor and contact the service personnel.**

3.5.2 Using the On-Screen Keyboard

The on-screen keyboard enables you to enter information:

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

3.5.3 Using the Barcode Reader

The monitor supports both linear (1D) barcode reader and two-dimension (2D) barcode reader. The barcode reader is connected to the monitor's USB connector.

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.**

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

If you are using the Mindray custom 2D barcode reader (Model HS-1R or HS-1M), before using 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.**

3.5.3.2 Setting the Barcode Reader

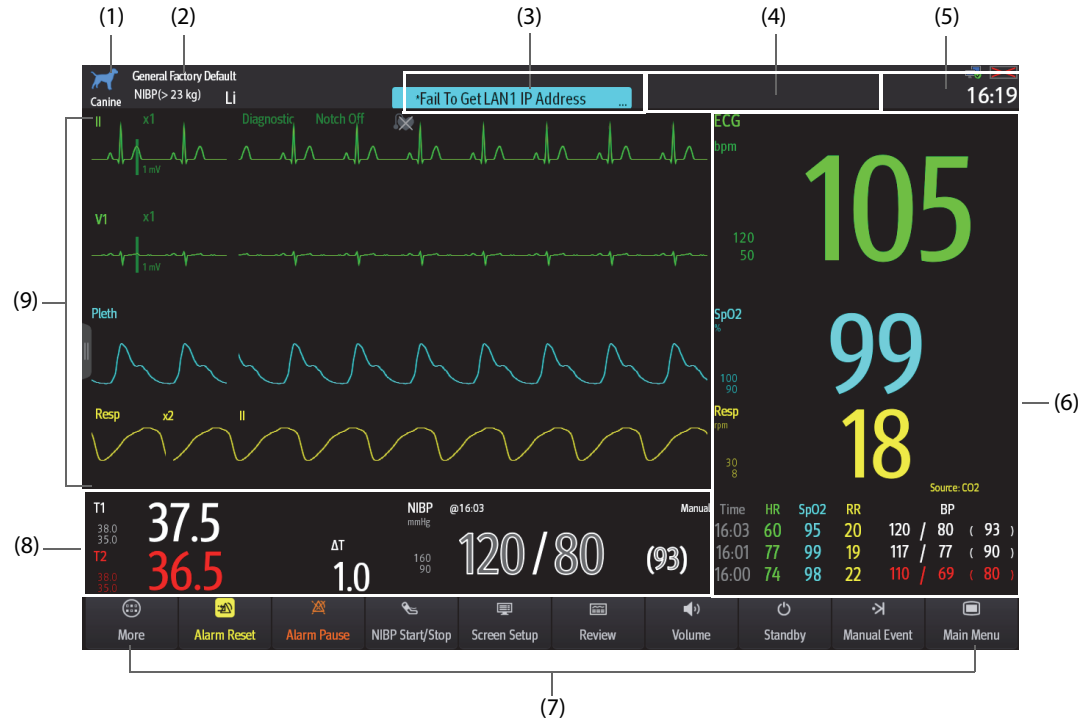
For information on setting the barcode reader, see *24.14 The Scanner Settings*.

3.5.4 Using the Remote Controller

You can use the remote controller to control the monitor by connecting the receiver of the remote controller to the USB connector. For more information on how to use the remote controller, see the Instructions for Use delivered with the remote controller.

3.6 Screen Display

The following figure shows the normal screen:



(1) Patient information area: displays patient information, including patient category, patient name, age, weight range, and so on. The displayed patient information is configurable. Selecting this area enters the **Patient Management** menu. For more information, see *5 Managing Patients*.

(2) The current configuration

(3) Technical alarm information area: displays prompt messages on the above; displays technical alarm messages at the bottom.

(4) Physiological alarm information area: displays high priority physiological alarms on the above; displays medium and low priority physiological alarms at the bottom.

(5) System status information area: displays alarm symbol, battery status, network status, storage device status, and system time. For more information, see *3.6.1 On-screen Symbols*.

(6) Parameter numerics area: displays parameter values, alarm limits, and alarm status. This area also displays parameter list. Selecting a parameter numeric block enters corresponding parameter menu. Selecting the parameter list enters tabular trend review. For more information, see *3.11.4 Accessing Parameter Setup Menus*.

(7) Quick key area: displays selected quick keys.

(8) Parameter waveform/numerics area: displays parameter waveforms, parameter values, alarm limits, and alarm status. This area also displays parameter list. Selecting a parameter numeric area or waveform area enters corresponding parameter menu. Selecting the parameter list enters tabular trend review. For more information, see *3.11.4 Accessing Parameter Setup Menus*.

(9) Parameter waveform area: displays parameter waveforms and parameter alarms. 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
	Canine, male		Canine, female
	Feline, male		Feline, female
	Other, male		Other, female
	Wireless network is connected. The solid part indicates network signal strength.		Wireless network is not connected.
	Wired network is connected.		Wired network is not connected.
	All the alarms are paused.		Individual physiological alarms are turned off or the monitor is in the alarm off status.
	Audible alarm tones are paused.		Audible alarm tones are turned off
	The alarm system is reset.		The battery 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.

3.6.2 Menus

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

(1) Menu heading

(2) Submenu tabs

(3) Operation buttons

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

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

(6) Switch:

- Green: the switch is on.
- Gray: the switch is off.

3.6.3 Quick Keys

The monitor provides quick keys for you to quickly access some functions. The quick key area is located at the bottom of the screen. The **Main Menu** key is permanently located the right bottom, and the **More** key is permanently located at the left bottom. Selecting the **More** quick key shows more quick keys. The quick keys displayed on the screen are configurable.

3.6.3.1 Available Quick Keys

The following table shows available quick keys.

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 alarm system.
	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.
	Zero IBP	Starts IBP zero calibration.		C.O. Measure	Opens the **C.O. Measure** window.
	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.
	ECG Full-Screen	Enters the 12-lead ECG full screen.		Night Mode	Enters the night mode.
	Call Help	Calls for help.		Intubation Mode	Enters the intubation mode.
	Volume	Enters the **Volume** menu.		Freeze	Freezes waveforms.

Symbol	Label	Function	Symbol	Label	Function
	Calculations	Enters the **Calculations** menu.		Load Config	Enters the **Load Config** menu.
	Print	Starts printing a real-time report.		Record	Starts/Stops a recording.
	End Case Report	Prints the selected end case reports.		ECG Lead/Gain	Enters the **ECG Lead/ Gain** menu.
	Discharge Patient	Enters the **Discharge Patient** dialog box.		Discharged Patients	Enters the **Discharged Patients** dialog box.
	Targeted Goal	Opens the Targeted Goal screen.		CPB Mode	Enters the CPB mode.
	ECG 24h Sum	Views the 24-hour ECG summary.			

3.6.3.2 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.

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 Night Mode

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

3.7.2.1 Entering the Night Mode

To enter the night mode, follow this procedure:

1. Select the **Night Mode** quick key, or 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**.

The night mode settings are as follows by default:

- **Brightness: 1**
- **Alarm Volume: 2**
- **QRS Volume: 1**
- **Key Volume: 0**
- **NIBP End Tone: Off**
- **Stop NIBP: Off**

CAUTION

- **Verify the night mode settings before entering the night mode. Pay attention to the potential risk if the setting value is low.**

3.7.2.2 Exiting the Night Mode

To cancel the night mode, follow this procedure:

1. Select the **Night Mode** quick key, or select the **Main Menu** quick key → from the **Display** column select **Exit Night Mode**.
2. Select **OK**.

NOTE

- **The monitor resumes the previous settings after exiting the night mode.**

3.7.3 Standby Mode

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

3.7.3.1 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.**

3.7.3.2 Changing the Patient Location at Standby

If you need to change the patient's location, select **Location** from the Standby screen.

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

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 saving time only when the auto daylight saving time function is disabled. For more information, see *24.9.2 The Daylight Savings Time Tab* for details.

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. If you are using the external power source, set **Brightness**. If you are using the battery to run the monitor, set **Brightness On Battery**.

NOTE

- **If the monitor is configured with the auto-brightness function, the screen brightness automatically changes with ambient light level when you can set Brightness to Auto.**

3.8.3 Adjusting the Volume

Select the **Volume** quick key to set **Alarm Volume**, **QRS Volume**, and **Key Volume**.

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 the corresponding sensor from the patient.
2. Disconnect the sensor from the patient cable.
3. Disconnect the patient cable from the parameter module.
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 also 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**. For more information, see *24.10 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 and the corresponding parameter module is plugged in, you cannot monitor this parameter.**

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 module front.
- ■ 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 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 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.

3.12.1 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
- ■ Remote View screen

3.12.2 Viewing Frozen Waveforms

To view the frozen waveforms, follow this procedure:

- ■ Select the < or > button in the **Freeze** window.
- ■ 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.**

3.12.3 Unfreezing Waveforms

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

3.12.4 Printing Frozen Waveforms

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

3.13 Capturing the Screen

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

1. Connect the USB drive to the monitor's USB connector.
2. Press and hold the **More** quick key. Wait till it turns from blue to grey.

The captured pictures are automatically saved in the USB drive.

3.14 Checking Software Licenses

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

■ ECG 24h Summary

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

To install the licenses, follow this procedure:

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

3.15 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

- **The monitor that was switched on prior to a power loss automatically switched on when the power is restored.**
- **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.**

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4 User Screens

The monitor provides different user screens to facilitate patient monitoring in different departments and clinical applications.

4.1 Choosing a Screen

To choose a screen, follow this procedure:

1. Access the **Choose Screen** page 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.

4.2 Normal Screen

The normal screen is most frequently used for patient monitoring.

4.2.1 Entering the Normal Screen

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

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

4.2.2 Configuring the Normal Screen

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 **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.

4.3 The Big Numerics Screen

The big numerics screen displays parameter numerics in big font size.

4.3.1 Entering the Big Numerics Screen

To enter the big numerics screen, choose any of the following ways:

- Swipe left or right across the touchscreen with two fingers until you switch to the big numerics screen.
- Select the **Screen Setup** quick key → select the **Choose Screen** tab → select **Big Numerics**.
- Select the **Main Menu** quick key → from the **Display** column select **Choose Screen** → select **Big Numerics**.

4.3.2 Configuring the Big Numerics Screen

To configure the big numerics screen, 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 **Big Numerics** tab
3. Select a parameter numeric area or waveform area, and then from the popup list select an element to display in this area.

4.4 Minitrends Screen

The Minitrends screen shows the recent graphic trends of parameters.

4.4.1 Entering the Minitrends Screen

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

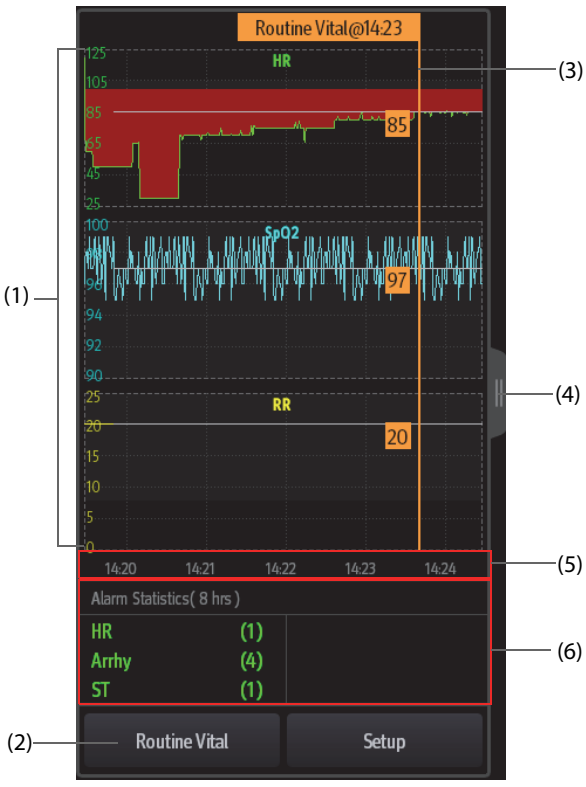
- ■ Select the **Minitrends** quick key.
- ■ Select the **Screen Setup** quick key → Select the **Choose Screen** tab→ select **Minitrends**.
- ■ Select the **Main Menu** quick key → from the **Display** column select **Choose Screen** → select **Minitrends**.

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.

4.4.2 The Display of Minitrends Screen

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



(1) Scale

(2) **Routine Vital** button.

(3) Routine Vital

(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

4.4.3 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.

4.4.4 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**.

4.4.5 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**.

4.4.6 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.

4.4.7 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**.

4.4.8 Routine Vital

The Routine vital/Baseline function is used for marking the parameter measurements of certain moment for later reference.

4.4.8.1 Manually Marking the Routine Vital

To manually mark the Routine Vital, follow this procedure:

1. Enter the Minitrends screen.
2. Select the **Routine Vital** button button.

NOTE

- **If you do not see the Routine Vital button in the Minitrends screen, you can set Routine Vital to Manual or Auto.**

4.4.8.2 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 **Auto** from the dropdown list of **Routine Vital**.
4. Select **Time** to set the time for marking the first routine vital sign values.
5. Select **Interval** to set the interval for marking the routine vital sign values.

4.5 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.

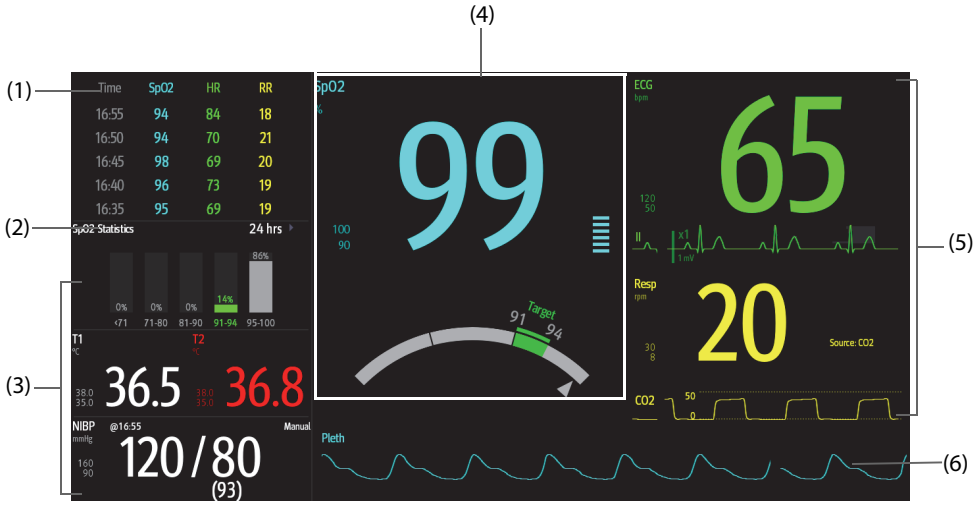
4.5.1 Entering the Targeted Goal Screen

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

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

4.5.2 The Display of the Targeted Goal Screen

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



(1) Parameter trends area: displays trends of the target parameter and secondary parameters. If the target parameter is Art, this area only lists the trend of arterial pressure.

(2) Target parameter statistics area: displays the statistics of the target parameter by sections.

(3) Other parameter area: displays parameter measurements and alarm limits of parameters other than the target parameter and secondary parameters.

(4) 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.

(5) 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.

(6) 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.

4.5.3 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.

4.5.4 Operating the Targeted Goal Screen

You can access parameter setup and trends review from the Targeted Goal screen. To do so, follow this procedure:

- ■ Select the parameter trends area to enter the **Tabular Trends** review page.
- ■ Select the target parameter statistics area to enter the parameter statistics setup menu. Set the range of each SpO_2 section and the target section.
- ■ Select the desired waveform area, parameter numeric area, or dashboard to enter corresponding parameter setup menu.

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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 *6.3 Setting Default Configuration*.

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

WARNING

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

5.1.1 Manually Discharging a Patient

To manually discharge a patient, choose any of the following ways:

- Swipe down the touchscreen with two fingers.
- Select the **Discharge Patient** quick key.
- Select the patient information area at the top left corner of the screen → **Discharge Patient**.
- Select the **Patient Management** quick key → **Discharge Patient**.
- Select the **Main Menu** quick key → from the **Patient Management** column select **Discharge**.

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 still uses the current 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, you must set Paced to Yes. If it is incorrectly set to No, the monitor could mistake a pace pulse for a QRS and fail to alarm when the ECG signal is too weak.**
- **For non-paced patients, 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 **Patient Management** quick key.
- 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.**

5.4 Exporting Patient Data

To export the data of the current patient and discharged patients, follow this procedure:

1. Connect the USB drive to the monitor's USB connector.
2. Access the **Discharged Patients** dialog box by either of the following ways:
   - Select the **Discharged Patients** quick key.
   - Select the **Main Menu** quick key → from the **Patient Management** column select **Discharged Patients**.
3. From the patient list select desired patients.
4. Select **Export Patient Data**.

5.5 Deleting Patient Data

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

1. Access the **Discharged Patients** dialog box by either of the following ways:
   - Select the **Discharged Patients** quick key.
   - Select 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. The monitor provides one general department with three different sets of configurations tailored for canine, feline and others. You can change some settings from a certain set of configuration and then save the changed configuration as a user configuration.

WARNING

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

6.2 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**.

6.3 Setting Default Configuration

The monitor will load the pre-set default configuration in the following cases:

- A patient is admitted.
- A patient is discharged.
- Patient data is cleared.
- 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 Specified Config**, the restored configuration is subject to the patient category (canine, feline or others). This configuration can be either factory configuration or a saved user configuration. As an example, select **Default Config(Canine)** and then select **Factory Default** or user configuration(s).
   - When you select **Load the Latest Config**, the latest configuration is loaded when the monitor is started or a patient is admitted.

6.4 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.

6.5 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**.

6.6 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.

6.6.1 Exporting a Configuration

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

1. connect the USB drive to the monitor's USB connector.
2. Select the **Main Menu** quick key → from the **Configuration** column select **Manage** → input the required password → select ↵.
3. Select **Export Configuration**.
4. Select the configurations and **User Maintenance Settings** to export.
5. Select **Export**.

6.6.2 Importing a Configuration

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

1. Connect the USB drive to the monitor's USB port.
2. Select the **Main Menu** quick key → from the **Configuration** column select **Manage** → input the required password → select ↵.
3. Select **Import Configuration**.
4. Select the configurations and **User Maintenance Settings** to import.
5. Select **Import**.

6.7 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**.

6.8 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.**

6.9 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**.

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7 Networked Monitoring

7.1 Network Introduction

You can connect the monitor to other monitors through wired LAN or wireless LAN.

7.2 Network Safety Information

CAUTION

- **Wireless network designing, deploying, debugging, and maintenance should be executed by Mindray service personnel or authorized technicians.**
- **Always set the wireless network according to local wireless regulations.**
- **Data communication must be performed within a closed network or within a virtually isolated network provided by a hospital for all network functions. The hospital is responsible for ensuring the security of the virtually isolated network.**
- **Keep network authentication information, for example password, safe, protecting the network from being accessed by unauthorized users.**
- **Do not connect non-medical devices to the monitor network.**
- **RF interference may result in wireless network disconnection.**
- **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 Viewing Other Patients

On your monitor, you can 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 waveforms of one remote device on your monitor.

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

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.**

7.3.1 Remote View

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

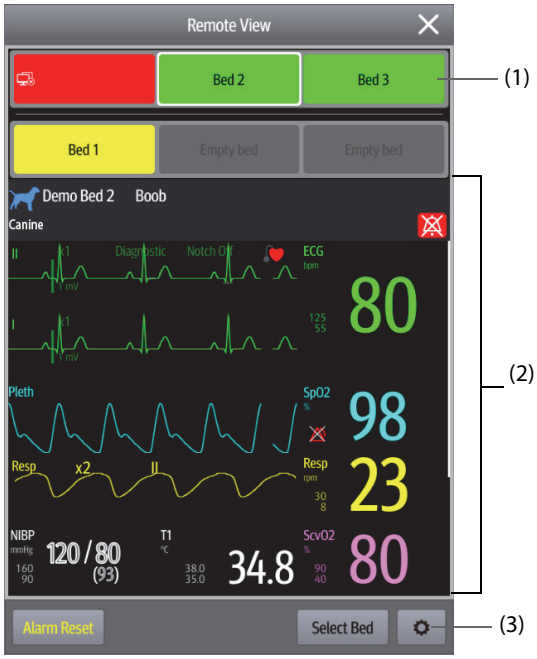
7.3.1.1 Entering the Remote View Window

To enter the **Remote View** window, 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 *7.3.2.2 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 **Primary Screen** tab → select the **Choose Screen** tab → select **Remote View**.

7.3.1.2 About the Remote View

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



(1) Alarm watch area

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

Background Color	Description
Green	No alarm is occurring 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, the icon 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 bed is in the standby mode.

(2) Main body

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

(3) Remote View setup button: select it to enters the Remote View setup menu.

7.3.1.3 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** window. To do so, choose either of the following ways:
   - In the **Remote View** window, select **Select Bed**. For more information, see *7.3.1.1 Entering the Remote View Window* for entering the **Remote View** window.
   - Select the icon at the alarm watch tile if the tile is configured to display on the main screen.
2. In the **Select Bed** window, select a desired department. All the beds under this department will be listed.

3. Select a desired tile at the A-W1 or A-W2 areas and then select a bed from the bed list. The selected bed will appear in the tile.

NOTE

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

7.3.1.4 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** window. Choose either of the following ways:
   - In the **Remote View** window, select **Select Bed**. For more information, see *7.3.1.1 Entering the Remote View Window* for entering the **Remote View** window.
   - Select the  icon in the alarm watch tile if the tile is configured to display on the main screen.
2. In the **Select Bed** window, select a bed at the A-W1 or A-W2 areas, and then select **Clear Bed**. If you want remove all beds, select **Clear All Beds**.

7.3.1.5 Displaying the Main Bed

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

7.3.1.6 Saving a Manual Event

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

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

7.3.1.7 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 Alarm Reset By Other Bed is switched on at the remote devices. For more information, see *24.4.4 The Remote View Tab*.**

7.3.2 Alarm Watch

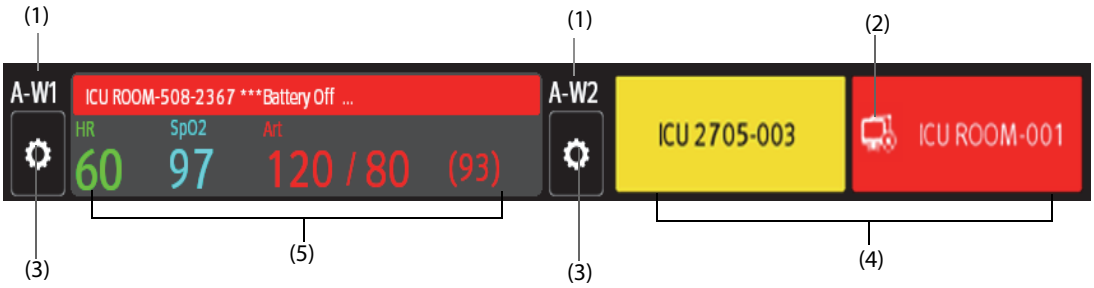
The alarm watch function provides the alarm notification by color and sound.

- The monitor sounds the highest priority alarm tone from all the monitored remote devices.
- The monitor displays the highest priority alarm in corresponding background color for each bed at following areas:
  - At the top of the **Remote View**. For more information, see *7.3.1.2 About the Remote View* for details.
  - On the main screen. For more information, see *7.3.2.1 About Alarm Watch Tile* for details.

7.3.2.1 About Alarm Watch Tile

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.



(1) Alarm watch tile label

(2) Disconnection icon: when the remote device is disconnected, this icon displays at the tile, and the tile background color is red.

(3) Select bed icon: select it to enter the **Select Bed** window.

(4) More than one bed tile: when more than one bed is assigned to a tile, the tile displays the alarm status, connection status, etc.

(5) One bed tile: when only one bed is assigned to a tile, the tile displays the parameter value and alarm message from this bed, etc.

The alarm watch tile is similar to alarm watch area in the **Remote View.** For more information, see *7.3.1.2 About the Remote View*.

7.3.2.2 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**.

7.3.3 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 the monitoring information from this remote bed.

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

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

1. From the **Remote View** screen, select  to enter the **Remote View** setup 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.

7.4 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.

7.5 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  .

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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 other monitors, alarms can be presented and controlled remotely. Remote suspension, inhibition, or reset of monitor alarms via other monitors may cause a potential hazard. For more information, see the operator's manuals of theother monitors.**
- **The monitors in your care area may each have different alarm settings to suit different patients. Always check that the alarm settings are appropriate for your patient before start monitoring. Always make sure that necessary alarm limits are active and set according to the patient's clinical condition.**
- **Setting alarm limits to extreme values may cause the alarm system to become ineffective.**
- **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 rely exclusively on the audible alarm system for monitoring. Adjustment of alarm volume to a low level may result in a hazard to the patient. 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 a sensor or component. Technical alarm conditions may also be caused when an algorithm cannot classify or interpret the available data.

Apart from the physiological and technical alarms, the monitor can also prompt 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: indicate a discomfort condition, a device malfunction, or an improper operation. Low priority alarms require you to be aware of this condition.
- Messages: provides additional information on the patient or the equipment.

8.3.3 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	Message	Comments
Alarm lamp		Red Flashing frequency: 1.4 - 2.8 Hz Duty ratio: 20 - 60%	Yellow Flashing frequency: 0.4 - 0.8 Hz Duty ratio: 20 - 60%	Cyan No flashing Duty ratio: 100%	None	None
Audible tone pattern	ISO	Repeat pattern of 2 × 5 beep tones	Repeat pattern of 3-beep tones	1-beep tone	None	None
	Mode 1	Repeat pattern of high-pitched 3-beep tones	Repeat pattern of 2-beep tones	Low-pitched 1-beep tone	None	
	Mode 2	Repeat pattern of high-pitched 3-beep tones	Repeat pattern of 2-beep tones	Low-pitched 1-beep tone	None	
Alarm message		White text inside a red box	Black text inside a yellow box	Black text inside a cyan box	White text	Alarm messages are displayed in the alarm information area at the top of the screen. You can select the alarm messages to show the alarm list.
Alarm priority indicator		***	**	*	None	The indicator shows in front of corresponding alarm message.
Parameter value		White text inside a flashing red box	Black text inside a flashing yellow box	Black text inside a flashing cyan box	None	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 technical 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 physiological alarms of different priority levels occur simultaneously and should be displayed in the same area, the monitor displays the high priority alarm, while the medium and low priority alarms are displayed circularly.**
- **When multiple alarms of the same priority levels occur simultaneously, alarm messages are displayed circularly.**

- **Lethal arrhythmia alarms, apnea, and SpO_2 Desat are exclusive high priority alarms. When these alarms occur, the monitor only displays messages of exclusive alarms. Other high priority alarms will not be displayed. When multiple exclusive alarms occur simultaneously, alarm messages are displayed circularly.**

8.3.4 Alarm Status Symbols

Apart from the alarm indicators as described in ***8.3.3 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.

8.4 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.

8.5 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 Changing Alarm Settings

Select the **Alarm Setup** quick key or from the **Alarm** column of the main menu select desired buttons to set alarm properties.

8.6.1 Setting Parameter Alarm Properties

To set parameter alarm properties, follow this procedure:

1. Access the **Limits** page in either of the following ways:
   - Select the **Alarm Setup** quick key.
   - 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 infor-mation, see *24.11 The Authorization Setup Settings*.

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

8.6.2 Setting Alarm Tone Properties

8.6.2.1 Changing the Alarm Volume

To change the alarm volume, follow this procedure:

1. Access the **Setup** page in either of the following ways:
   - ◆ Select the **Alarm Setup** quick key → select the **Setup** tab.
   - ◆ 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 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.**

8.6.2.2 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 *24.4.1 The Audio Tab*.

8.6.3 Setting the Auto Limits for New Patient Switch

If the Auto Limits for New Patient function is enabled, a dialog box pops up to ask you whether to set alarm limits basing on the latest parameter measurements for a newly admitted patient. To set the **Auto Limits for New Patient** switch, follow this procedure:

1. Access the **Setup** page in either of the following ways:
   - ◆ Select the **Alarm Setup** quick key → select the **Setup** tab.
   - ◆ Select the **Main Menu** quick key → from the **Alarm** column select **Setup.**
2. Set the **Auto Limits for New Patient** switch.

When **Auto Limits for New Patient** is switched on, the confirmation dialog box pops up if all of the following requirements are met:

- Within 10 minutes after the patient is admitted.
- Continuous measurements are stable.
- An NIBP measurement has been taken
- HR alarm switch is on.
- No fatal alarms are triggered.
- The patient is not in poor perfusion condition.
- Alarm limit of any parameter was not manually changed.
- The monitor is not in intubation mode or CPB mode.

NOTE

- **The Auto Limits for New Patient function is intended for newly admitted patients only.**
- **The automatically set alarm limits take effect only after being confirmed.**

8.6.4 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. Access the **Limits** page in either of the following ways:
   - Select the **Alarm Setup** quick key.
   - 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.

Then the monitor will 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 from the **Limits** menu. 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	Lower Limit	Upper Limit	Auto Limit Range
ECG	HR/PR (bpm)	(HR - 30) or 90 (whichever is greater)	(HR + 40) or 200 (whichever is smaller)	55 to 225
Resp	RR (rpm)	(RR - 10) or 30 (whichever is greater)	(RR + 25) or 85 (whichever is smaller)	10 to 90
SpO_2	SpO_2 (%)	Same as the default alarm limit	Same as the default alarm limit	Same as the measurement range
NIBP	NIBP-S (mmHg)	(SYS × 0.68 + 10)	(SYS × 0.86 + 38)	Weight >23kg or >50 lb: 45 to 270 Weight 10 to 23 kg or 21 to 50 lb: 45 to 185 Weight <10 kg or <21 lb: 45 to 185
	NIBP-D (mmHg)	(Dia × 0.68 + 6)	(Dia × 0.86 + 32)	Weight >23kg or >50 lb: 25 to 225 Weight 10 to 23 kg or 21 to 50 lb: 25 to 150 Weight <10 kg or <21 lb: 25 to 150
	NIBP-M (mmHg)	(Mean × 0.68 + 8)	(Mean × 0.86 + 35)	Weight >23kg or >50 lb: 30 to 245 Weight 10 to 23 kg or 21 to 50 lb: 30 to 180 Weight <10 kg or <21 lb: 30 to 180

Module	Parameter	Lower Limit	Upper Limit	Auto Limit Range
Temp (xx refers to temperature site)	Txx (°C)	(Txx - 0.5)	(Txx + 0.5)	1 to 49
	TD (°C)	Same as the default alarm limit	Same as the default alarm limit	Same as the measurement range
IBP: ART/Ao/UAP/BAP/ FAP/LV/P1-P4 (Arterial pressure)	IBP-S (mmHg)	(SYS - 15) or 45 (whichever is greater)	(SYS + 15) or 105 (whichever is smaller)	35 to 115
	IBP-D (mmHg	(Dia - 15) or 20 (whichever is greater)	(Dia + 15) or 80 (whichever is smaller)	20 to 90
	IBP-M (mmHg)	(Mean - 15) or 35 (whichever is greater)	(Mean + 15) or 95 (whichever is smaller)	25 to 105
IBP: PA	IBP-S (mmHg)	SYS × 0.75	SYS × 1.25	3 to 120
	IBP-D (mmHg	Dia × 0.75	Dia × 1.25	
	IBP-M (mmHg)	Mean × 0.75	Mean × 1.25	
IBP: CPP	CPP (mmHg)	(CPP-15) or 35, (whichever is greater)	(CPP+15) or 95, (whichever is smaller)	25 to 100
IBP: CVP/LAP/RAP/UVP/ P1-P4 (Venous pressure)	IBP-M	Mean × 0.75	Mean × 1.25	3 to 40
C.O.	TB (°C)	(TB - 1)	(TB + 1)	Same as the measurement range
CO_2	$EtCO_2$ (mmHg)	0 to 32: remains the same	0 to 32: remains the same	Same as the measurement range
		33 to 35: 29	33 to 35: 41	
		36 to 45: ($EtCO_2$ - 6)	36 to 45: ($EtCO_2$ + 6)	
		46 to 48: 39	46 to 48: 51	
		>48: remains the same	>48: remains the same	
	$FiCO_2$	None	Same as the default alarm limit	
	awRR (rpm)	(awRR - 10) or 30 (whichever is greater)	(awRR+25) or 85 rpm (whichever is smaller)	10 to 90
AG	$EtCO_2$	Same as the CO_2 module		
	$FiCO_2$			
	awRR (rmp)	(awRR - 10) or 30 (whichever is greater)	awRR+25 or 85 (whichever is smaller)	10 to 90
	FiAA/EtAA	Same as the default alarm limit		Same as the measurement range
	$FiO_2/EtCO_2$			
	FiN_2O/EtN_2O			

8.6.5 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 *24.4.6 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.**

8.6.5.1 Setting the Apnea Delay Time

To set the apnea delay time, follow this procedure:

1. Access the **Setup** page in either of the following ways:
   - Select the **Alarm Setup** quick key → select the **Setup** tab.
   - Select the **Main Menu** quick key → from the **Alarm** column select **Setup.**
2. Select **Apnea Delay** to set the apnea delay time.

8.6.6 Restoring the Default Alarm Settings

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

1. Access the **Limits** page in either of the following ways:
   - Select the **Alarm Setup** quick key.
   - Select the **Main Menu** quick key → from the **Alarm** column select **Limits.**
2. Select **Defaults** at the bottom.

8.6.7 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. Access the **Setup** page in either of the following ways:
   - Select the **Alarm Setup** quick key → select the **Setup** tab.
   - Select the **Main Menu** quick key → from the **Alarm** column select **Setup.**
2. Set **Printing Duration On Alarm**.

8.6.8 Setting the Switch of the SpO_2 Desat Alarm Off

You can choose whether switching off the SpO_2 Desat alarm is permissible or not. This function is password protected. For more information, see *24.4.6 The Other Tab*.

WARNING

- **If you switch off the SpO2 Desat alarm, the monitor will not alarm when the patient's SpO_2 is extremely low. This may result in a hazard to the patient. Always keep the patient under close surveillance.**

8.6.9 Setting the Switch of the Apnea Alarm Off

You can choose whether switching off the apnea alarm is permissible or not. This function is password protected. For more information, see *24.4.6 The Other Tab*.

WARNING

- **If you switch off the apnea alarm, the monitor will not issue the apnea alarm in case that apnea happens. This may result in a hazard to the patient. Keep the patient under close surveillance.**

8.7 Pausing Alarms/Pausing Alarm Tones

8.7.1 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 *24.4.2 The Pause/Reset Tab*.

8.7.2 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.
- For technical alarms, alarm sounds 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 *24.4.2 The Pause/Reset Tab*.

8.7.2.1 Switching Off All Alarms

If **Pause Time** is set to **Permanent** (see *24.4.2 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.**

8.7.3 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.

8.7.3.1 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 *24.4.2 The Pause/Reset Tab*.

8.7.3.2 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 *24.4.2 The Pause/Reset Tab*.

NOTE

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

8.7.3.3 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 *24.4.2 The Pause/Reset Tab*.

8.7.3.4 Switching Off Alarm Sound

If **Pause Time** is set to **Permanent** (see *24.4.2 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.**

8.8 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.**

8.8.1 Resetting Physiological Alarms

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

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

8.8.2 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 *D.2 Technical Alarm Messages*.

8.9 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 *24.4.3 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.**

8.10 Nurse Call

The monitor provides a nurse call connector to output nurse call signal when a user-defined alarm occurs. To obtain nurse call signal, use the nurse call cable to connect the hospital nurse call system with the monitor's nurse call connector.

Alarms are indicated on the nurse call device only when the following conditions are met:

- The nurse call system is enabled.
- A user-defined alarm occurs.
- Alarms are not paused or reset.

WARNING

- **Do not rely exclusively on the nurse call system for alarm notification. Remember that the most reliable alarm notification combines audible and visual alarm indications with the patient's clinical condition.**

8.11 Calling for Help

In case of needing a help, you can call monitors in the same department, and the nurse call system from your monitor so that nearby doctors and nurses can come for help.

To call help, select the **Call Help** quick key and select **OK** from the popup dialog box. If you did not select **OK**, the monitor will automatically send out the call help signal in five seconds.

After the call help signal is sent out, the **Call Help** quick key flashes in red. If you need to stop calling for help, select the **Call Help** quick key again.

Monitors receiving the call help signal issue a sound and a dialog box pops up indicating which monitor is calling. Select **OK** to acknowledge the call and stop the sound at this monitor.

NOTE

- **The call help function works only when the monitor is connected to the network.**
- **The call help sound may disturb patients in the same department.**

8.12 CPB Mode

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, choose either of the following ways:

- Select the **CPB Mode** quick key.
- 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, choose either of the following ways:

- Select the **CPB Mode** quick key.
- Select the **Main Menu** quick key → from the **Alarm** column select **Exit CPB Mode**.

8.13 Intubation Mode

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

8.13.1 Entering the Intubation Mode

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

- Select the **Intubation Mode** quick key.
- From the bottom of the **Resp**, **CO2** or **AG** 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:

- Select the **Exit Intubation Mode** quick key.
- From the bottom of the **Resp**, **CO2** or **AG** 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, the alarm lamp illuminates, one after the other, in red, yellow, and cyan. This indicates that the visible and audible alarm indicators function correctly.

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

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 *D Alarm Messages*.

9 Monitoring ECG, Arrhythmia, ST and QT

9.1 ECG Introduction

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

9.2 ECG Safety Information

WARNING

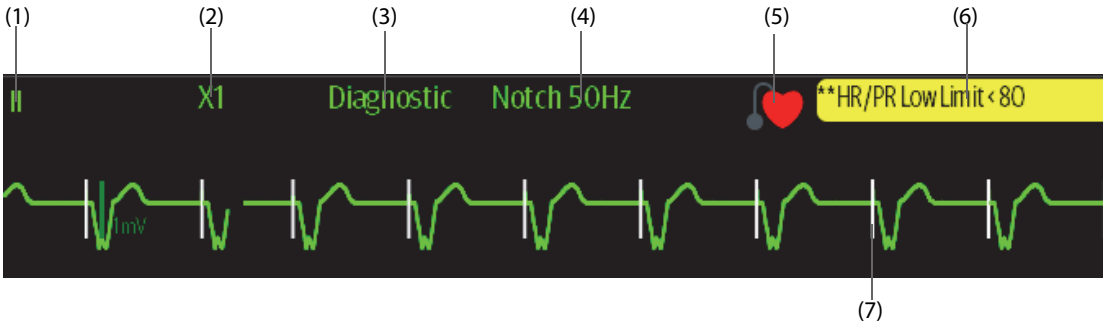
- **This equipment is not intended for direct cardiac application.**
- **Make sure the conductive parts of electrodes and associated connectors, including the neutral electrode, do not contact any other conductive parts including earth.**
- **Use defibrillation-proof ECG cables during defibrillation.**
- **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.**

9.3 ECG Display

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



(1) ECG lead label of the displayed waveform

(2) ECG waveform gain

(3) ECG filter mode

(4) Notch filter status

(5) Paced status: If **Paced** is set to **Yes**, is displayed. If **Paced** is set to **No**, is displayed.

(6) HR/PR alarm message

(7) Pace pulse marker: If **Paced** is set to **Yes**, pace pulse markers "|" are displayed corresponding to detected pacer for each beat.

(8) Parameter label

(9) HR unit

(10) HR alarm limits

(11) HR value

(12) ECG signal quality index (ECG SQI)

(13) Pleth signal quality index (Pleth SQI)

SQI with five highlighted bars indicates the best signal. SQI with one highlighted bar indicates the poorest signal. If the SQI is poor, check ECG electrodes or SpO_2 sensor application. Reposition the electrodes or sensor if necessary.

The CrozFusion™ function analyzes the ECG signal and the Pleth wave signal together to achieve more accurate arrhythmia analysis result and HR/PR measurements. To view the on-screen help for the CrozFusion™ function, select the **CrozFusion** tab from the **ECG** menu.

The ECG SQI, Pleth SQI, and signal fusion status are displayed when the CrozFusion™ function is enabled. The following table lists SQI indications of different signal fusion status:

	The quality of both ECG and Pleth signal is good. ECG signal and Pleth signal are independently analyzed.
	The quality of Pleth signal is poor. The PR value may be erroneous. The ECG signal is being used to correct the PR value.
	The quality of ECG signal is poor. The HR value and arrhythmia analysis may be erroneous. The Pleth signal is being used to correct the HR value and for arrhythmia analysis.

If the CrozFusion™ function is disabled, ECG signal and the Pleth wave signal will not be analyzed together, and the ECG SQI and Pleth SQI are not displayed. For more information, see *9.5.6 Disabling the CrozFusion™ Function*.

NOTE

- **The ECG numeric area and waveform area are configured to be different for different lead type and ECG settings.**
- **The CrozFusion™ function uses ECG arrhythmia analysis leads according to the Analysis Mode setting. So the ECG SQI indicates the signal quality of the ECG arrhythmia analysis leads.**

9.4 Preparing for ECG Monitoring

9.4.1 Preparing the Patient Skin

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

1. 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.

9.4.2 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.**

9.4.3 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

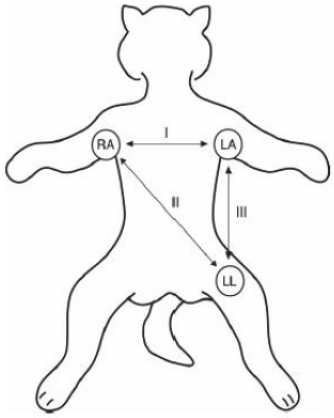
9.4.4 ECG Electrode Placements

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

9.4.4.1 3-leadwire Electrode Placement

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

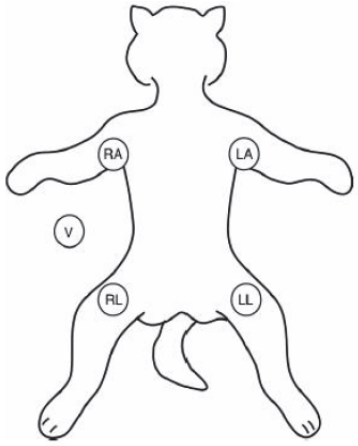
- RA placement: on the right foreleg.
- LA placement: on the left foreleg.
- LL placement: on the left hind leg.



9.4.4.2 5-leadwire and 6-leadwire Electrode Placement

The following is an electrode configuration when 5-leadwires is used:

- RA placement: on the right foreleg.
- LA placement: on the left foreleg.
- RL placement: on the right hind leg.
- LL placement: on the left hind leg.
- V placement: exploring lead or see *9.4.4.4 Chest Electrode Placement* for more information.



For 6-leadwire placement, you can use the position for the 5 -leadwire placement but with two chest leads. The two chest leads (Va and Vb) can be positioned according to *9.4.4.4 Chest Electrode Placement* or the physician's preference.

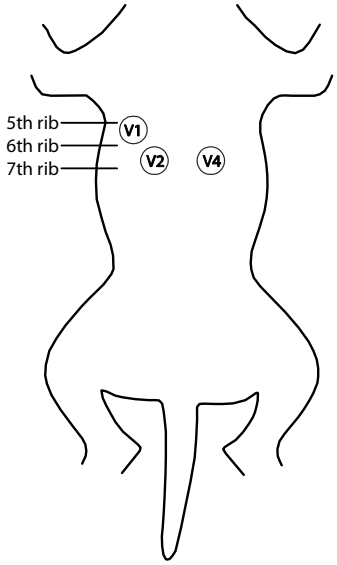
9.4.4.3 10-leadwire Electrode Placement

12-lead ECG uses 10 electrodes, which are placed on the patient's four limbs and chest. The limb electrodes should be placed on the soft skin and the chest electrodes placed according to *9.4.4.4 Chest Electrode Placement* or the physician's preference.

9.4.4.4 Chest Electrode Placement

The chest electrodes most commonly used for patients are V1, V2, V4 and V10:

- V1 placement: fifth intercostal space on the right side near the sternum.
- V2 placement: sixth intercostal space on the left side near the sternum.
- V4 placement: sixth intercostal space on the left side at the costochondral junction.
- V10 placement: over the dorsal spine of the seventh thoracic vertebra.



9.4.4.5 Lead Placement for Surgical Patients

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

WARNING

- **To reduce the hazard of burns during use of electrosurgical units (ESU), the ECG electrodes should not be located between the surgical site and the ESU return electrode.**
- **Never entangle the ESU cable and the ECG cable together.**
- **When using ESU, never place ECG electrodes near the grounding plate of the ESU, as this can cause a lot of interference on the ECG signal.**

9.4.5 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.

9.4.6 Checking Paced Status

It is important to correctly set the paced status before you start 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*.

WARNING

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

9.4.7 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 Reject only when Paced is set to Yes. If Paced is set to No, the setting of Pacer Reject is disabled.**

9.5 Changing ECG Settings

9.5.1 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 ECG monitoring, besides the normal screen, you can also choose 7-lead full screen or 7-lead half screen.
- For 6-lead ECG monitoring, besides the normal screen, you can also choose 8-lead full screen or 8-lead half screen.
- For 12-lead ECG monitoring, besides the normal screen, you can also choose 7-lead full screen, 7-lead half 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**, **Half-Screen**, or **12-Lead** (for 12-lead ECG monitoring).

9.5.2 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.

9.5.3 Setting the Analysis Mode

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 2) as calculation leads.
   - **Single Lead**: the monitor uses one lead (ECG1) as calculation lead.

NOTE

- **When a 3-lead ECG cable is used, the monitor always uses single lead as calculation lead.**

9.5.4 Changing ECG Wave Settings

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

CAUTION

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

9.5.4.2 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.

9.5.4.3 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.

9.5.4.4 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**.

9.5.4.5 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**.

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

9.5.4.7 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

- **Notch Filter can only be switched on or off when Filter is set to Diagnostic. In other filter modes, Notch Filter is always on.**

9.5.5 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**.

9.5.6 Disabling the CrozFusion™ Function

The CrozFusion™ function is enabled by default. However, in some situations you may need to disable this function, or the CrozFusion™ function may not be able to work. You shall disable the CrozFusion™ function in the following situation:

- Administrating CPR
- Performing CPB
- Administrating IABP
- Other situations that the CrozFusion™ function is not applicable

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 **Setup** tab.
3. Switch off **CrozFusion**.

WARNING

- **The monitor is used for single patient at a time. Simultaneously monitoring more than one patient may result in a hazard to the patient.**
- **ECG signal and Pleth signal from different patients may result in incorrect signal fusion.**

9.5.7 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.

9.5.8 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.**

9.6 Monitoring Arrhythmia

9.6.1 Arrhythmia Safety Information

WARNING

- **Heart rate reading may be affected by cardiac arrhythmias. Do not rely entirely on heart rate alarms when monitoring patients with 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.**

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.**

9.6.2 Arrhythmia Events

This section lists all arrhythmia events and their criteria.

9.6.2.1 Lethal Arrhythmia Events

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

9.6.2.2 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.
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%)
PVCs/min	PVCs/min exceeds high limit.
Pauses/min	Pauses/min exceeds high limit.
Irr Rhythm End	Irregular rhythm no longer detected for the irregular rhythm end delay time.

*N: normal beat; V: ventricular beat

9.6.3 Displaying Arrhythmia Information

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

1. Access **Tile Layout** 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**.

9.6.4 Changing Arrhythmia Settings

9.6.4.1 Changing Arrhythmia Alarm Settings

To set the arrhythmia alarm properties, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** 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 enabled Lethal Arrhys Off. For more information, see *9.6.4.2 Setting the Lethal Arrhythmia Alarms Switch*.**
- **The priority of lethal arrhythmia alarms is always high. It cannot be altered.**

9.6.4.2 Setting the Lethal Arrhythmia Alarms Switch

You can choose whether switching off lethal arrhythmia alarms is permissible or not. This function is password protected. For more information, see *24.4.6 The Other Tab*.

WARNING

- **If you switch off all arrhythmia alarms, the monitor will not alarm for any arrhythmia event. This may result in a hazard to the patient. Always keep the patient under close surveillance.**

NOTE

- **If any of the lethal arrhythmia alarms is switched off, the ECG waveform area displays the "Lethal Arrhys Off" message.**

9.6.4.3 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.**

9.6.4.4 Arrhythmia Threshold Range

Arrhythmia	Threshold Range
Asystole Delay	3 s to 10 s
Tachy(HR High)	60 bpm to 295 bpm
Brady(HR Low)	16bpm 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	1.5s, 2.0s, 2.5s, 3.0s
Irr Rhy End Time	0, 1 min, 2 min, 3 min, 4 min, 5 min, 10 min, 15 min, 30 min

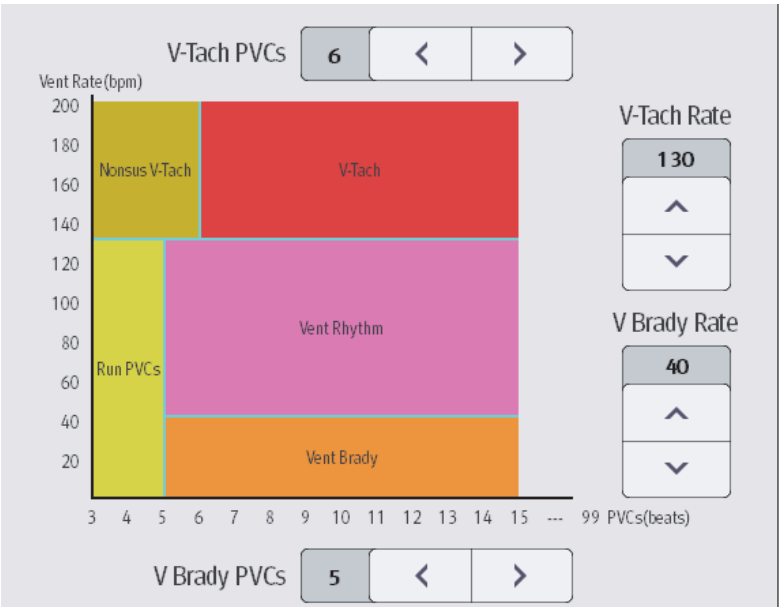
9.6.4.5 Setting Thresholds for PVC-Related Alarms

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

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

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



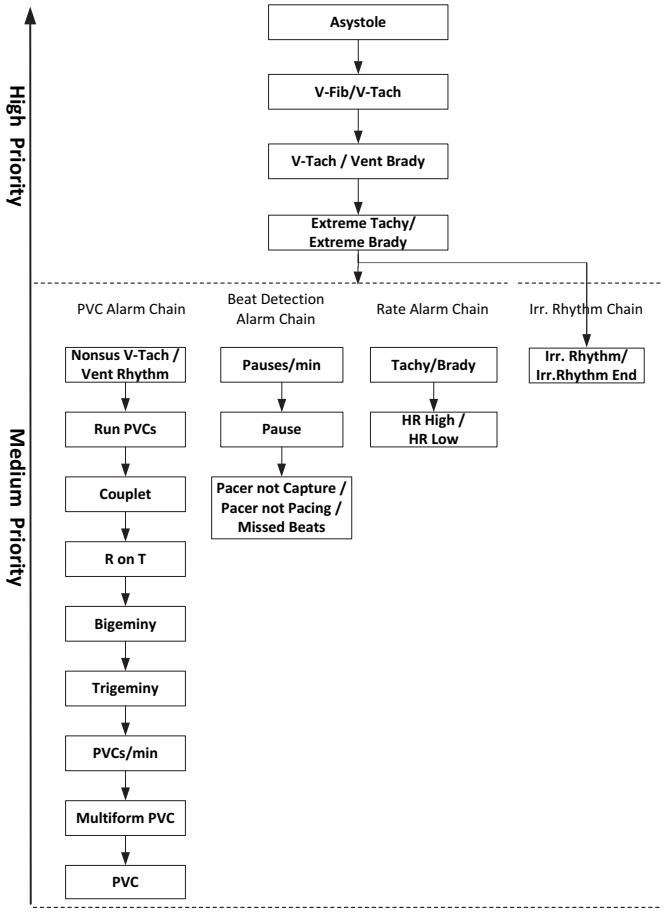
- If the number of consecutive PVCs is greater than or equal to the V-Tach PVCs limit (6), and the ventricular rate (Vent Rate) is greater than or equal to the V-Tach Rate limit (130), a V-Tach alarm is generated.
- If the number of consecutive PVCs is lower than the V-Tach PVCs limit (6) but greater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

9.6.5 Arrhythmia Alarms

Normally, an arrhythmia alarm is presented when an alarm condition is detected. However, there are certain situations that can inhibit audible and visible alarm indications even though an alarm condition was detected. For more information, see *9.6.5.1 Arrhythmia Alarm Chains* and *9.6.5.2 Setting Arrhythmia Alarm Shielding Period*.

9.6.5.1 Arrhythmia Alarm Chains

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



9.6.5.2 Setting Arrhythmia Alarm Shielding Period

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

This function is password protected. For more information, see **Arrhy Shield Time** in *24.4.6 The Other Tab*.

NOTE

- **For the following alarms, alarm light and alarm tone cannot be disabled: HR High, HR Low, Tachy, Brady, Irr Rhythm End.**
- **Alarm indication rules for alarms in the Irr. Rhythm chain are the same with those for the medium priority chains.**
- **The arrhythmia shielding period is only applicable to the alarms in the medium priority chains and Irr. Rhythm chain. For the alarms in the high priority chain, alarm tone and alarm light are presented as soon as the alarm condition is detected.**

9.6.5.3 Arrhythmia Alarm Shielding Rules

The following table explains how auidble and visual alarm indicate during arrhythmia alarm shielding period.

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

9.7 ST Segment Monitoring

9.7.1 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 ST deviation measurement algorithm has been tested for accuracy. The significance of ST segment changes needs to be determined by a physician.**
- **This monitor provides ST deviation level change information. The clinical significance of the ST level change information should be determined by a physician.**

9.7.2 Enabling ST Monitoring

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

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

Reliable ST monitoring cannot be ensured under the following situations:

- You are unable to get a lead that is not noisy.
- Arrhythmias cause irregular baseline.
- The patient is continuously ventricularly paced.
- The patient has left bundle branch block.

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

9.7.3 Displaying ST Numerics

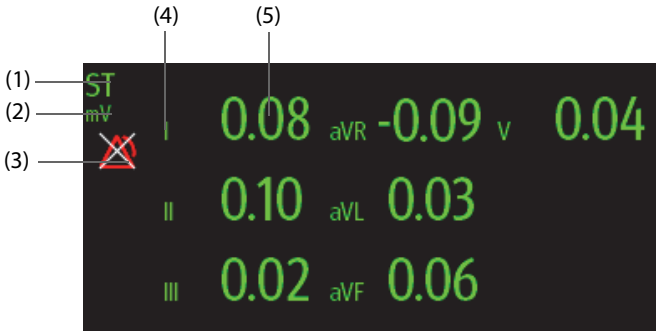
To display ST numerics and Segments, follow this procedure:

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 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. Your monitor screen may look slightly different:



(1) Parameter label.

(2) ST unit

(3) ST alarm off symbol

(4) Lead labels

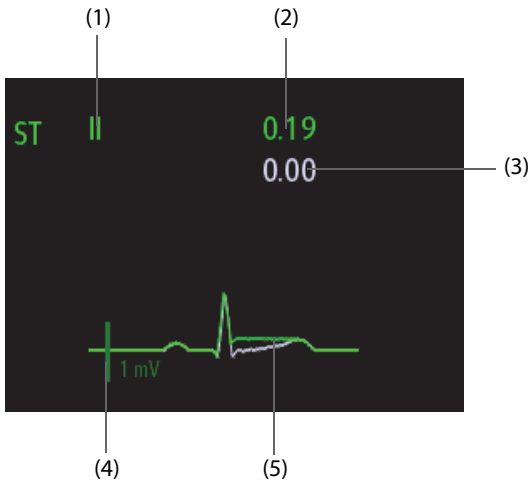
(5) ST numerics: a positive value indicates ST segment elevation, and a negative value indicates ST segment depression.

9.7.4 Displaying ST Segments in the Waveform Area

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

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

9.7.5 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".**

9.7.6 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

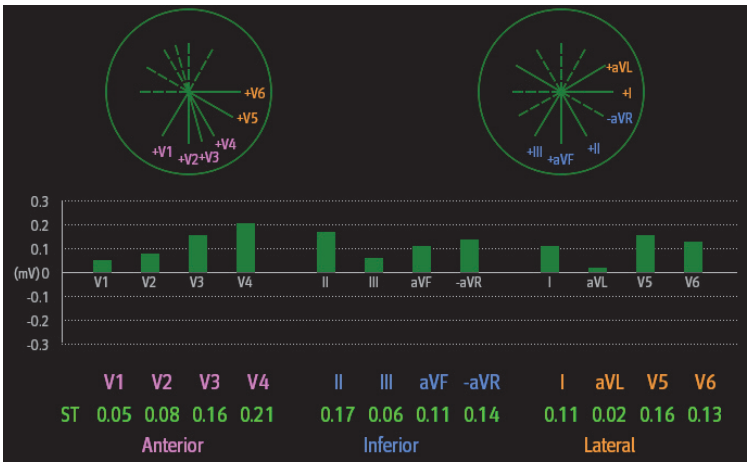
- **Updating ST baseline affects ST alarms.**

9.7.7 Entering the ST Graphic Window

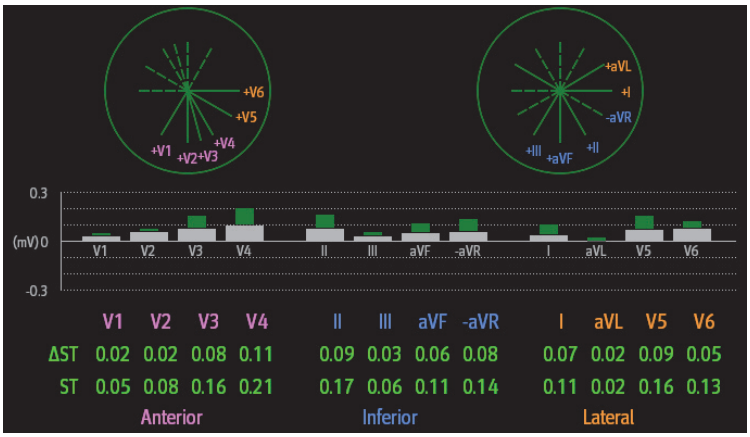
To display **ST Graphic** window, follow this procedure:

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".**

9.7.8 Changing ST Settings

9.7.8.1 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.

9.7.8.2 Changing Leads for ST Display

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

1. Select the 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.

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

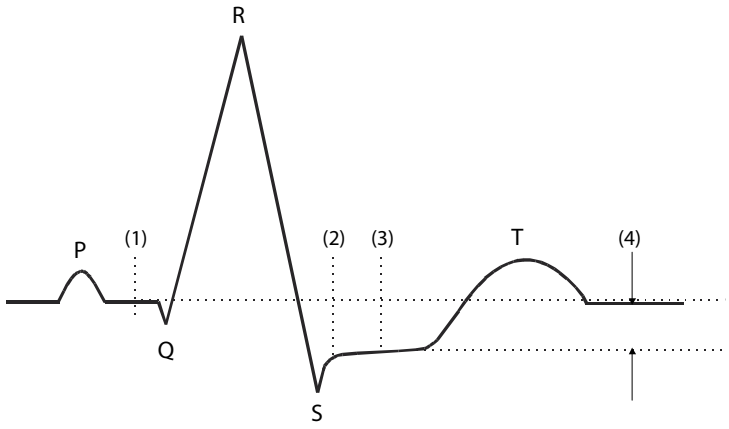
In the waveform area, the ISO point, J point, and ST point mark do not display on the ST segments by default. To show these marks, follow this procedure:

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**.

9.7.9 Adjusting ST Measurement Points

9.7.9.1 About ST Point, ISO Point, and J Point

The ST deviation value for each beat is the potential difference between the isoelectric (ISO) point and the ST point. The ISO point provides the baseline. The ST point is at the midpoint of the ST segment. The J point is the end of the QRS complex. As the J point is a fixed distance away from the ST point, it can be useful to help you correctly position the ST point.



(1) ISO point (2) J point (3) ST point (4) ST deviation

9.7.9.2 Setting ST Point, ISO Point, and J Point

CAUTION

- **You need to adjust the ST points before starting monitoring, or if the patient's heart rate or ECG morphology changes significantly, as this may affect the size of the QT interval and thus the placement of the ST point. Artifactual ST segment depression or elevation may occur if the isoelectric point or the ST point is incorrectly set.**
- **Always make sure that the positions of ST points are appropriate for your patient.**

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 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**.

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

9.8 QT/QTc Interval Monitoring

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

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

9.8.1 QT/QTc Monitoring Limitations

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

- R-wave amplitudes are too low
- The presence of frequent ventricular ectopic beats
- 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, 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 180bpm), 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.

9.8.2 Enabling QT/QTc Monitoring

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

1. Select the 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**.

9.8.3 Displaying QT/QTc Numerics and Segments

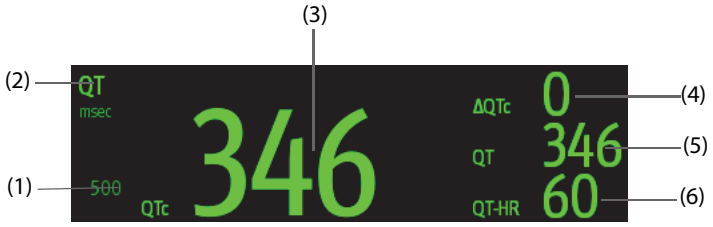
To display QT/QTc numerics and Segments, follow this procedure:

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 *9.8.4 Entering the QT View*.**

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



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

(2) Parameter label (3) QTc value

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

(5) QT value (6) QT-HR value

NOTE

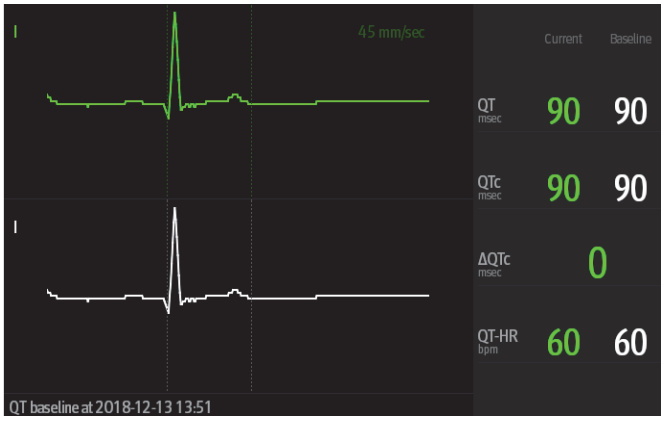
- **The display of the QT numeric area differs as related settings change.**

9.8.4 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".**

9.8.5 Saving the Current QTc as Baseline

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

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

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

9.8.6 Changing QT Settings

9.8.6.1 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.

9.8.6.2 Selecting Leads for QT Calculation

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

1. Select the 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.

◆

9.9 ECG 24h Summary

The ECG 24h Summary provides ECG statistics of the current patient over the latest 24 hours. You can view the following information through the ECG 24h Summary:

- Heart rate statistics
- Arrhythmia event statistics
- QT/QTc measurement statistics
- Maximum and minimum ST statistics of each lead
- Pacer statistics
- Typical ECG strips

NOTE

- **The ECG 24h Summary is intended for the current patient. It is not intended for discharged patients.**
- **Pacer statistics is intended for paced patients.**
- **Patient data is saved, collected and displayed together in the ECG 24h Summary. Data displayed in the ECG 24h Summary is not recalculated.**
- **A license is required for the ECG 24h Summary function.**

9.9.1 Viewing the ECG 24h Summary

To view the ECG 24h Summary, choose either of the following ways:

- Select the **ECG 24h Sum** quick key.
- Select the **Main Menu** quick key → from the **CAA** column select **ECG 24h Summary**.

9.9.2 Selecting Typical ECG Strips

The **Typical Strips** area displays ECG strips of the following situations:

- Maximum heart rate
- Minimum heart rate
- Four arrhythmia events

You can select a typical ECG strip of each situation. For example, to select the typical ECG strip of asystole, follow this procedure:

1. Select the currently displayed asystole strip.
2. From the popup strips, select the desired strip as the typical strip of asystole.

9.9.3 Reviewing ECG Summary

From the ECG 24h Summary window, you can review corresponding trends and events.

- Select the **Heart Rate** area to review HR graphic trends.
- Select the **Max ST/Min ST** area to review the current ST reference and ST graphic trends.
- Select the **Pace** area to review historic pace events.
- Select the **QT** area to review QT/QTc graphic trends.

- Select the **Arrhythmia** area to review arrhythmia statistics.
- Select **Full Disclosure** to review ECG full disclosure waveforms. For more information, see ***19.2.8 Full Disclosure Review Page***.

9.10 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.

9.10.1 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.

9.10.2 Initiating an ECG Relearning Manually

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

- **Take care to initiate ECG relearning only during periods of predominantly normal rhythm and when ECG signal is relatively noise-free. If ECG learning takes place during arrhythmia, the ectopics may be incorrectly learned as normal QRS complex. This may result in missed detection of subsequent events of arrhythmia.**

9.11 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 *24.5.1 The ECG Tab*.

9.12 Defibrillation Synchronization Pulse Output

The monitor provides an analog out 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.**
- **According to AAMI specifications the peak of the synchronized defibrillator discharge should be delivered within 60 ms of the peak of the R wave. The signal at the ECG output (sync pulse) on the monitor is delayed by maximum of 30 ms. Your biomedical engineer should verify that your ECG/ Defibrillator combination does not exceed recommended maximum delay of 60 ms.**
- **Before defibrillation, the user must ensure both defibrillator and monitor have passed the system test and can be safely used together.**

9.13 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 *28.1 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 *9.4.1 Preparing the Patient Skin* and *9.4.2 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 *9.4.1 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 *9.4.1 Preparing the Patient Skin* and *9.4.2 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 *9.5 Changing ECG Settings*. 2. Perform skin preparation again and re-place the electrodes. For more information, see *9.4.1 Preparing the Patient Skin* and *9.4.2 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 *9.5.4 Changing ECG Wave Settings*. 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 *9.4.1 Preparing the Patient Skin* and *9.4.2 Applying Electrodes*. 3. Check for ECG filter setting. Set ECG Filter mode to **Monitor** to reduce baseline wander on the display.

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10 Resting 12-Lead ECG Analysis

10.1 Resting 12-Lead ECG Analysis Introduction

The monitor can be configured Mindray 12-lead ECG analysis algorithm.

10.2 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**.

10.3 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.

10.4 Changing 12-Lead ECG Analysis Settings

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

10.4.1 Setting the High Frequency Filter

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

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

The high frequency filter is a low-pass filter. That is to say signal 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.

10.4.2 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 the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.
3. 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.**

10.5 Printing the 12-Lead Interpretation Report

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

10.6 Exiting the ECG 12-Lead Screen

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

11 Monitoring Respiration (Resp)

11.1 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.

11.2 Resp Safety Information

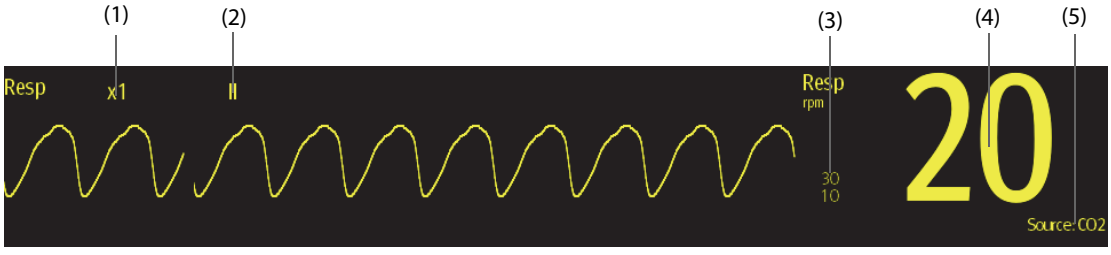
WARNING

- **When monitoring the patient's respiration, do not use ESU-proof ECG cables.**
- **If you do not set the detection level for the respiration correctly in manual detection mode, it may not be possible for the monitor to detect apnea. If you set the detection level too low, the monitor is more likely to detect cardiac activity, and to falsely interpret cardiac activity as respiratory activity in the case of apnea.**
- **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.**
- **If operating under conditions according to the EMC Standard IEC 60601-1-2 (Radiated Immunity 3V/m), field strengths above 3V/m may cause erroneous measurements at various frequencies. Therefore, it is recommended to avoid the use of electrically radiating equipment in close proximity to the respiration measurement unit.**
- **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.**
- **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.**
- **Respiration monitoring is not for use on the patients who are very active, as this will cause false alarms.**

11.3 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.**

11.4 Preparing for Resp Monitoring

11.4.1 Preparing the Patient Skin

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.

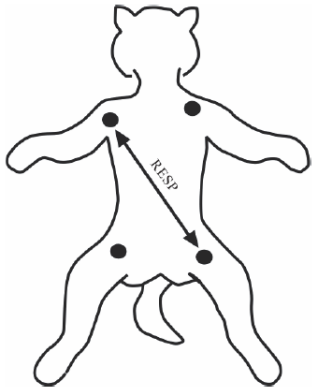
CAUTION

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

11.4.2 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 *9.4.4 ECG Electrode Placements*.



5-lead Electrode Placement

CAUTION

- **Correct electrodes placement can help to reduce cardiac overlay: avoid the liver area and the ventricles of the heart in the line between the respiratory electrodes.**
- **Some patients with restricted movements breathe mainly abdominally. In these cases, you may need to place the left leg electrode on the left abdomen at the point of maximum abdominal expansion to optimize the respiratory wave.**
- **In clinical applications, some patients expand their chests laterally, causing a negative intrathoracic pressure. In these cases, it is better to place the two respiration electrodes in the right midaxillary and the left lateral chest areas at the patient's maximum point of the breathing movement to optimize the respiratory waveform.**

- **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.**
- **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.**

11.5 Changing Resp Settings

11.5.1 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.**

11.5.2 Setting the RR Source

To set RR source, follow this procedure:

1. Select the Resp numeric area or waveform area to enter the **Resp** 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 **RR Source** to **Auto**.

11.5.3 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.

11.5.4 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**.

11.5.5 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**.

11.5.6 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 *11.5.7 Adjusting the Resp Waveform Detection Threshold*.

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

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

11.5.7 Adjusting the Resp Waveform Detection Threshold

Use the manual detection mode in the following situations:

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

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

1. Select the Resp numeric area or waveform area to enter the **Resp** 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 set, the detection level will not adapt automatically to different respiration depths. It is important to remember that if the depth of breathing changes, you may need to change the detection level.

11.6 Resp Troubleshooting

For more information, see *D Alarm Messages*.

12 Monitoring Pulse Oxygen Saturation (SpO_2)

12.1 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.

The following types of SpO_2 can be configured for the SpO_2 module:

- Mindray SpO_2: the connector is blue without any no logo.
- Nellcor SpO_2: the connector is gray with a logo of Nellcor.
- Masimo SpO_2: the connector is purple with a logo of Masimo SET.

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 measurement are statistically distributed and about two-thirds of the measurements are expected to come within the specified accuracy range compared to CO-oximeter measurements.**
- **A functional tester or 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.**

12.2 SpO_2 Safety Information

WARNING

- **When a trend toward patient deoxygenation is indicated, analyze the blood samples with a laboratory co-oximeter to completely understand the patient's condition.**
- **Do not use SpO_2 sensors during magnetic resonance imaging (MRI). Induced current could potentially causes burns. The sensor may affect the MRI image, and the MRI unit may affect the accuracy of the oximetry measurements.**
- **Prolonged continuous monitoring may increase the risk of undesirable changes in skin characteristics, such as irritation, reddening, blistering or burns. Inspect the sensor site every two hours and move the sensor if the skin quality changes. Change the application site every four hours. For patients with poor peripheral blood circulation or sensitive skin, inspect the sensor site more frequently.**
- **If the sensor is too tight because the application site is too large or becomes too large due to edema, excessive pressure for prolonged periods may result in venous congestion distal from the application site, leading to interstitial edema and tissue ischemia.**
- **When patients are undergoing photodynamic therapy they may be sensitive to light sources. Pulse oximetry may be used only under careful clinical supervision for short time periods to minimize interference with photodynamic therapy.**
- **Setting alarm limits to extreme values may cause the alarm system to become ineffective.**
- **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 and completely disconnect the pulse oximeter before bathing the patient.**
- **The pulse oximeter is not an apnea monitor.**

- **The pulse oximeter should not be used for arrhythmia analysis.**

CAUTION

- **Change the application site or replace the sensor and/or patient cable when a persistent SpO2 Low Signal Quality message is displayed on the equipment. These messages may indicate that patient monitoring time is exhausted on the patient cable or sensor.**
- **Replace the cable or sensor when a "SpO2 Sensor Off", "SpO2 No Sensor", or "SpO2 Low Signal Quality" message is consistently displayed while monitoring consecutive patients after completing troubleshooting steps listed in this manual.**
- **Variation in measurements may be profound and may be affected by sampling technique as well as the patient's physiological conditions. Any results exhibiting inconsistency with the patient's clinical status should be repeated and/or supplemented with additional test data. Blood samples should be analyzed by laboratory instruments prior to clinical decision making to completely understand the patient's condition.**
- **Use only SpO_2 sensors specified in this manual. Follow the SpO_2 sensor's instructions for use and adhere to all warnings and cautions.**
- **Do not place the pulse oximeter where the controls can be changed by the patient.**
- **If using pulse oximetry during full body irradiation, keep the sensor out of the radiation field. If the sensor is exposed to the radiation, the reading might be inaccurate or the device might read zero for the duration of the active irradiation period.**

NOTE

- **Additional information specific to the Masimo sensors compatible with the equipment, including information about parameter/measurement performance during motion and low perfusion, may be found in the sensor's directions for use (DFU).**
- **Masimo cables and sensors are provided with X-Cal™ technology to minimize the risk of inaccurate readings and unanticipated loss of patient monitoring. Refer to the Cable or Sensor DFU for the specified duration of the patient monitoring time.**

12.3 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

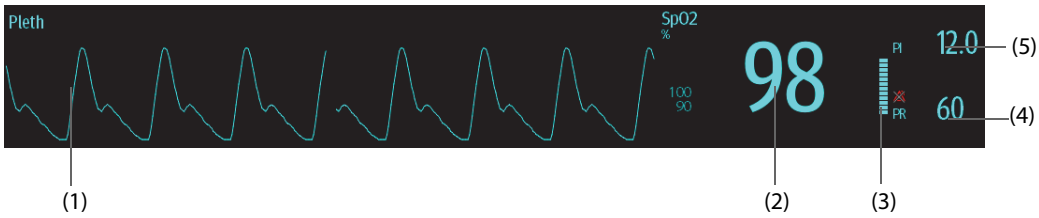
■ Environmental conditions:

- 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.

12.4 SpO_2 Display



(1) Pleth waveform (Pleth): visual indication of patient's pulse. The waveform is not normalized.

(2) Oxygen saturation of arterial blood (SpO_2): percentage of oxygenated hemoglobin in relation to the sum of oxyhemoglobin and deoxyhemoglobin.

(3) Perfusion indicator: the pulsatile portion of the measured signal caused by arterial pulsation.

(4) Pulse rate (derived from the pleth wave): detected pulsations per minute.

(5) Perfusion index (PI): gives the numerical value for the pulsatile portion of the measured signal caused by arterial pulsation. PI is an indicator of the pulsatile strength. You can also use it to assess the 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.

NOTE

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

12.5 Preparing for SpO_2 Monitoring

12.5.1 Applying the SpO_2 Sensor

To applythe SpO_2 sensor, follow this procedure:

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

5. Select an appropriate extension cable according to the connector type and plug the cable into the SpO_2 connector.
6. Connect the sensor to the extension cable.

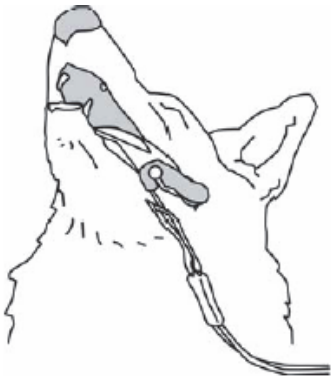
CAUTION

- **Do not apply sensor too tightly as this results in venous pulsation which may severely obstruct circulation and lead to inaccurate measurements.**
- **At elevated ambient temperatures be careful with measurement sites that are not well perfused, because this can cause burns after prolonged application.**
- **Avoid placing the sensor on extremities with an arterial catheter, an NBP cuff or an intravascular venous infusion line.**

12.5.2 SpO_2 Sensor Placement

The SpO_2 sensor selection and application site depend on the patient category.

The preferred sensor site for canine, feline and equine is on the tongue. The other sites such as ear, lip, toe, prepuce or vulva can also be measured. The optical components of the sensor should be positioned to the center of the tongue, you can place the sensor as shown below.



12.6 Changing the SpO_2 Settings

12.6.1 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 SPO2 Desat Alarm Off in enabled. For more information, see section *8.6.8 Setting the Switch of the SpO_2 Desat Alarm Off*.**

12.6.2 Nellcor Sat-Seconds Alarm Management

With traditional alarm management, high and low alarm limits are set for monitoring oxygen saturation. During monitoring, once an alarm limit is violated, an audible alarm immediately sounds. When the patient 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.

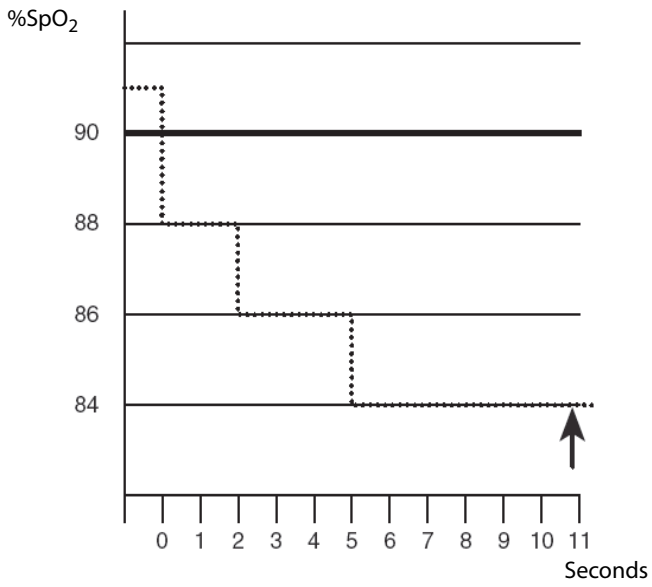
The method of calculation is as follows: the percentage points of the SpO_2 saturation falling outside the alarm limit is multiplied by the number of seconds remaining outside the limit. This can be stated as the equation:

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.**

12.6.3 Setting the Nellcor SpO_2 Sat-Seconds

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**.

12.6.4 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.

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. Select the **Setup** tab.
3. Set **Sensitivity** to **Maximum, Normal, or APOD**.

CAUTION

- **When using the Maximum Sensitivity setting, performance of "SpO2 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 the Latest Config" 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 "SpO2 Sensor Off" detection may be compromised. Refer to *Section 6.3 Setting Default Configuration* for managing configuration.**

12.6.5 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.

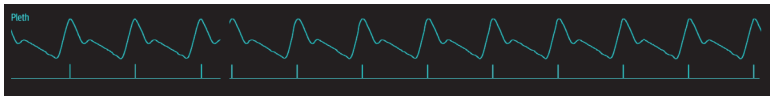
The reliability of FastSAT is dependent on the setting for the averaging time and the input signal. FastSAT is disabled by default. To enable FastSAT, follow this procedure:

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

12.6.6 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**.

12.6.7 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. Select the **Setup** tab.
3. Set **Averaging**.

12.6.8 Changing 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 the **Setup** tab.
3. Select **Sensitivity**, and then toggle between **High**, **Med** and **Low**, which respectively correspond to 7 s, 9 s and 11 s.

12.6.9 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. Select the **Setup** tab.
3. Switch on or off **Display PI.**

12.6.10 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**.

12.6.11 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. Select the **Setup** tab.
3. Set **Speed**.

12.7 Changing the PR Settings

12.7.1 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.

12.7.2 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. For information, see *24.10 The Other Settings*.

12.7.3 Setting the PR Source

Current pulse source is displayed in the PR numeric area. The PR from current pulse source has the following characteristics:

- PR is monitored as system pulse and generates alarms when you select PR as the active alarm source.
- PR is stored in the monitor's database and reviewed in the graphic/tabular trends; in trend graphs, as the PR curve is in the same color with that of the PR source, it is unlikely to distinguish the PR 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.

12.7.4 Showing/Hiding PR

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

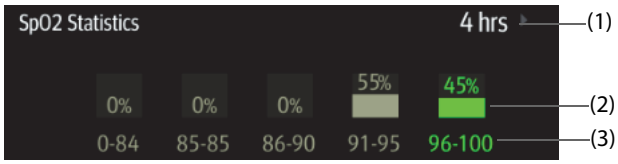
1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** menu.
2. Select the **PR** tab.
3. Select the **Setup** tab.
4. Switch on or off **Display PR.**

12.8 Displaying SpO_2 Statistics

You can show SpO_2 statistics for a defined period of time. To do so, follow this procedure:

1. Access the **Tile Layout** page in either of the following ways:
   - Select the **Screen Setup** quick key.
   - Select the **Main Menu** quick key → from the **Display** column select **Tile Layout**.
2. Select the parameter numeric area where you want to display SpO_2 statistics, and then from the popup list select **SpO2** → **SpO2 Statistics**.

The following figure shows the SpO_2 statistics area.



(1) Duration of SpO_2 statistics

(2) Results of SpO_2 statistics

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

12.8.1 Selecting the Range of each SpO_2 Section and the Target Section

To define the SpO_2 range of each section, follow this procedure:

1. Select the SpO_2 statistics area.
2. 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.

12.8.2 Selecting the SpO_2 Statistics Length

The Duration of SpO_2 statistics is configurable. From the SpO_2 statistics area, select the duration to redefine the length of SpO_2 statistics.

12.9 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 *D 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 *24.10 The Other Settings*. 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.
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 Sensor Off** 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 *12.3 SpO_2 Measurement Limitations*. 3. Check the monitor or the SpO_2 module for proper functioning.

12.10 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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13 Monitoring Temperature (Temp)

13.1 Temperature Introduction

You can continuously monitor the patient's skin temperature and core temperature. 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 up to two temperature sites and calculate the difference between two measured sites.

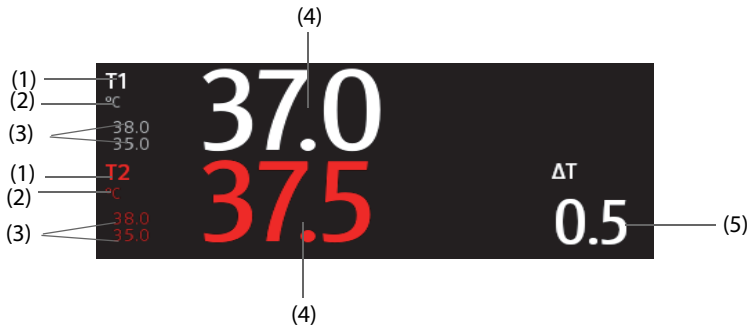
13.2 Displaying the Temp Numerics Area

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 **Any Temp**.

13.3 Temperature Display

The following figure shows the Temp numeric area for temperature monitoring. Your display may be configured to look different.



(1) Temperature site (2) Temperature unit (3) Alarm limits (4) Temperature value

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

13.4 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 probe, connect the probe to the temperature cable.
3. Follow the probe manufacturer's instructions to connect the probe to the patient.

13.5 Changing Temperature Settings

13.5.1 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.

13.5.2 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.

13.5.3 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**.

13.6 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 *D 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.

14 Monitoring Noninvasive Blood Pressure (NIBP)

14.1 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. The Oscillometric devices measure the amplitude of pressure changes in the occluding cuff as the cuff deflates from above systolic pressure. The amplitude suddenly increases as the pulse breaks through the occlusion in the artery. As the cuff pressure decreases further, the pulsations increase in amplitude, reach a maximum (which approximates to the mean pressure), and then diminish. The oscillometric method measures the mean pressure and determines the systolic and diastolic pressures.

NOTE

- **Blood pressure measurements determined with this device are equivalent to those obtained by a trained observer using the cuff/stethoscope auscultatory method or an intra-arterial blood pressure measurement device, within the limits prescribed by the American National Standard: manual, electronic, or automated sphygmomanometers.**
- **NIBP measurement can be performed during electro-surgery and discharge of defibrillator.**

14.2 NIBP Safety Information

WARNING

- **Be sure to select the correct patient category setting for your patient before NIBP measurement.**
- **Do not measure NIBP on patients with sickle-cell disease or on the limb where skin damage has occurred or is expected.**
- **Use clinical judgment to determine whether to perform frequent unattended blood pressure measurements on patients with severe blood clotting disorders because of the risk of hematoma in the limb fitted with the cuff.**
- **Do not use the NIBP cuff on a limb with an intravenous infusion or arterial catheter in place. This could cause tissue damage around the catheter when the infusion is slowed or blocked during cuff inflation.**
- **Do not apply cuff on the arm on the side of a mastectomy or lymph node clearance.**
- **Continuous cuff pressure due to connection tubing kinking may cause blood flow interference, and 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.**
- **Devices that exert pressure on tissue have been associated with purpura, ischemia, and neuropathy. Inspect the application site regularly to ensure skin quality and inspect the extremity of the cuffed limb for normal color, warmth and sensitivity. If the skin quality changes, or if the extremity circulation is being affected, move the cuff to another site or stop the blood pressure measurements immediately. Check more frequently when making automatic or STAT measurements. Auto NIBP measurements with one and two minute intervals are not recommended for extended periods of time.**
- **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 measurement depends on using a cuff of proper size. It is essential to measure limb circumference and choose a cuff with proper size.**

14.3 NIBP Measurement Limitations

Measurements are impossible with heart rate extremes of less than 30 bpm or greater than 300 bpm, or if the patient is on a heart-lung machine. The measurement may be inaccurate or impossible in the following situations:

- Regular arterial pressure pulses are hard to detect
- With excessive and continuous patient movement such as shivering or convulsions
- With cardiac arrhythmias
- With rapid blood pressure changes
- With severe shock or hypothermia that reduces blood flow to the peripheries
- On an edematous extremity.

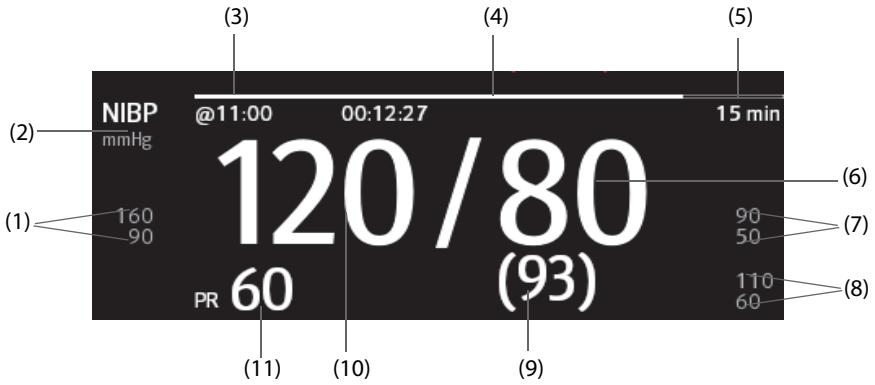
14.4 Measurement Modes

There are four NIBP measurement modes:

- Manual: measurement on demand.
- Auto: repeated measurements at set interval.
- STAT: continually rapid series of measurements over a five-minute period.
- Sequence: continually automatic measurement at set durations and intervals.

14.5 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.**

14.6 Preparing for NIBP Measurements

14.6.1 Preparing the Patient for NIBP Measurements

In normal use, perform NIBP measurement on a patient who is still and quiet:

NOTE

- **It is recommended to calm down the patient as much as possible before performing the measurement and keep the patient still and quiet during the measurement.**
- **It is recommended to keep the patient still and quiet 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.**

14.6.2 Placing the NIBP Cuff

To place the NIBP cuff, follow this procedure:

1. Verify that the setting of weight range is correct. If not, enter the **NIBP** menu to change the setting. For more information, see *14.9.2 Setting Weight Range*.
2. Connect the air tubing to the NIBP connector.
3. Select an appropriately sized cuff for the patient, and then wrap it around the limb or tail directly over the patient's skin as follows:
   a Determine the patient's limb circumference.
   b Select an appropriate cuff by referring to the limb circumference marked on the cuff. The width of the cuff should be 50% of the limb circumference, or 2/3 of the limb length. The inflatable part of the cuff should be long enough to encircle at least 50% to 80% of the limb.
   c Apply the cuff to the patient's limb and make sure the Φ marking on the cuff matches the artery location. The cuff should fit snugly, but with little or no air present within the cuff. Otherwise it may cause discoloration and ischemia of the extremities. Make sure that the cuff index line falls within the range markings on the cuff.
   d Middle of the cuff should be at the level of the right atrium of the heart. If it is not, you must use the measurement correction formula to correct the measurement. For more information, see *14.9.11 Correcting the NIBP Measurements*.
4. Connect the cuff to the air tubing. Avoid compression or restriction of pressure tubes. Air must pass unrestricted through the tubing.

CAUTION

- **A wrong cuff size and a folded or twisted bladder 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.**

14.6.3 NIBP Cuff Placement

The cuff placement depends on the patient category and weight.

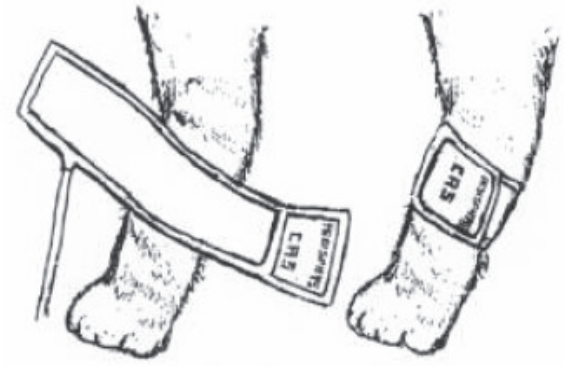
■ For a canine

For measurements in canines, it is preferable to use the right lateral, stemal or dorsal recumbent position. If the canine is in a sitting position, place the front paw on your knee and then take measurements.

The metacarpus, metatarsus and anterior tibial are recommended for the cuff placement. For anesthetized patients, most surgeries are done on the posterior part of the body so the metacarpal area of the forelimb is most convenient. In situations where this is not possible, place the cuff around the metatarsus just proximal to the tarsal pad or around the hind leg next to the hock. For conscious patients, measurements from the coccygeal artery can be used over the tail site.

■ For a feline

For conscious patients, measurements from the coccygeal artery can be taken by wrapping the cuff around the base of the tail. For anesthetized patients, measurements from the median artery on the foreleg can be used by wrapping the cuff around the forelimb, between the elbow and carpus. For felines less than 5 lb when measurements are difficult to obtain, place the cuff around the leg above the elbow to obtain measurements from the brachial artery. Hair need not be clipped except when heavily matted.



■ For larger animals

It is preferable for a large animal, such as a horse and a cow, to be in a stock, standing still. Measurements from the coccygeal artery on the ventral surface may be used by placing the cuff around the base of the tail.

14.7 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 STAT** quick key	**STAT** button
	NIBP Measure quick key → **STAT**	
Stop the current NIBP measurements	**NIBP Start/Stop** quick key	**Stop NIBP** button
End auto NIBP series or NIBP Sequence	**NIBP Stop All** quick key	**NIBP Stop All** button
Stop STAT measurement and end series	**NIBP Start/Stop** quick key	**Stop NIBP** or **NIBP Stop All** button
	NIBP Stop All quick key	

14.8 Viewing NIBP Analysis

NIBP analysis provides you a dynamic analysis of NIBP changes and distribution over the time scale. It allows you to know the patient's condition of the latest 24 hours before you entering the NIBP Analysis window.

To view NIBP analysis, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** menu.
2. Select the **Setup** tab.
3. Select **Analysis**.

You can also select anywhere in the **NIBP Analysis** window to enter the tabular trends review page. For more information, see *19 Review*.

14.9 Changing NIBP Settings

14.9.1 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.

14.9.2 Setting Weight Range

It is import to correctly set the weight range before your start NIBP measurements. To set the weight range, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** menu.
2. Select **Weight Range**, and then select the appropriate setting.

14.9.3 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.**

14.9.4 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.

14.9.5 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.

14.9.6 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**.

14.9.7 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.

14.9.8 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**.

14.9.9 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.**

14.9.10 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.**

14.9.11 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.

14.10 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 **Venipuncture** quick key or 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.

During venous puncture, pay attention to the cuff pressure and the remaining time displayed in the NIBP numerics area.

14.11 NIBP Maintenance

14.11.1 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.

14.11.2 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.

14.12 NIBP Troubleshooting

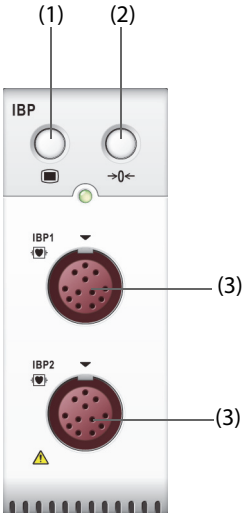
For more information, see *D Alarm Messages*.

15 Monitoring Invasive Blood Pressure (IBP)

15.1 IBP Introduction

You can monitor up to 4 (using the built-in IBP module and the external IBP module together) invasive blood pressures.

The following picture shows the external IBP module.



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

15.2 IBP Safety Information

WARNING

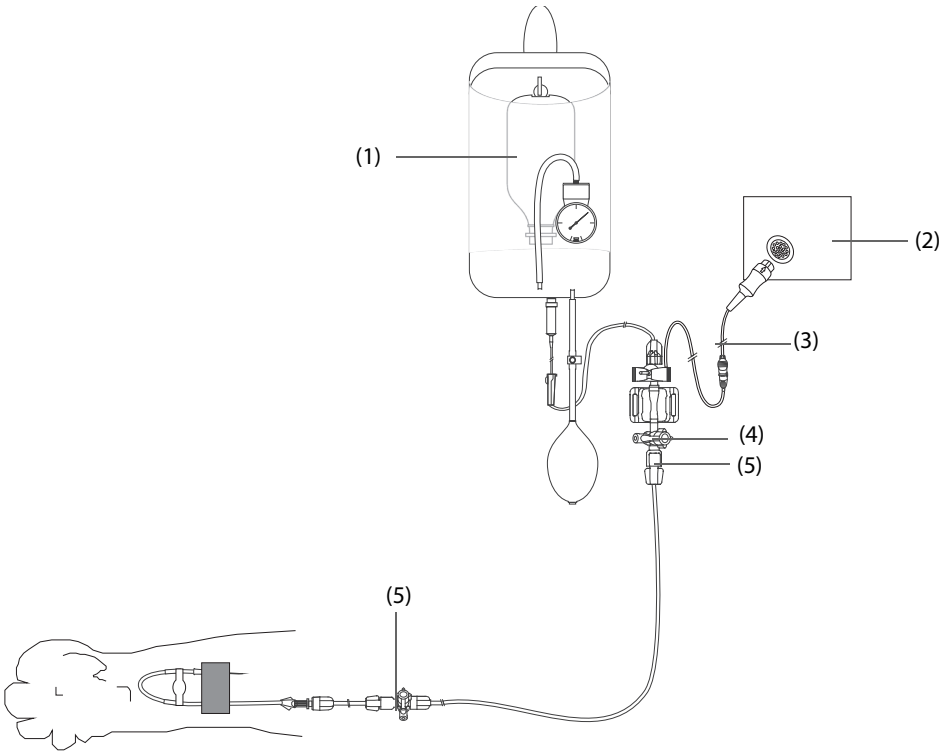
- **Use only pressure transducers specified in this manual. Never reuse disposable pressure transducers.**
- **Make sure that the applied parts never contact other conductive parts.**
- **To reduce the hazard of burns during high-frequency surgical procedure, ensure that the monitor's cables and transducers never come into contact with the high-frequency surgical units.**
- **When using accessories, their operating temperature should be taken into consideration. For more information, see instructions for use of accessories.**
- **All invasive procedures involve risks to the patient. Use aseptic technique. Follow catheter manufacturer's instructions.**
- **Mechanical shock to the invasive blood pressure transducer may cause severe shifts in zero balance and calibration, and cause erroneous readings.**

CAUTION

- **Using IABP may cause IBP, including PR, measurements inaccurate or failed.**

15.3 Preparing for IBP Monitoring

15.3.1 IBP Equipment to Patient Connection



(1) Pressure bag

(2) IBP connector

(3) IBP cable

(4) IBP transducer

(5) Three-way valve

15.3.2 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 *15.6.2 Changing the Pressure Label*.
5. Zero the IBP transducer. For more information, see.*15.3.3 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.**
- **If measuring intracranial pressure (ICP) on a patient, level the transducer with the top of the patient's ear. Incorrect leveling may give incorrect values (not applicable if measuring ICP with the Codman ICP transducer).**

15.3.3 Zeroing the IBP transducer

To avoid inaccurate pressure readings, the monitor requires a valid zero. Zero the transducer in accordance with your hospital policy. The IBP transducer should be zeroed in the following conditions:

- The IBP transducer, adapter cable or module 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. Zero the transducer by one of the following methods:
   - Press the **Zero** hard key on the module.
   - Select the numeric area (such as the Art numeric area), and then select **Zero** button.
   - Select the **Zero IBP** quick key.
4. 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.

15.4 Measuring ICP Using the Codman ICP Transducer

15.4.1 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.

15.4.2 Measuring ICP

To perform the ICP measurement, follow this procedure:

1. Zero the Codman ICP transducer. For more information, see section *15.4.1 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 *15.4.1 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:

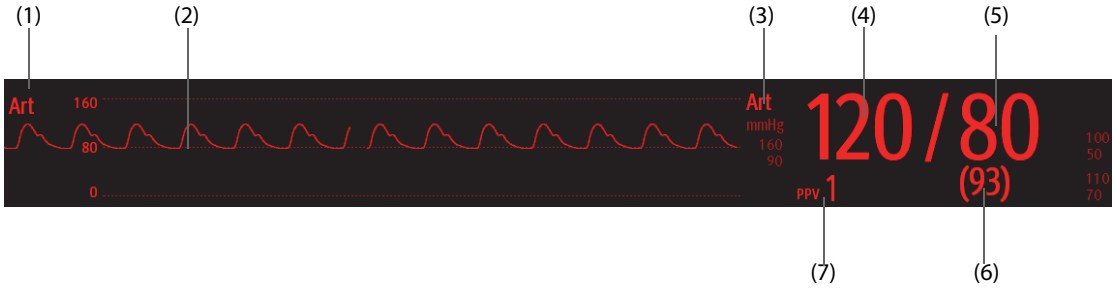
1. Disconnect the ICP adapter cable from the measurement module, or remove the module from the monitor.
2. Connect the ICP adapter cable, measurement module, and the target monitor, or insert the measurement module into the target monitor.
3. Check that the zero reference value displayed on the monitor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

15.5 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

15.6 Changing IBP Settings

15.6.1 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.

15.6.2 Changing the Pressure Label

The pressure label is a unique identifier for each type of pressure. Therefore, you should select a proper pressure label for the source of the pressure you want to 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
CPP	Cerebral perfusion pressure	P1 to P4	Non-specific pressure label

NOTE

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

15.6.3 Setting the Pressure Type for Display

For the non-specific pressure (P1, P2, P3 or P4), the displayed pressure type is configurable. To set the displayed pressure type, follow this procedure:

1. Select the numeric area or waveform area of the non-specific pressure to enter the corresponding pressure menu.
2. Select the **Setup** tab.
3. Set **Measure**:
   - If this non-specific 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 non-specific pressure is venous pressure, set the **Measure** to **Mean Only**. In this case, its corresponding numeric area displays only the mean pressure.

15.6.4 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**.

15.6.5 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 following properties of the IBP waveform:
   - **Speed**
   - **Scale**: if **Auto** is selected, the size of the pressure's waveform will be adjusted automatically.

15.6.6 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**.

15.6.7 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.**

15.6.8 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 *20.4 Hemodynamic Calculations*.

15.6.9 Enabling PPV Measurement

PPV indicates pulse pressure variation. When measuring the arterial pressure (except PA), the PPV measurement is available. To enable the PPV measurement, follow this procedure:

1. Select the IBP numeric area or waveform area to enter the corresponding pressure menu.
2. Select the **PPV Setup** tab.
3. Switch on **PPV Measure**.

You can select PPV source after enabling the PPV measurement.

WARNING

- **This monitor can calculate PPV from beat-to-beat values of any arterial pulsatile pressure. The circumstances under which the calculation of a PPV value is clinically meaningful, appropriate and reliable must be determined by a physician.**
- **The clinical value of the derived PPV information must be determined by a physician. According to recent scientific literature, the clinical relevance of PPV information is restricted to sedated patients receiving controlled mechanical ventilation and mainly free from cardiac arrhythmia.**
- **The PPV measurement has been validated only for adult patients.**
- **PPV calculation may lead to inaccurate values in the following situations:**
  - **at respiration rates below 8 rpm**

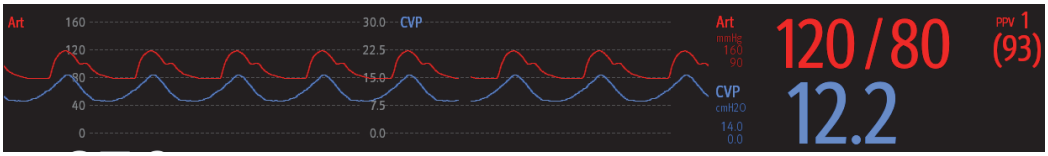
- **during ventilation with tidal volumes lower than 8 ml/kg**

- **for patients with acute right ventricular dysfunction ("corpulmonale").**

15.6.10 Overlapping IBP Waveforms

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

1. Access **Tile Layout** by either of the following ways:
   - Select the **Screen Setup** quick key → select the **Tile Layout** tab.
   - Select 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.**

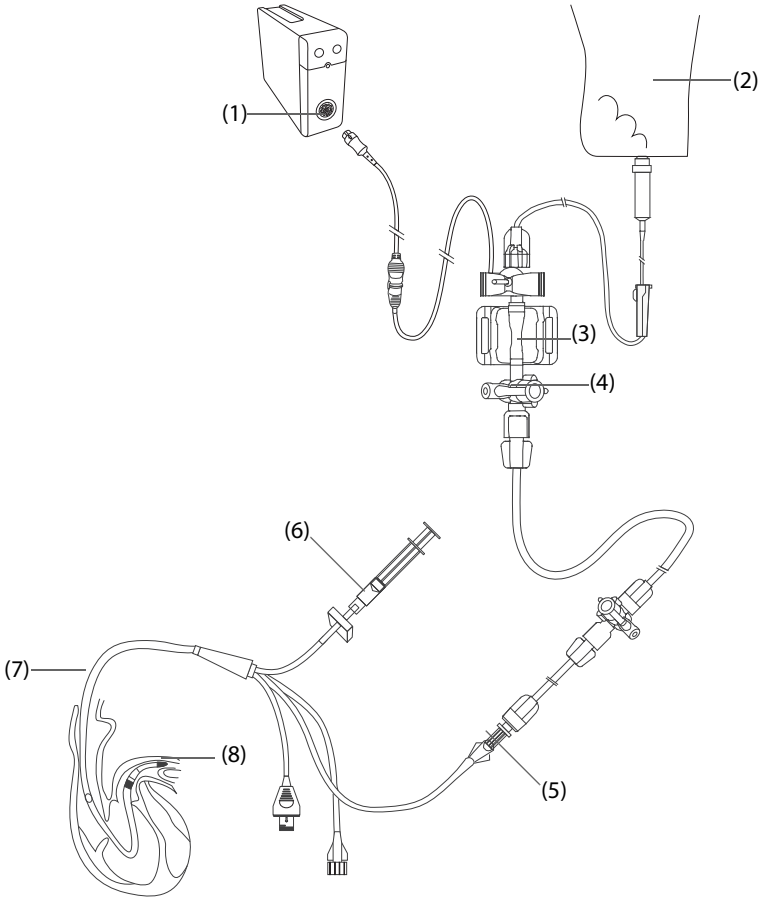
15.7 Measuring PAWP

Pulmonary Artery Wedge Pressure (PAWP) values, used to assess cardiac function, are affected by fluid status, myocardial contractility, and valve and pulmonary circulation integrity.

Obtain the measurement by introducing a balloon-tipped pulmonary artery flotation catheter into the pulmonary artery. When the catheter is in one of the smaller pulmonary arteries, the inflated balloon occludes the artery allowing the monitor to record changes in the intrathoracic pressures that occur throughout the respiration cycle.

The pulmonary wedge pressure is the left ventricular end diastolic pressure when the airway pressure and valve function are normal. The most accurate PAWP values are obtained at the end of the respiration cycle when the intrathoracic pressure is fairly constant and the artifact caused by respiration is minimal.

15.7.1 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

15.7.2 Preparing to Measure PAWP

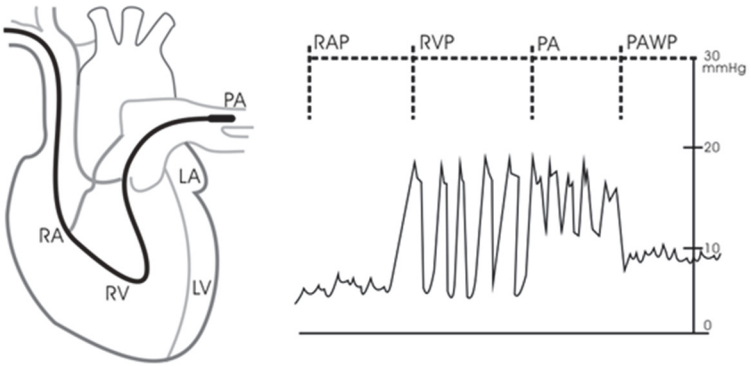
To prepare to monitor PAWP, follow this procedure:

1. Connect the IBP transducer, the IBP cable and the monitor. For more information, see *15.3.2 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 *15.3.3 Zeroing the IBP transducer*.
4. Set the IBP label to **PA** since the PAWP is measured on PA. For more information, see *15.6.2 Changing the Pressure Label*.

15.7.3 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

- **Prolonged inflation can cause pulmonary hemorrhage, infarction or both. Inflate the balloon for the minimum time necessary to get an accurate measurement.**
- **If the PAWP is greater than the PA (systolic), deflate the balloon and report the incident in accordance with hospital policy. Because the pulmonary artery could be accidentally ruptured, and the PAWP value derived will not reflect the patient's hemodynamic state, but will merely reflect the pressure in the catheter or balloon.**
- **If the flotation/thermodilution catheter drifts into the wedge position without inflation of the balloon, the PA waveform assumes a wedged appearance. Take appropriate action, in accord with standard procedures, to correct the situation.**

NOTE

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

15.7.4 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.

15.7.5 Performing Hemodynamic Calculation

On the **PAWP** screen, select **Hemo Calcs** to enter the **Hemo Calcs** menu. For more information, see *20.4 Hemodynamic Calculations*.

15.8 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 *D 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 in the **Screen Setup** menu. For more information, see *24.11 The Authorization Setup Settings* 2. Check that if the IBP parameter switch is enabled. 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 the 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 *15.3.3 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 *15.6.3 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 *15.3.3 Zeroing the IBP transducer*. 3. If zero calibration still fails, replace the transducer.

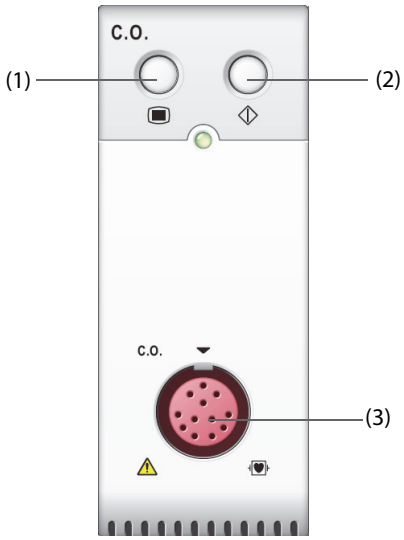
16 Monitoring Cardiac Output (C.O.)

16.1 C.O. Introduction

The cardiac output (C.O.) measurement invasively measures cardiac output and other hemodynamic parameters using the right heart (atria) thermodilution method. A cold solution of known volume and temperature is injected into the right atrium through the proximal port of a pulmonary artery (PA) catheter. The cold solution mixes with the blood in the right ventricle and the change in blood temperature is measured with a thermistor at the distal end of the catheter in the pulmonary artery. The temperature change is displayed as a curve on the C.O. split screen, and the monitor calculates the C.O. value from this curve. The C.O. value is inversely proportional to the area under the curve. As cardiac output varies continuously, a series of measurements must be carried out to achieve a reliable C.O. average value. Always use the average of multiple thermodilution measurements for therapy decisions. The monitor is capable of storing 6 measurements.

You can monitor C.O. using the built-in C.O. module or the external C.O. module.

The following picture shows the external C.O. module.



(1) C.O. menu hard key (2) C.O. measure menu hard key (3) C.O. cable connector

16.2 C.O. Safety Information

WARNING

- **The C.O. measurement results may be erroneous during electrosurgery.**
- **All invasive procedures involve risks to the patient. Use aseptic technique and follow catheter manufacturer's instructions.**
- **Use only accessories specified in this manual. Make sure that the accessories never come into contact with conductive parts.**

16.3 C.O. Measurement Limitations

The following factors may influence the accuracy of C.O. measurement:

- temperature of injectate solution
- volume of injectate solution
- baseline of patient's blood temperature
- patient's inspiratory/expiratory cycle
- placement of catheter with relation to proximity of lung field
- the catheter itself
- patient's heart rate and hemodynamic status
- any solution infused with intravenous injection during the C.O. measurement

To obtain accurate C.O. measurements, follow these recommendations:

- Temperature of injectate solution must be at least 10 ºC cooler than that of the patient's blood.
- Inject solution at end of expiration.
- Inject solution rapidly and smoothly.
- Finish injection within four to five seconds.

16.4 C.O. Display

The C.O. display shows only C.O., C.I (cardiac index), and TB (blood temperature) in the C.O. numeric area.

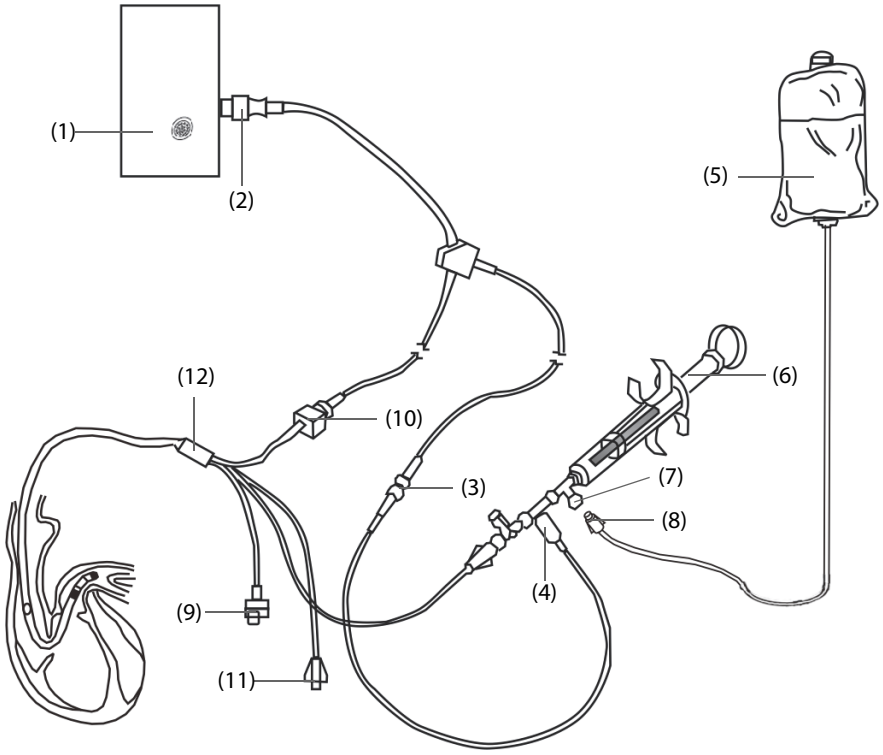
(1) C.O. label

(2) Primary parameter unit

(3) Labels and values for primary parameter

(4) Labels and values for secondary parameter

16.5 C.O. Equipment to Patient Connection



(1) C.O. module	(2) 12-pin C.O. cable (Model: CO7702)	(3) TI cable connector
(4) Temperature probe	(5) Injectate solution	(6) Injectate syringe
(7) Three-way valve	(8) Proximal injectate port	(9) Balloon inflation valve
(10) Thermistor connector	(11) PA distal port	(12) TB cable connector

16.6 Performing C.O. Measurement

16.6.1 Preparing for C.O. Measurement

1. Connect the C.O. cable to the C.O. connector and thermistor connector, making sure the C.O. numeric area is displayed on the monitor's main screen.
2. Follow the hospital's policy and procedures to prepare the patient for the C.O. measurement.
3. Follow the manufacturer's instructions to set up the catheter and other accessories.
4. Check that all the accessories are properly connected.

NOTE

- **For an in-line probe setup, make sure the in-line sensor is securely connected to the tubing. For the bath probe setup, make sure the bath probe is correctly sensing the injectate temperature.**

16.6.2 Setting C.O. Measurement

Before performing the C.O. measurement, follow this procedure:

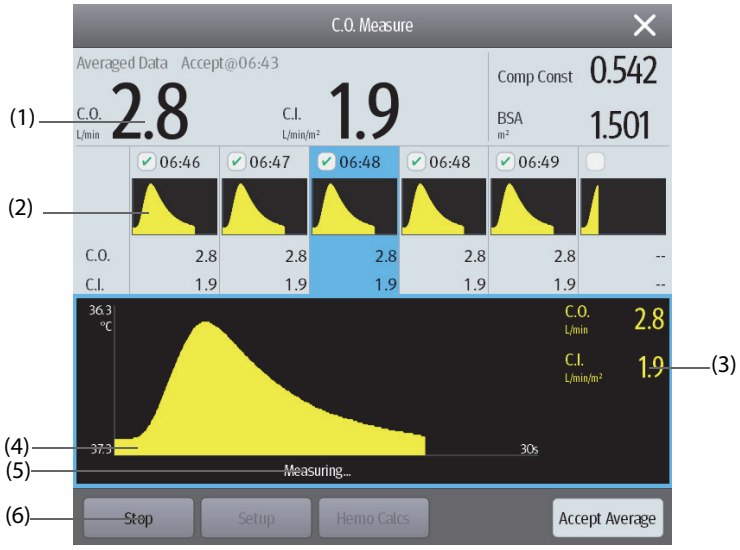
1. Select the C.O. numeric area to enter the **C.O. Measure** menu.
2. Select the **Setup**.
3. Perform the following check or setup:

- Check if the height and weight are appropriate for your patient. Change if necessary. The patient's height and weight values are required for determining cardiac index (C.I.).
- Check that the correct computation constant is entered. The computation constant has a close relationship with the entered injectate volume, injectate probe type (in-line probe or bath probe) and temperature. See the Instruction for Use of pulmonary artery catheter to determinate. To change the computation constant, select **Comp Const** and then input the correct value. When a new catheter is used, the computation constant should be adjusted in accordance with the manufacturer's instructions for use.
- Switch on or off **Auto TI**. If **Auto TI** is switched on, the system automatically detects the injectate temperature, and **TI** setting is disabled. If **Auto TI** is switched off, you need to input the injectate temperature at **TI**.
- Switch on or off **Auto Start**. If **Auto Start** is switched on, the monitor automatically takes the C.O. measurement after establishing a baseline of blood temperature. If **Auto Start** is switched off, you need to click the **Start** button in the **C.O. Measure** window for a new measurement.

16.6.3 Performing C.O. Measurement

To perform the C.O. measurement, follow this procedure:

1. Select the C.O. numeric area to enter the **C.O. Measure** menu.



(1) Average values

(2) Historical measurement windows

(3) Current measurement values

(4) Current C.O. curve

(5) Prompt message area

(6) Buttons

2. Proceed as follows to perform the C.O. measure:
   - If **Auto Start** is switched off, select the **Start** button, and then inject the solution quickly when you see the message **Please Wait**. As shown in the figure above, during the measurement, the currently measured thermodilution curve is displayed. At the end of the measurement, the thermodilution curve is transferred to one of the 6 measurement windows and the monitor prompts you to wait for a certain period of time before starting a new measurement.
   - If **Auto Start** is switched on, inject the solution quickly when you see the message **Ready For New Set Of Measurements**. The monitor consecutively takes C.O. measurements automatically without the need for pressing the **Start** button between two measurements. A new thermodilution measurement is possible as soon as the message **Inject Now!** is displayed on the screen. The monitor automatically detects further thermodilution measurements.
3. Acquire the average value of C.O. and C.I. A maximum of 6 measurements can be stored. If you perform more than six measurements without rejecting any, the oldest will automatically be deleted when a seventh curve is stored. Select from the 6 measurement curves and the system will automatically calculate and display the averaged C.O. and C.I. values. Then select the **Accept Average** button to accept and store the averaged values.

When injecting, the stopcock to the thermodilution catheter is open and the stopcock to the injectate solution is closed. After completing the measurement, turn off the stopcock to the thermodilution catheter and turn on the stopcock to the injectate solution, and then draw the injectate solution into the injectate syringe.

The button area also provides you with the following functions:

- Select **Stop** to stop the current measurement.
- Select **Setup** to enter the **C.O.** menu.
- Select **Hemo Calcs** to enter the **Calculations** menu.

NOTE

- **Starting a measurement without blood temperature being stable may cause measurement failure.**
- **The TB alarms are inactivated during a C.O. measurement, and will be reactivated automatically after the completion of C.O. measurement.**
- **Please see the Instructions for Use of thermodilution catheter to determine the Comp Const and the volume of injectate solution.**

16.7 Changing C.O. Settings

16.7.1 Setting C.O. Alarm Properties

To set the C.O. alarm properties, follow this procedure:

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

16.7.2 Selecting the Primary C.O. Parameter

You can select C.O. or C.I. as the main C.O. parameter. The measurement of the primary parameter displays in larger numerics. To do so, follow this procedure:

1. Select the C.O. parameter area to enter the **C.O. Measure** menu.
2. Select the **Setup** tab.
3. Set **Primary Parameter**.

16.8 C.O. 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 *D Alarm Messages*.**

Problem	Solution
Do not see C.O. numeric area on the main screen	1. Check that the C.O. is set to display in the **Screen Setup** menu. For more information, see *24.10The Other Settings*. 2. Check that if the C.O. parameter switch is enabled. If not, enable the C.O. measurement. For more information, see *3.11.1 Switching On or Off a Parameter*. 3. Check the connection of C.O. cable, thermodilution catheter and TI sensor.

Problem	Solution
C.O. value is inaccurate	1. Check that the thermodilution catheter is positioned properly. 2. Check that the computational constant is proper for current injectate temperature, injectate volume and injectate probe type. 3. Inject solution rapidly and smoothly. 4. Finish injection within four to five seconds. 5. Inject more volume, or inject colder solution. 6. Check that the height and weight of patient is properly configured. 7. If **Auto TI** is switched off, check that the entered temperature is correct.
C.O. measurement fails	1. Inject more volume, or inject colder solution. Make sure that the injectate temperature is at least 10°C colder than the patient blood temperature. 2. Finish injection within four to five seconds. 3. Check the connection of C.O. cable, thermodilution catheter and TI sensor.

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.

CO_2 measurement are used to monitor the patient's respiratory status. The following two methods are used for measuring CO_2:

- Mainstream CO_2 measurement

  Directly insert a CO_2 sensor into the patient's breathing system.

- Sidestream/Microstream CO_2 measurement

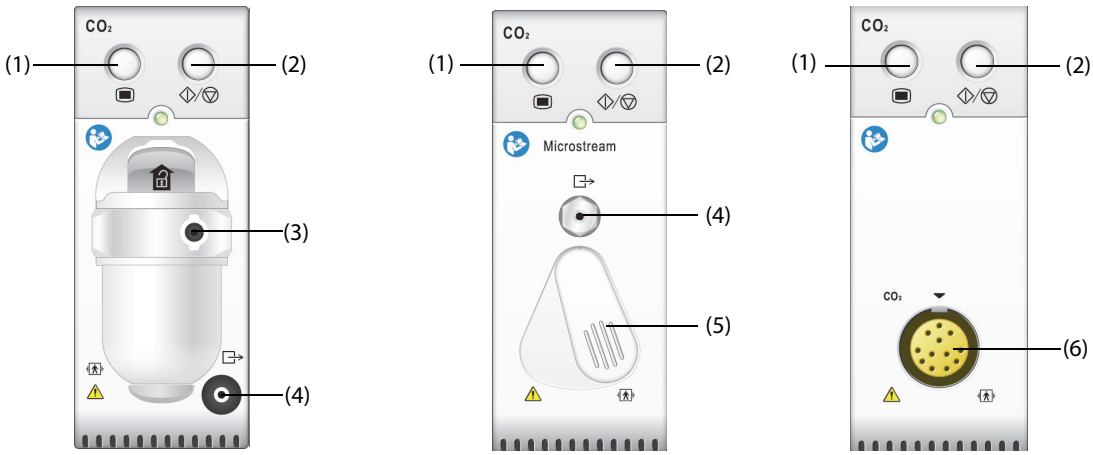
  Take a sample of the respiratory gas with a constant sample flow from the patient's airway and analyze it with a remote CO_2 sensor built into the Sidestream or Microstream CO_2 module.

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

The mainstream CO_2 measurement can be used, with specified accessories, with intubated patients. The sidestream and microstream CO_2 measurement can be used, with specified accessories, with intubated and non-intubated patients. With intubated patients, a sample of the respiratory gas is drawn from the patient's breathing circuit through an airway adapter and a gas sampling line. With non-intubated patients, the gas sample is drawn through a nasal cannula.

You can monitor CO_2 using the built-in CO_2module or the external CO_2 module.

The following external modules are sidestream CO_2 module, microstream CO_2 module and mainstream CO_2 module from left to right.



(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

If you measure CO_2 using the AG module, see *18 Monitoring Anesthetic Gas (AG)*.

17.2 CO_2 Safety Information

WARNING

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

CAUTION

- **Avoid mechanical shock to the sidestream CO_2 module configuring the paramagnetic oxygen sensor.**
- **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.**

NOTE

- **The CO_2 module automatic 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

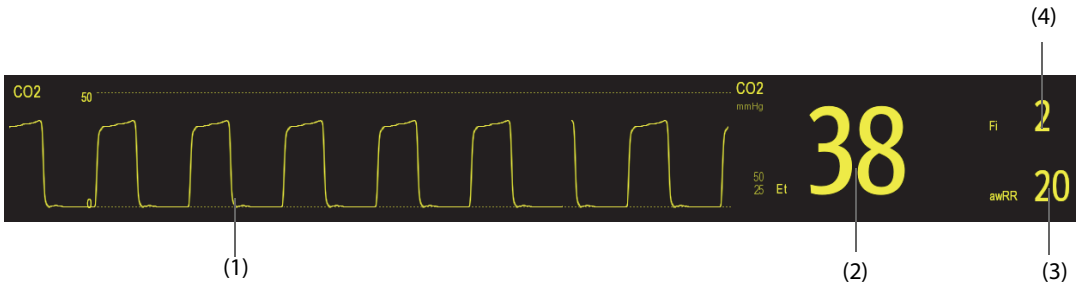
The following factors may influence the measurement accuracy:

- Leaks or internal venting of sampled gas
- Mechanical shock
- Cyclic pressure up to 10 kPa (100 cmH_2O)
- Other sources of interference, if any

Measurement accuracy of the sidestream CO_2 module may be affected by the breath rate and inspiration/expiration (I/E) ratio. Measurement accuracy of the microstream CO2 module may be affected by the breath rate. For more information, see *A.13.9 CO_2 Specifications*.

17.4 CO_2 Display

The CO_2 numeric and waveform area provide $FiCO_2$ measurement, $EtCO_2$ measurement, awRR measurement, and a CO_2 waveform.



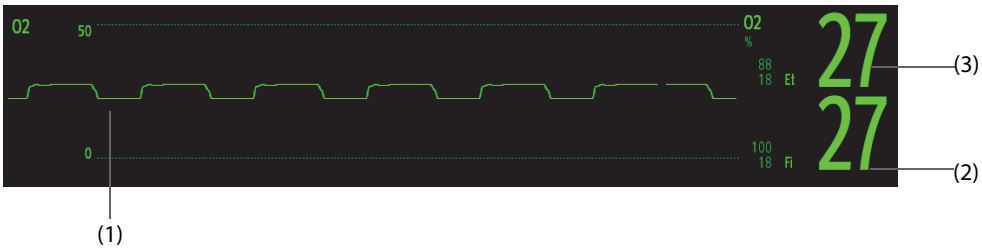
(1) CO_2 waveform

(2) End tidal CO_2 value ($EtCO_2$)

(3) Airway respiration rate (awRR)

(4) Fraction of inspired CO_2 ($FiCO_2$)

If your sidestream CO_2 module is configured with the oxygen sensor, O_2 waveform and parameters can be displayed as follows:



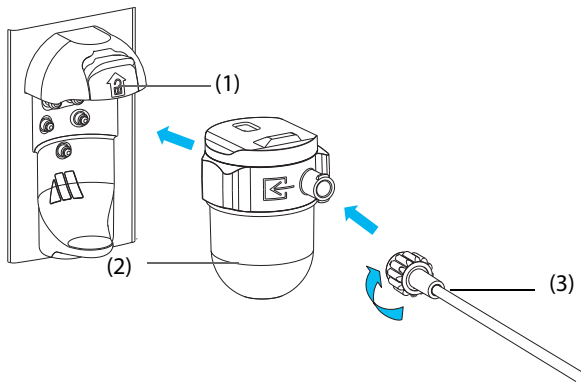
(1) O_2 waveform (2) FiO_2 measurement (3)EtO_2 measurement

17.5 Measuring CO_2 Using Sidestream/Microstream CO_2 Module

17.5.1 Preparing to Measure CO_2 Using Sidestream CO_2 Module

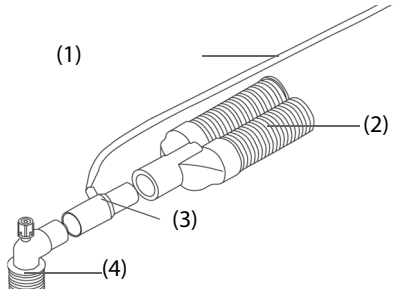
To prepare the CO_2 module for measurement, follow this procedure:

1. Select the appropriate gas sample line and watertrap according to the patient category.
2. Connect the DRYLINE II watertrap to the CO_2 module, and connect the gas sample line to the watertrap.



(1) Watertrap receptacle (2) DRYLINE II watertrap (3) Gas sample line

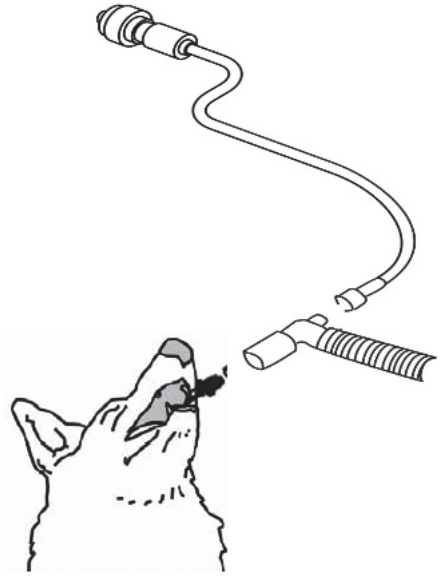
3. Connect the other end of the gas sample line to the patient.
   - For intubated patients requiring an airway adapter, install the airway adapter between the patient circuit and the ventilator Y-piece.



(1) Sample line (2) Connect to the ventilator

(3) Airway adapter (4) Connect to the patient

◆ For non-intubated patients, connect the other end of the gas sample line to the patient.



4. Connect the gas outlet to the scavenging system using an exhaust tube.

After the CO_2 module is connected, it enters measure mode by default and the monitor displays **CO2 Starting**. CO_2 can be measured after the start-up is complete.

WARNING

- **Connect the gas outlet to the scavenging system when measuring CO_2 using the sidestream CO_2 module.**

CAUTION

- **Leakage in the breathing or sampling system may cause the displayed $EtCO_2$ values to be significantly low. Always make sure that all components are securely connected.**
- **Inspect the airway adapter for a tight connection and proper operation before attaching it to the patient.**
- **Squeezing or bending the sample line during the sidestream or microstream CO_2 measurement may cause inaccurate CO_2 reading or no reading.**
- **To avoid blocking the airway, empty the DRYLINE II watertrap container whenever half full. Dispose of accumulated fluids in accordance with hospital policy or your local regulations.**
- **The DRYLINE II watertrap has a filter preventing bacterium, water and secretions from entering the module. Extended use could destroy the filter in watertrap and fail to stop the bacterium, water and secretions entering the module, result in damaging the gas module and having infection risk. Replacing the DRYLINE II watertrap once a month is recommended.**

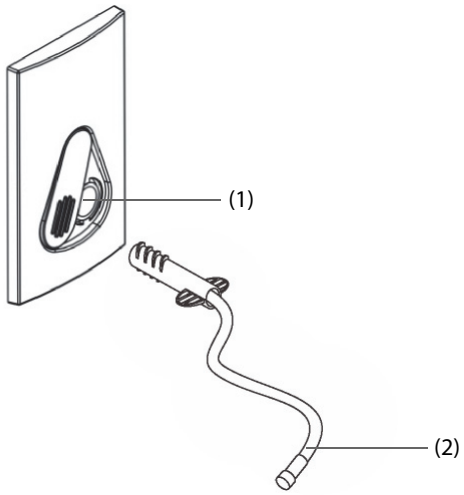
NOTE

- **To extend the lifetime of the watertrap and module, disconnect the watertrap from the module and set the operating mode to Standby mode when CO_2 monitoring is not required.**
- **The sample rates are different when different types of watertraps are used.**
- **The emptying interval of the watertrap is 26 hours @ 120 ml/min, sample gas of 37 °C, room temperature of 23 °C, 100% RH.**

17.5.2 Preparing to Measure CO_2 Using Microstream CO_2 Module

To prepare the CO_2 module for measurement, follow this procedure:

1. Connect one end of the sample line to the microstream CO_2 module.



(1) Sample line connector (2) Sample line

2. Connect the other end of the sample line to the patient.
   - For intubated patient requiring an airway adapter, install the airway adapter between the patient circuit and the ventilator Y-piece.
   - For non-intubated patient, place the nasal cannula onto the patient.
   - For patient prone to mouth breathing, place the oral-nasal cannula onto the patient.
3. Connect the gas outlet to the a scavenging system using an exhaust tube.

After the CO_2 module is connected, it enters measure mode by default and the monitor displays **CO2 Sensor Warmup**. CO_2 can be measured after the start-up is complete.

CAUTION

- **Connect the gas outlet to the scavenging system when measuring CO_2 using the microstream CO_2 module.**

NOTE

- **Disconnect the sample line from the module when CO_2 monitoring is not required.**

17.5.3 Zeroing the Sidestream/Microstream CO_2 Module

The sidestream and microstream CO_2 modules perform a zero calibration automatically when needed. Once the zero calibration is started, the CO_2 module stops measuring and "**Zeroing**" is displayed in the CO_2 numeric area.

After the zero calibration is completed, the CO_2 module reacquires the CO_2 readings. During the reacquisition period, "**Zero Recovering**" is displayed in the CO_2 numeric area. Valid data will reappear 30 seconds after the zero calibration is started. You can hide the display of the "**Zero Recovering**" message, but values displayed during the reacquisition period may not be accurate.

The automatic zero calibration will not start under the following conditions:

- Physiological alarms related to CO_2 or AG are active.
- An apnea alarm is active.
- No breath has been detected for over 30 seconds.

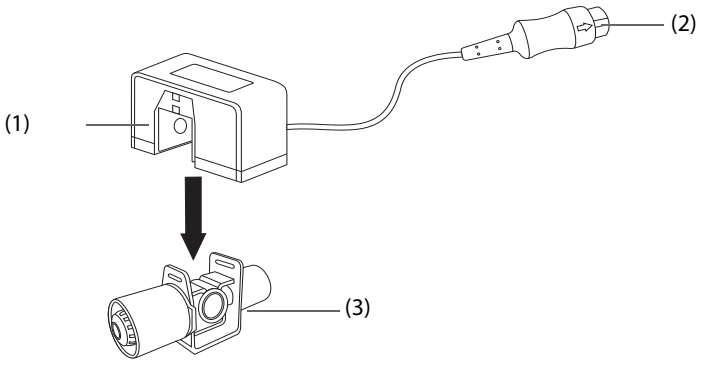
You can also perform the zero calibration manually.

17.6 Measuring CO_2 Using Mainstream CO_2 Module

17.6.1 Preparing to Measure CO_2 Using Mainstream CO_2 Module

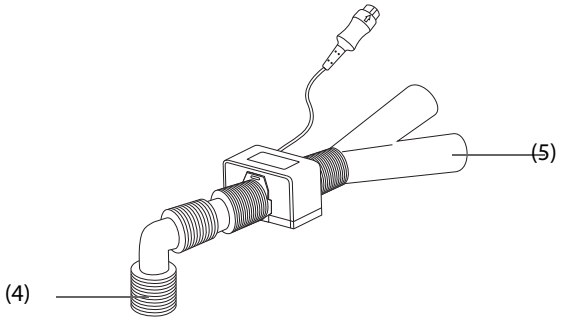
To prepare the CO_2 module for measurement, follow this procedure:

1. Connect the airway adapter to the sensor head.



(1) Sensor (2) Connect to module (3) Airway adapter

2. Attach the sensor connector to the CO_2 connector on the mainstream CO_2 module.
3. Zero the sensor after the warm-up is finished. For details, see *17.6.2 Zeroing the Mainstream CO_2 Sensor*.
4. After the zero calibration is finished, connect the airway as shown below.



(4) Connect to patient (5) Connect to ventilator

5. Make sure that no leakages are in the airway and then start a measurement.

NOTE

- **Be sure to set the barometric pressure properly before using the mainstream CO_2 module. Improper settings will result in erroneous CO_2 reading.**
- **Always position the sensor with the adapter in an upright position to avoid collection of fluids in the windows of the adapter. Large concentrations of fluids at this point will obstruct gas analysis.**
- **To avoid dead space, place the sensor as close to the patient as possible.**

17.6.2 Zeroing the Mainstream CO_2 Sensor

For mainstream CO_2 modules, the sensor should be zeroed in the following conditions:

- Before each measurement.
- A new adapter is used.
- Reconnect the sensor to the module.

■ The message **CO2 Zero Required** displays. In this case, check the airway adapter for any blockage, e.g. mucus, etc. If a blockage is detected, clear or replace the adapter.

To zero the sensor, follow this procedure:

1. Connect the sensor to the module.
2. In the **CO2** menu, select **Setup** tab.
3. Set the **Operating Mode** to **Measure**. The message **CO2 Sensor Warmup** is displayed.
4. After warm-up is finished, connect the sensor to a clean, dry airway adapter. The adapter should be vented to the air and isolated from CO_2 sources, such as ventilator, the patient's breathing, your own breathing, etc.
5. Select **Zero** in the **CO2** menu. The message **Zeroing** is displayed.

It takes about 15 to 20 seconds. The message disappears when the zero calibration is completed.

WARNING

- **When perform a zero calibration during the measurement, disconnect the sensor from the patient's airway first.**
- **Please do not rely on the readings during zeroing.**

17.7 Changing Settings for All CO_2 Modules

17.7.1 Changing CO_2 Alarm Settings

To change the CO_2 alarm settings, follow this procedure:

1. Select the CO_2 numeric area or waveform area to enter the **CO2** menu.
2. Select the **Alarm** tab.
3. Enter the password if required.
4. Set alarm properties as desired.

17.7.2 Setting the CO_2 Waveform

To set the CO_2 waveform, follow this procedure:

1. Select the CO_2 numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set **Waveform Type**, **Speed, Scale**, or **CO2 Scale** of the CO_2 waveform.

17.7.3 Setting the RR Source

To set the respiration rate (RR) source, follow this procedure:

1. Select the CO_2 numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set **RR Source**.

When the current RR source does not have valid measurement, the system will automatically switch **RR Source** to **Auto**.

17.7.4 Entering the Standby Mode

You can set the CO_2 module to one of the following modes according to the module status:

■ Select **Measure** mode when you use the CO_2 module for monitoring.

■ Select **Standby** mode when you do not use the CO_2 module to prolong the serviec life of the CO_2 module.

The default operating mode is **Measure**. If you are not using the CO_2 module, you can proceed as follows to enter the Standby mode:

1. Select the CO_2 numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set **Operating Mode** to **Standby**.

17.7.5 Entering the Intubation Mode

When performing intubation during general anesthesia, you can enter the intubation mode in order to reduce unnecessary alarms. To enter the intubation mode, follow this procedure:

1. Select the CO_2 numeric area or waveform area to enter the **CO2** menu.
2. Select **Intubation Mode**.

For the details of the intubation mode, see *8.13 Intubation Mode*.

17.8 Changing Settings for Sidestream and Microstream CO_2 Module

17.8.1 Setting the Auto Standby

The monitor enters standby mode automatically after the configured period of time if no breath is detected since the last detected breath. To set the auto standby, follow this procedure:

1. Select the CO_2 numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set **Auto Standby**.

17.8.2 Setting Humidity Compensation

Sidestream and microstream CO_2 modules are configured to compensate CO_2 readings for either Body Temperature and Pressure, Saturated Gas (BTPS), to account for humidity in the patient's breath, or Ambient Temperature and Pressure, Dry Gas (ATPD).

- ATPD: $P_{CO2}(mmHg)=CO_2(vol\%) \times P_{amb}/100$
- BTPS (sidestream): $P_{CO2}(mmHg)=CO_2(vol\%) \times (P_{amb}- 47)/100$
- BTPS (microstream): $P_{CO2}(mmHg)=CO_2(vol\%) \times (1- 0.03) \times P_{amb}/100$

Where, $P_{CO2}(mmHg)$= *partial pressure, vol%=*CO_2 *concentration,* P_{amb}*=ambient pressure, and unit is mmHg.*

For the sidestream and microstream CO_2 module, you can set the humidity compensation on or off according to the actual condition.

To set the humidity compensation, follow this procedure:

1. Select the CO_2 numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set **BTPS Compensation**.
   - Switch on for BTPS.
   - Switch off for ATPD.

17.9 Changing O_2 Settings (for Sidestream CO_2 Module Integrating O_2)

17.9.1 Changing O_2 Alarm Settings

To change the O_2 alarm settings, follow this procedure:

1. Select the CO_2 numeric area or waveform area to enter the **CO2** menu.
2. Select the **Alarm** tab.
3. Enter the password if required.

4. Set alarm properties as desired.

17.9.2 Setting the O_2 Waveform

To set the O_2 waveform, follow this procedure:

1. Select the CO_2 numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set **Speed** and **O2 Scale** of the O_2 waveform.

17.10 Setting the Gas Compensation

The presence of interfering gas affects the CO_2 measurement. To get the best possible measuring result, it is needed to set the gas compensation. The configured concentration of the interfering gas should be in accordance with its actual proportion.

For the microstream CO_2 module, gas compensations are not required.

WARNING

- **Make sure to use the appropriate compensations. Inappropriate compensations may cause inaccurate measurement values and result in misdiagnosis.**

For the sidestream CO_2 module, follow this procedure to set the gas compensation:

1. Select the CO_2 numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set the compensation according to the actual condition.

For the mainstream CO_2 module, follow this procedure to set the gas compensation:

1. Select the CO_2 numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set the following compensation according to the actual condition.

- **Balance Gas**
  - Select **Room Air** when air predominates in the ventilation gas mixture.
  - Select **N2O** when N_2O predominates in the ventilation gas mixture.
  - Select **He** when He predominates in the ventilation gas mixture.
- **O2 Compensation**
  - Select **Off** when the amount of O_2 is less than 30%.
  - Select an appropriate setting according to the amount of O_2 in the ventilation gas mixture.
- **AG Compensation**: enters the concentration of anesthetic gas present in the ventilation gas mixture. This could compensate for the effect of AG on the readings.

17.11 Choosing a Time Interval for Peak-Picking

For microstream and mainstream CO_2 modules, you can select a time interval for picking the highest CO_2 as the $EtCO_2$ and the lowest as the $FiCO_2$.

To set the time interval, follow this procedure:

1. Select the CO_2 numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set **Maximum Hold**.
4. Toggle between **Single Breath**, **10 s**, **20 s** and **30 s** if microstream CO_2 module is configured; toggle between **Single Breath**, **10 s** and **20 s** if mainstream CO_2 module is configured.

- **Single Breath**: $EtCO_2$ and $FiCO_2$ are calculated for every breath.
- **10 s**, **20 s**, or **30 s**: $EtCO_2$ and $FiCO_2$ are calculated using 10, 20 or 30 seconds of data.

17.12 Changing Barometric Pressure

Both sidestream and microstream CO_2 modules have the function of automatic barometric pressure compensation (the system automatically measures the barometric pressure to which the patient monitor is exposed). However, the mainstream CO_2 module does not have such function. For the mainstream CO_2 module, the default barometric pressure is 760 mmHg. You must modify the barometric pressure based on the actual situation.

This function is password protected. For more information, see *24.11 The Authorization Setup Settings*.

WARNING

- **Be sure to set the barometric pressure properly before using the mainstream CO_2 module. Improper settings will result in erroneous CO_2 reading.**

17.13 Performing the Leakage Test

When measuring CO_2 using the sidestream CO_2 module, leakage test is required every time before the CO_2 measurement. To perform the CO_2 leakage test, follow this procedure:

1. Connect the measuring accessories as per section *17.5.1 Preparing to Measure CO_2 Using Sidestream CO2 Module*.
2. Wait until the startup finishes. Completely block the gas inlet on the sidestream CO2 module or on the N1. Then the alarm message "**CO2 Airway Occluded**" will appear on the screen.
3. Block the gas inlet for another one minute.
4. Select the **Main Me** quick key → from the **System** column select **Maintenance** → input the required password → select .
5. Select the **Module** tab → **CO2** tab.
6. Check that the current flow rate is less than 10ml/min, and the alarm message "**CO2 Airway Occluded**" does not disappear. This indicates that the module does not leak. If the alarm message disappears, or the flow rate is equal to 10ml/min or greater, it indicates that the module leaks. Perform the leakage test again. If the problem remains, contact your service personnel for help.

17.14 CO_2 Calibration

For sidestream and microstream CO_2 modules, a calibration is needed every year or when the measured values have a great deviation. For maintream CO2 module, no calibration is needed.

To calibrate the CO_2 module, contact the service personnel.

CAUTION

- **Connect the gas outlet to the scavenging system when calibrating the CO_2 module.**

17.15 CO_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 *D Alarm Messages*.**

17.15.1 Troubleshooting the Sidestream/Microstream CO_2 Module

Problem	Solution
$EtCO_2$measurements too low	1. Ventilate the room if the environmental CO_2 concentration is too high. 2. Check the sample line and connectors for leakage. 3. Check the patient status.

17.15.2 Troubleshooting the Mainstream CO_2 Module

Problem	Solution
Elevated baseline	1. Check the patient status. 2. Check the sensor.

17.16 Oridion Information

Microstream

This trademark is registered in Israel, Japan, German and America.

Oridion Patents

The capnography component of this product is covered by one or more of the following US patents: 6,428,483; 6,997,880; 6,437,316; 7,488,229; 7,726,954 and their foreign equivalents. Additional patent applications pending.

No Implied License

Possession or purchase of this device does not convey any express or implied license to use the device with unauthorized CO_2 sampling consumables which would, alone, or in combination with this device, fall within the scope of one or more of the patents relating to this device and/or CO_2 sampling consumable.

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18 Monitoring Anesthetic Gas (AG)

18.1 AG Introduction

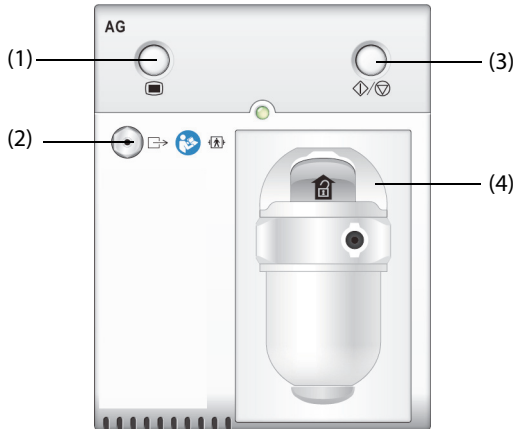
The anesthetic gas (AG) module measures the patient's anesthetic and respiratory gases by connecting to the airway of intubated patients or collecting the gases with specified accessories. It also incorporates the features of the O_2 module.

The AG module determines the concentration of certain gases using the infrared (IR) light absorption measurement. The gases that can be measured by the AG module absorbing IR light. Each gas has its own absorption characteristic. The gas is transported into a sample cell, and an optical IR filter selects a specific band of IR light to pass through the gas. For multiple gas measurements, there are multiple IR filters. The higher the concentration of gas in a given volume, the more IR light is absorbed. This means that higher concentration of IR absorbing gas causes a lower transmission of IR light. The amount of IR light transmitted after it has been passed through an IR absorbing gas is measured. From the amount of IR light measured, the concentration of gas present can be calculated.

Oxygen does not absorb IR light as other breathing gases and is therefore measured relying on its paramagnetic properties. Inside the O_2 sensor are two nitrogen-filled glass spheres mounted on a strong rare metal taut-band suspension. This assembly is suspended in a symmetrical non-uniform magnetic field. In the presence of paramagnetic oxygen, the glass spheres are pushed further away from the strongest part of the magnetic field. The strength of the torque acting on the suspension is proportional to the oxygen concentration. From the strength of the torque, the concentration of oxygen is calculated.

You can monitor AG using the external AG module.

The following picture shows the external AG module.



(1) AG menu hard key
(2) Gas outlet
(3) AG Measure/standby hard key
(4) Watertrap seat

NOTE

- **The AG module is configured with automatic barometric pressure compensation function.**

18.2 AG Safety Information

WARNING

- **To avoid explosion hazard, do not use flammable anesthetic agent such as ether and cyclopropane for this equipment.**
- **The presence of other substances in the patient's breathing circuit, such as ethanol, acetone, methanol, isopropanol, freon, asthma medication carrier gases, and other infrared absorbing gases, can influence the anesthesia agent identification and lead to incorrect measurements and identification.**
- **Using high-frequency electrosurgical units may increase the risk of skin burn. In this case, do not use antistatic or conductive respiratory tubing.**
- **Route all tubing away from the patient's throat to avoid strangulation.**

CAUTION

- **Perform the measurement in a well-ventilated environment.**
- **$EtCO_2$ values measured from the AG module may differ from that of from the blood gas analysis.**

NOTE

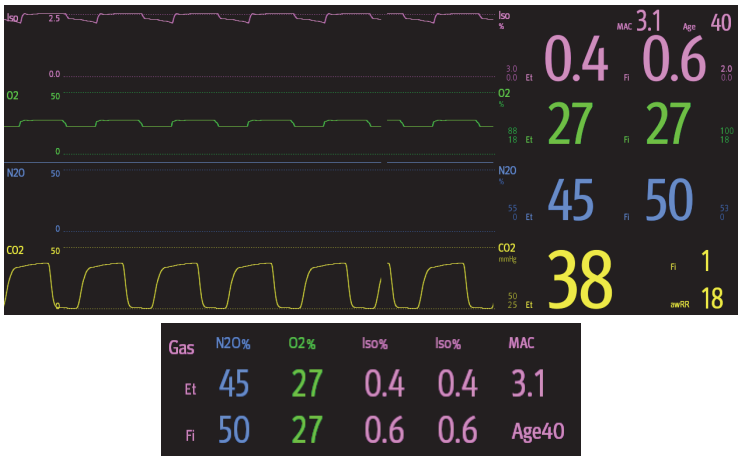
- **The AG module automatic suppress physiological alarms until breathing waves have been detected. Make sure that a patient is properly connected when monitoring with the AG module.**

18.3 AG Measurement Limitations

The following factors may influence the measurement accuracy:

- Leaks or internal venting of sampled gas
- Mechanical shock
- Cyclic pressure up to 10 kPa (100 cmH_2O)
- Other sources of interference, if any

18.4 AG Display



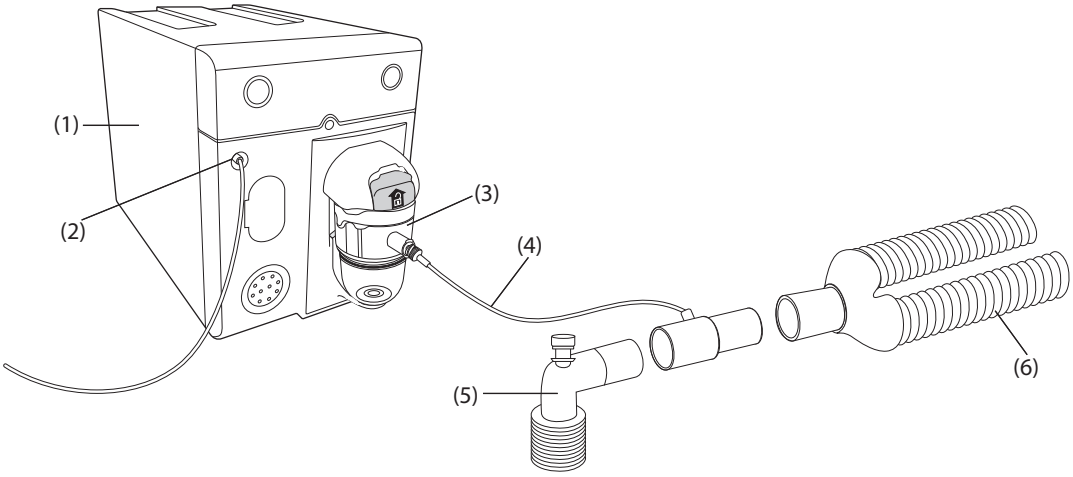
The AG module can send waves and numerics for all measured anesthetic gases for display on the monitor, including:

- CO_2, O_2, N_2O and AA waves
- awRR: airway respiratory rate
- MAC: minimum alveolar concentration
- End tidal (Et) and fraction of inspired (Fi) numerics for CO_2, O_2, N_2O and AA

AA represents one of the following agents: Des (desflurane), Iso (isoflurane), Enf (enflurane), Sev (sevoflurane), or Hal (halothane).

If only one anesthetic agent is used, the AA waveform area displays the waveform of this anesthetic agent. If several anesthetic agents are used, the AA waveform area displays the waveform of the primary anesthetic agent.

18.5 AG Equipment to Patient Connection



(1) AG module

(2) Gas outlet

(3) Watertrap

(4) Gas sample line

(5) Airway adapter (connected to patient)

(6) Y-piece (connected to the anesthesia machine)

18.6 Preparing for AG Monitoring

To prepare to monitor AG, follow this procedure:

1. Select the appropriate gas sample line and watertrap according to the patient category.
2. Connect the watertrap to the AG module, and connect the gas sample line to the watertrap.
3. Connect the other end of the gas sample line to the patient via the airway adapter.
4. Connect the gas outlet to a scavenging system using an exhaust tube.
5. Check that the connections are tight.

After the AG module is connected, the AG module enters the measurement mode by default and the monitor prompts **AG Starting**. AG measurement is available after the start-up is completed.

WARNING

- **Connect the gas outlet to the scavenging system when using the AG module.**
- **Make sure that the connections are tight. Any leak in the system can result in erroneous readings due to ambient air mixing with patient gases.**
- **Always inspect the airway adapter for a tight connection and proper operation before attaching it to the patient.**
- **Squeezing or bending the gas sample line during AG measurement may cause erroneous readings or no readings.**

CAUTION

- **Position the airway adapter so that the part connecting to the gas sample line is pointing upwards. This prevents condensed water from passing into the gas sample line and causing an occlusion.**

- **The watertrap collects water drops condensed in the sample line and therefore prevents them from entering the module. To avoid blocking the airway, empty the watertrap container whenever half full. Dispose of accumulated fluids in accordance with hospital policy or your local regulations.**
- **The watertrap has a filter preventing bacterium, water and secretions from entering the module. After long-term use, dust or other substances may compromise the performance of the filter or even block the airway. In this case, replace the watertrap. Replacing the watertrap once a month is recommended.**

NOTE

- **To extend the lifetime of the watertrap and module, disconnect the watertrap from the module and set the operating mode to Standby when AG monitoring is not required.**

18.7 Zeroing the AG Module

The AG module performs a zero calibration automatically when needed. Once the zero calibration is started, the AG module stops measuring and "**Zeroing**" is displayed in the AG numeric area.

After the zero calibration is completed, the AG module reacquires the AG readings. During the reacquisition period, "**Zero Recovering**" is displayed in the AG numeric area. Valid data will reappear 30 seconds after the zero calibration is started. You can hide the display of the "**Zero Recovering**" message, but values displayed during the reacquisition period may not be accurate. .

The automatic zero calibration will not start under the following conditions:

- Physiological alarms related to CO_2 or AG are active.
- An apnea alarm is active.
- No breath has been detected for over 30 seconds.

You can also perform the zero calibration manually.

18.8 MAC Values

Minimum alveolar concentration (MAC) is the minimum concentration of the agent in the alveoli. It is a basic index to indicate the depth of anesthesia. The standard ISO 80601-2-55 defines MAC as this: alveolar concentration of an inhaled anesthetic agent that, in the absence of other anesthetic agents and at equilibrium, prevents 50% of patients from moving in response to a standard surgical stimulus.

MAC values are listed below:

Agent	Des	Iso	Enf	Sev	Hal	N_2O
1 MAC	6%	1.15%	1.7%	2.1%	0.77%	105%*

* indicates 1 MAC nitrous oxide can only be reached in hyperbaric chamber.

NOTE

- **The MAC values shown in the table above are those published by the U.S. Food and Drug Administration for a healthy 40-year-old adult male patient.**
- **In actual applications, the MAC value may be affected by age, weight and other factors.**

The formula to calculate the MAC value is as follows:

$$MAC = \sum_{i=0}^{N-1} \frac{EtAgent}{AgentVol_{age}i}$$

Where N is the number of all agents (including N_2O) that the AG module can measure, $EtAgent_i$ is the concentration of each agent, and $AgentVol_{age}i$ is the concentration of each agent at 1 MAC with age correction.

The formula for calculating age correction of 1 MAC is:

$$MAC_{age} = MAC_{40} \times 10^{(-0.00269 \times (age - 40)}$$

For example, the Des concentration at 1 MAC of a 60-year old patient is.

$$6\% \times 10^{(-0.00269 \times (60-40))} = 6\% \times 0.88$$

The AG module measures 4% of Des, 0.5% of Hal and 50% of N_2O in the patient's end-tidal gas:

$$MAC = \frac{4.0\%}{6\% \times 0.88} + \frac{0.5\%}{0.77\% \times 0.88} + \frac{50\%}{105\% \times 0.88} = 2.04$$

NOTE

- **The formula above is only suitable for patients who are older than one year. If the patient is less than one year, the system uses one year old to do age correction.**

18.9 Changing AG Settings

18.9.1 Changing AG Alarm Settings

To change the AG alarm settings, follow this procedure:

1. Select the AG numeric area or waveform area to enter the **Gas** menu.
2. Select the desired gas tab.
3. Select the **Alarm** tab.
4. Enter the password if required.
5. Set the alarm properties of the desired gas.

18.9.2 Setting the O_2 Compensation

If the AG module does not incorporate the O_2 module, you need to set the amount of O_2 in the ventilation gas mixture. To set the O_2 compensation, follow this procedure:

1. Select the AG numeric area or waveform area to enter the **Gas** menu.
2. Select the **Setup** tab.
3. Set **O2 Compensation**:
   - Select **Off** when the amount of O_2 is less than 30%.
   - Select the other options in accordance with the O_2 concentration in the gas mixture.

The **O2 Compensation** setting is available only when the AG module does not incorporate the O_2 module. If the AG module incorporates the O_2 module, the system directly uses the O_2 concentration detected by the O_2 module to make compensation.

18.9.3 Entering the Standby Mode

You can set the AG module to one of the following modes according to the module status:

- Select **Measure** mode when you use the AG module for monitoring.
- Select **Standby** mode when you are not using the AG module.

The default operating mode is **Measure**. If you are not using the AG module, follow this procedure to enter the Standby mode:

1. Select the AG numeric area or waveform area to enter the **Gas** menu.
2. Select the desired gas tab.
3. Select the **Setup** tab.
4. Set **Operating Mode** to **Standby**.

18.9.4 Setting Auto Standby

The monitor enters the standby mode automatically after the configured period of time if no breath is detected since the last detected breath. To set the auto standby, follow this procedure:

1. Select the AG numeric area or waveform area to enter the **Gas** menu.
2. Select the desired gas tab.
3. Select the **Setup** tab.
4. Set **Auto Standby**.

18.9.5 Setting the Gas Waveform

To set the gas waveform, follow this procedure:

1. Select the AG numeric area or waveform area to enter the **Gas** menu.
2. Select the desired gas tab.
3. Select the **Setup** tab.
4. Set the speed and scale of gas waveforms. For CO_2, you can also set **Waveform Type**.

18.9.6 Setting the RR Source

To set the RR (respiration rate) source, follow this procedure:

1. Select the AG numeric area or waveform area to enter the **Gas** menu.
2. Select the desired gas tab.
3. Select the **Setup** tab.
4. Set **RR Source**.

When the current RR source does not have valid measurement, the system will automatically switch **RR Source** to **Auto**.

18.9.7 Entering the Intubation Mode

When performing intubation during general anesthesia, you can enter the intubation mode in order to reduce unnecessary alarms. To enter the intubation mode, follow this procedure:

1. Select the AG numeric area or waveform area to enter the **Gas** menu.
2. Select **Intubation Mode** from the bottom of the menu.

For the details of the intubation mode, see ***8.13 Intubation Mode***.

18.9.8 Enabling or Disabling MAC Display

You can set whether MAC value is displayed in the AG numeric area. To do so, follow this procedure:

1. Select the AG numeric area or waveform area to enter the **Gas** menu.
2. Select the desired anesthetic agent tab.
3. Switch on or off **MAC**.

18.10 Changing the Anesthetic Agent

When the anesthetic agent used on the patient is changed, the AG module detects the mixed anesthetic gas during the transition of two anesthetic agents. The time required for completing the replacement of anesthetic agent depends on anesthesia type (low flow or high flow) and the characteristics of anesthetic agents (pharmacokinetics). During the transition of two anesthetic agents, the monitor gives no prompt messages and the MAC value displayed may be inaccurate.

The AG module can identify two anesthetic agents automatically. When the proportion of primary and secondary anesthetic agents in the mixture changes, the AG module can distinguish between them according to their contributions to the MAC value. Then primary and secondary anesthetic agents will be exchanged for display.

18.11 Performing AG Leakage Test

The AG leakage test is required every time before the AG measurement. To perform the AG leakage test, follow this procedure:

1. Plug the AG module into the module rack.
2. Wait for about one minute until the AG module warms up. Completely block the gas inlet of the AG module. Then the alarm message "**AG Airway Occluded**" will appear on the screen.
3. Block the gas inlet for another one minute.
4. Select the **Main Menu** quick key → turn to the third page → from the **System** column select **Maintenance** → input the required password → select ↵.
5. Select the **Module** tab → **AG** tab.
6. Check that the current flow rate is less than 10ml/min, and the alarm message "**AG Airway Occluded**" does not disappear. This indicates that the module does not leak. If the alarm message disappears, or the flow rate is equal to 10ml/min or greater, it indicates that the module leaks. Perform the leakage test again. If the problem remains, contact your service personnel for help.

18.12 Calibrating the AG Module

Calibrate the AG module every year or when the measured value is outside the specification. To calibrate the AG module, contact the service personnel.

CAUTION

- **Connect the gas outlet to the scavenging system when calibrating the AG module.**

18.13 AG Troubleshooting

If the AG airway is occluded, the message "**AG Airway Occluded**" appears. In this case, check for the follows until the message disappears:

1. Check the airway adapter for occlusion and replace if necessary.
2. Check the sample line for occlusion or kinking and replace if necessary.
3. Check the watertrap for water or occlusion. Empty the watertrap, or replace the watertrap if necessary.
4. Check the gas outlet and the exhaust tube for any occlusion.

If the message does not disappear, it is probably the module fault. Contact the service personnel in this case.

NOTE

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

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19 Review

19.1 Review Overview

Trends are patient data collected over time and displayed in graphic, tabular, or other forms to give you a picture of how your patient's condition is developing.

19.2 Review Page

The **Review** page contains tabs to display trend data in tabular, graphic, or other forms.

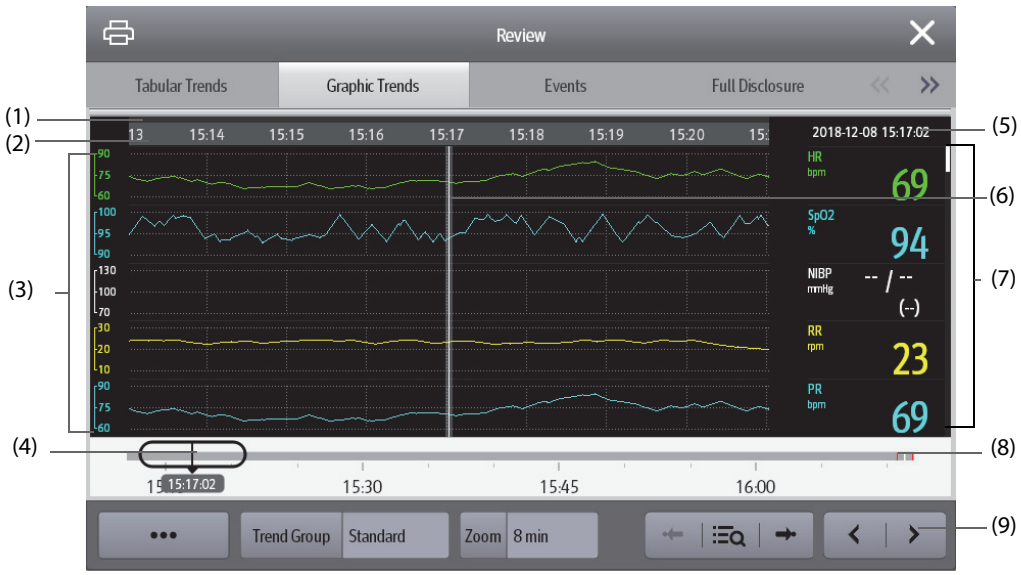
19.2.1 Accessing the Review Page

Choose one of the following methods to enter the review page:

- Select the **Review** quick key.
- Select the **Main Menu** quick key → from the **Review** column select the desired option.

19.2.2 Example Review Page

The review pages have similar structure. We take the graphic trends review page as an example.



(1) Event type indicator: different color blocks match different types of events:

- Red: high priority alarm event
- Yellow: medium priority alarm event
- Cyan: low priority alarm event
- Green: manual event
- White: operation-related event

(2) Current window time line: indicates the time length of the current window. In case of system time change, the question mark "?" is displayed beside the time.

(3) Waveform area: displays trend curves. The color of trend curves is consistent with the color of parameter labels.

(4) Slider: indicates the position of current window time in the entire time length. Dragging this button left or right enables you to locate the trend data at a specific time and also refreshes trend data in current window accordingly.

(5) Event area: displays the event of the cursor time. Selecting the event accesses the event list. If there is no event at the cursor time, the cursor time is displayed.

(6) Cursor

(7) Numeric area: displays numeric values at the cursor indicated time. The background color of numeric values matches the alarm priority.

(8) Time line: indicates the entire time length.

- : indicates the time length of reviewable trend data. can be moved within this time length.
- : indicates the time length of no trend data. cannot be moved within this time length.
- Different color blocks at the time line indicate events of different types. See the color definition for the event type indicator.

(9) Button area.

19.2.3 Symbols on Review Pages

The following table lists the symbols on review pages.

Symbol	Description
	Slider: indicates the position of current window time in the entire time length. Dragging the slider left or right enables you to locate the trend data at a specific time and also refreshes data in current window accordingly.
or	Goes to the previous or next event.
	Event list: displays events in a chronological order. The most recent event is displayed at the top.The number of asterisk symbols before an event matches alarm priority.
	Record button: select it to output patient information and data through the recorder.
	Print button: select it to output patient information and data through the printer.

19.2.4 Common Operations

This section describes common operations for all review pages.

19.2.4.1 Browsing Trend Data

Browse trend data in one of the following ways:

- Move the cursor.
- Move the slider .
- Slide your finger on the screen.

19.2.4.2 Viewing Events

You can view the following types of events:

- Manually triggered events
- Parameter-related operation events and alarm-related events
- Operation events not related to parameters, such as system time change

View events in either of the following ways:

- Select and select the desired event.
- Select or to view the previous or next event.

Events are displayed in a chronological order. The most recent event is displayed at the top. The number of asterisk symbols before and event matches alarm priorities as follows:

- ***: high priority alarm
- **: medium priority alarm
- *: low priority alarm

19.2.5 Tabular Trends Review Page

The tabular trends review page displays trend data in a tabular form.

19.2.5.1 Entering the Tabular Trends Review Page

Choose one of the following methods to enter the **Tabular Trends** review page:

- Select the **Review** quick key → select the **Tabular Trends** tab.
- Select the **Main Menu** quick key → from the **Review** column select **Tabular Trends**.

19.2.5.2 Changing the Trend Group

To change the trend group, follow this procedure:

1. Enter the **Tabular Trends** review page.
2. Set **Trend Group**.

19.2.5.3 Editing the Trend Group

The setting of the **Trend Group** defines the contents of displayed printed trends. To edit the trend group, follow this procedure:

1. Enter the **Tabular Trends** review page.
2. Select **Group Setup** → select the desired tab.

NOTE

- **You cannot edit trend group labeled All or Standard.**
- **ECG parameter and waveform are always displayed in the first row on the trend page. It cannot be deleted or moved.**

19.2.5.4 Changing the Resolution of Trend Data

The interval of tabular trends defines the interval of displaying trend data. Short interval is especially where the clinical situation may change very quickly.

To change the interval of trend data, follow this procedure:

1. Enter the **Tabular Trends** review page.
2. Select **Interval**.
   - **5 sec or 30 sec**: select to view up to 4 hours of tabular trends at an interval of 5 seconds or 30 seconds.
   - **1 min, 5 min, 10 min, 15 min, 30 min, 1 hr, 2 hrs, or 3 hrs**: select to view up to 120 hours of tabular trends at selected interval.
   - Select parameters, such as NIBP, C.O. to view the tabular trends when parameter measurements are acquired.

19.2.5.5 Printing a Tabular Trends Report

To print a tabular trends report, follow this procedure:

1. Enter the tabular trends review page.
2. Select  at the upper left corner of the review page to enter the **Print Setup** menu.
3. Set the tabular trends report as described in *22.6.3 Setting Tabular Trends Reports*.
4. Select **Print**.

19.2.6 Graphics Trends Review Page

The **Graphic Trends** review page displays trend data in a graphic form.

19.2.6.1 Entering the Graphic Trends Review Page

Choose one of the following methods to enter the **Graphic Trends** review page:

- Select the **Review** quick key → select the **Graphic Trends** tab.
- Select the **Main Menu** quick key → from the **Review** column select **Graphic Trends**.

19.2.6.2 Changing the Trend Group

To change the graphic trend group, follow this procedure:

1. Enter the **Graphic Trends** review page.
2. Select ••• and set **Trend Group**.
3. Set **Trend Group**.

19.2.6.3 Editing the Trend Group

The setting of the **Trend Group** defines the contents of displayed and printed trends. To edit the graphic trend group, follow this procedure:

1. Enter the **Graphic Trends** review page.
2. Select ••• → select **Group Setup** → select the desired tab.
3. Select **Group Setup** → select the desired tab.

19.2.6.4 Changing the Resolution of Trend Data

To change the length of trend data displayed on the current screen, follow this procedure:

1. Enter the **Graphic Trends** review page.
2. Select **Zoom**.
   - **8 min:** the screen displays eight minutes of trend data. You can view the recent one hour data.
   - **30 min, 1 hr, 2 hrs, 4 hrs**: the screen displays 30 minutes, one hour, two hours, or four hours of trend data. You can view the recent four hour data.
   - **8 hrs, 12 hrs, 24 hrs, 48 hrs**: the screen displays eight hours, 12 hours, 24 hours, or 48 hours of trend data. You can view the recent 120 hours of data.

19.2.6.5 Changing the Number of Waveforms

To change the number of waveforms displayed on the trend review page, follow this procedure:

1. Enter the **Graphic Trends** review page.
2. Select ••• and set **Trends**.
3. Select **Trends**.

19.2.6.6 Printing a Graphic Trends Report

Before print a graphic trends report, set the **Graphic Trends** report as described in *22.6.3 Setting Tabular Trends Reports*.

To print a **Graphic Trends** report, follow this procedure:

1. Enter the **Graphic Trends** review page.
2. Select  at the upper left corner to enter the **Print Setup** menu.
3. Select **Print**.

19.2.7 Events Review Page

The monitor stores events in real time, including technical alarm events, physiological alarm events, manual events, and operational events. When an event occurs, all the measurement numerics and three event-related waveforms 16 seconds before and after the event are stored.

NOTE

- **A total loss of power has no impact on the events stored.**
- **Alarms are saved as events and will be maintained if the equipment is powered down. The time of equipment power down is not recorded as an event and cannot be reviewed.**
- **Earlier events will be overwritten by later ones if the capacity is reached.**

19.2.7.1 Entering the Events Review Page

Choose one of the following methods to enter the **Events** review page:

- Select the **Review** quick key → select the **Events** tab.
- Select the **Main Menu** quick key → from the **Review** column select **Events**.

The **Events** page displays event list. Events are displayed in descending chronological order. The most recent event is displayed at the top.The number of asterisk symbols before an event indicate alarm priorities.

Different color blocks are displayed on the left of each event to indicate different event types.

- Red: high priority alarm event
- Yellow: medium priority alarm event
- Cyan: low priority alarm event
- Green: manual event
- White: operation-related event

19.2.7.2 Configuring the Filter

You can filter events to facilitate event review.. To configure the filter, follow this procedure:

1. Enter the **Events** page.
2. Select **Filter**. From the drop-down list, select the desired item.

You can customize two criteria. To do so, follow this procedure:

1. From the **Filter** drop-down list, select **Custom 1** or **Custom 2** to enter the **Filter Setup** menu.
2. Select the **Name** field to edit the name of the custom criterion.
3. Select desired items.

If you want to review events happened around certain time, select the  button → set the time → select **OK**. Then the cursor jumps to the event happened closest to the defined time.

19.2.7.3 Editing Events

To edit events, follow this procedure:

1. Enter the **Events** page and tick off the desired events.
2. Select  to edit the selected events.
   - **Lock**: manually lock the event. Locked events cannot be deleted.
   - **Note**: enter comments for the event.

19.2.7.4 Viewing Event Details

To view waveforms and parameter values at the event time, follow this procedure:

1. Enter the **Events** review page.
2. Select **Detail**.

To display beat labels on the first ECG waveform, switch on **Beat Anno:**. The white beat labels indicate heart beats classification and may explain suspected, missed, or false arrhythmia calls. Heart beats are classified as follows:

- N = Normal
- V = Ventricular ectopic
- S = Supraventricular premature
- P = Paced
- L = Learning
- ? = Insufficient information to classify beats
- I = Inoperative (for example, Lead Off)
- M = Missed beat

19.2.7.5 Printing Event Reports

You can print event reports either via a printer or via a recorder.

To do so, follow this procedure:

1. Enter the **Events** review page.
2. Select  at the upper left corner to enter the **Print Setup** menu.
3. Select the desired options.
   - **Print All Event List**: print the entire event list.
   - **Print List of Selected Events**: print the list of selected events.
   - **Print Detail of Selected Events**: print the details of selected events.
   - **Print Displayed Event Detail**: print the waveforms and parameters of the currently displayed event.
4. Select **Print**.

To print a report via a recorder, select  .

19.2.8 Full Disclosure Review Page

You can review up to 48-hour waveform data on the **Full Disclosure** review page. You can view both the compressed waveforms, full waveforms and numeric values.

19.2.8.1 Entering the Full Disclosure Review Page

Choose one of the following methods to enter the **Full Disclosure** review page:

- Select the **Review** quick key → select the **Full Disclosure** tab.
- Select the **Main Menu** quick key → from the **Review** column select **Full Disclosure**.

19.2.8.2 Selecting Waveforms

Before reviewing compressed waveforms, you must select waveforms you want to store and display. To store and display the desired waveforms, follow this procedure:

1. Enter the **Full Disclosure** review page.
2. Select  → **Setup** to enter the **Select Waveform** page.
3. Select **Setup** to enter the **Select Waveform** page.
4. Select the **Storage** tab and set the desired waveforms to be stored in the monitor. Select the **Display(Maximum: 3)** tab and set the desired waveforms to be displayed on the **Full Disclosure** page.

NOTE

- **The more waveforms selected in the Storage column, the shorter the waveform storage time. The waveforms may not be stored for 48 hours. Please exert caution when selecting waveforms.**

In case of alarms, the background of compressed waveform block at the alarm time is marked with a special color:

- Red: high alarm priority
- Yellow: medium alarm priority
- Cyan: low alarm priority

19.2.8.3 Setting Scale and Duration

To set the length and size of displayed compressed waveforms, follow this procedure:

1. Enter the **Full Disclosure** review page.
2. Select ●●●, and then select **Scale** to set ECG waveform gain.
3. Select **Duration** to set the length of displayed waveforms.

19.2.8.4 Viewing Details of Compressed Waveforms

To view the full waveforms and numeric values, follow this procedure:

1. Enter the **Full Disclosure** review page.
2. Select **Detail**.

You can perform the following operations on the this page:

- Switch on **Beat Anno:**. For more information, see *19.2.7.4 Viewing Event Details*.
- Select ●●● and set **Speed** and **ECG Gain**, or **Save As Event**.
- Select **Overview** to switch to the compressed waveform page.

19.2.8.5 Printing the Full Disclosure Waveform Report

To print a compressed waveform report, follow this procedure:

1. Enter the **Full Disclosure** review page.
2. Select  and set the time range for printing.
3. Select **Print**.

19.2.9 12-Lead ECG Review Page

When 12-lead ECG analysis is performed, you can review the most recent 20 events of 12-lead analysis. For more information, see *10 Resting 12-Lead ECG Analysis*.

19.2.9.1 Entering the 12-Lead Review Page

Choose one of the following methods to enter the 12-lead ECG review page:

- Upon completion of 12-lead ECG analysis, select **Review** from the **12-Lead Interpretation** screen. For more information, see *10 Resting 12-Lead ECG Analysis*.
- Select the **Review** quick key → select **12-Lead ECG**.
- Select the **Main Menu** quick key → from the **Review** column select **12-Lead ECG**.

19.2.9.2 Setting 12-Lead ECG Waveforms

To set the 12-lead ECG waveforms on the review page, follow this procedure:

1. Enter the 12-lead review page.
2. Set **Speed**, **Gain**, and **Layout**.

19.2.9.3 Printing the 12-Lead ECG Report

To print the 12-Lead ECG report, follow this procedure:

1. Enter the 12-lead review page.
2. Select  .

19.2.10 ST Review Page

When ST analysis is enabled, the monitor saves ST segments and values at an interval of one minute. You can review the latest 120 hours of ST data.

19.2.10.1 Entering the ST Review Page

Choose either of the following methods to enter the ST review page:

- Select the **Review** quick key → select the **ST** tab.
- Select the **Main Menu** quick key → from the **Review** column select **ST**.

19.2.10.2 Setting the ST Reference

You can set the currently displayed ST as reference. To do so, follow this procedure:

1. Enter the ST review page.
2. Select **Set Reference**.

NOTE

- **The ST baseline is used as ST reference by default.**

19.2.10.3 Displaying/Hiding the ST Reference

To display or hide ST reference, follow this procedure:

1. Enter the ST review page.
2. Select **Display Reference** or **Hide Reference**.

19.2.10.4 Displaying/Hiding Markers

To display or hide markers, follow this procedure:

1. Enter the ST review page.
2. Select **Display Marker** or **Hide Marker**.

19.2.10.5 Printing ST Data

To print ST data, follow this procedure:

1. Enter the ST review page.
2. Select  .

19.3 Reviewing Discharged Patients

For discharged patients, you can review the trend data in the review page. You can also review the events and 12-lead ECG analysis results.

19.3.1 Checking the Data of a Discharged Patient

1. Access the **Discharged Patients** dialog box by either of the following ways:
   - Select the **Discharged Patients** quick key.
   - Select the **Main Menu** quick key → from the **Patient Management** column select **Discharged Patients**.
2. From the patient list select the desired patient.
3. Select **Detail**.

19.3.2 Checking the Information of a Discharged Patient

1. Access the **Discharged Patients** dialog box by either of the following ways:
   - Select the **Discharged Patients** quick key.
   - Select the **Main Menu** quick key → from the **Patient Management** column select **Discharged Patients**.
2. From the patient list select the desired patient.
3. Select **Detail**.
4. Select  to enter the **Patient Management** dialog box.
5. Select **OK** to exit the **Patient Management** dialog box.

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20 Calculation

20.1 Calculation Overview

The monitor provides calculation functions. The calculated values, which are not directly measured, are computed based on the values you provide. The calculation feature is independent of other monitoring functions and can be therefore used for patients being monitored by other monitors. Any operation in a calculation window does not affect the patient monitored by the current monitor.

You can perform the following calculations:

- Drug calculations
- Hemodynamic calculations
- Oxygenation calculations
- Ventilation calculations
- Renal calculations

20.2 Calculation Safety Information

WARNING

- **Decisions on the choice and dosage of drugs administered to patients must always be made by the physician in charge. The drug calculations are based on the values input, it does not check the plausibility of the calculation performed.**
- **Check that the entered values are correct and the calculated values are appropriate. We assume no responsibility for any consequences caused by wrong entries and improper operations.**

20.3 Drug Calculations

The monitor provides the drug calculation function.

20.3.1 Performing Drug Calculations

To perform drug calculations, follow this procedure:

1. Access drug calculator by either of the following ways:
   - Select the **Calculations** quick key.
   - Select the **Main Menu** quick key → from the **Calculations** column select **Drug**.
2. Set **Drug Name.** If the dose of drug is weight dependent, you must input the patient's weight. The dose calculation program has a library of commonly used drugs, of which Drug A through Drug E are user defined.
3. Enter the known values, for example **Drug Amount** and **Solution Volume.**
4. Select **Calculate**. The calculated values are indicated by red arrows.

NOTE

- **If available, the patient category and weight from the Patient Demographics menu are automatically entered when you first access drug calculation. You can change the patient weight. This will not change the patient category and weight stored in the patient demographic information.**

20.3.2 Checking the Titration Table

The titration table shows information on the currently used drugs. Use the titration table to see what dose of a drug your patient will receive at different infusion rates. To access the titration table, follow this procedure:

1. Access drug calculator by either of the following ways:
   - Select the **Calculations** quick key.
   - Select the **Main Menu** quick key → from the **Calculations** column select **Drug**.
2. Select the **Titration Table** tab.
3. Select **Dose Type** to set the type of dose unit in the titration table.
4. Select **Interval** to set the interval between two adjacent titration table items.

You can select how to display the titration table:

- **Dose**: the titration table is listed in the sequence of increased drug dose.
- **Infusion Rate**: the titration table is listed in the sequence of increased infusion rate. Normally the resolution of the infusion rate is one (1). By selecting **Exact Rate** the resolution of the infusion rate can reach 0.01 so that you can display the infusion rate more accurately.

20.3.3 Drug Calculation Formula

Description	Unit	Formula
Dose	Dose/hr Dose/min	Dose = Infusion Rate × Concentration
Dose (weight based)	Dose/kg/hr Dose/kg/min	Dose (weight based) = Infusion Rate × Concentration/ Weight
Drug Amount	g series: mcg, mg, g unit series: Unit, KU, MU mEq series: mEq	Drug Amount =Dose × Duration
Drug Amount (weight based)	g series: mcg, mg, g unit series: Unit, KU, MU mEq series: mEq	Drug Amount (weight based) = Dose × Duration × Weight
Duration	hr	Duration = Amount/Dose
Duration (weight based)	hr	Duration (weight based) = Amount/(Dose × Weight)
Concentration	mcg/ml, mg/ml, g/ml, Unit/ml, KU/ml, MU/ml, mEq/ml	Concentration = Drug Amount/Solution Volume
Solution volume	ml	Volume = Infusion Rate × Duration
Infusion rate	ml/hr	Infusion Rate = Dose/Concentration
Infusion rate (weight based)	g•ml/hr	Infusion Rate = Dose × Weigh/Concentration

20.3.4 Titration Table Calculation Formula

Description	Unit	Formula
Infusion Rate	ml/hr	Infusion Rate = Dose/Concentration
Infusion Rate (weight based)	ml/hr	Infusion Rate = Weight × Dose/Concentration
Dose	Dose/hr Dose/min	Dose = Infusion Rate × Concentration
Dose (weight based)	Dose/kg/hr Dose/kg/min	Dose (weight based) = INF Rate × Concentration/ Weight

20.4 Hemodynamic Calculations

The monitor provides the hemodynamic calculation function. The monitor can save the results of up to 10 calculations, which are displayed in groups.

20.4.1 Performing Hemodynamic Calculations

To perform hemodynamic calculation, follow this procedure:

1. Access hemodynamic calculation by either of the following ways:
   - Select the **Calculations** quick key → **Hemodynamics** tab.
   - Select the **Main Menu** quick key → from the **Calculations** column select **Hemodynamics**.
2. Enter the known values. For a patient who is being monitored, the currently measured values are automatically taken.
3. Select **Calculate**.

   The calculated value greater than the normal upper limit is indicated by an up arrow "↑". The calculated value lower than the normal lower limit is indicated by a down arrow "↓".

You can select **Range** to show the normal range of each parameter.

20.4.2 Input Parameters for Hemodynamic Calculations

Input Parameter	Label	Unit
cardiac output	C.O.	L/min
heart rate	HR	bpm
pulmonary artery wedge pressure	PAWP	mmHg
artery mean pressure	PMAP	mmHg
pulmonary artery mean pressure	PA Mean	mmHg
central venous pressure	CVP	mmHg
end-diastolic volume	EDV	ml
height	Height	cm
weight	Weight	kg

NOTE

- **If you enable Use PA-D as PAWP, PA-D value will be used to replace PAWP value for hemodynamic calculation. For more information, refer to *15.6.8 Setting the Use PA-D as PAWP Switch*.**

20.4.3 Calculated Parameters and Formulas for Hemodynamic Calculations

Calculated Parameters	Label	Unit	Formula
cardiac index	C.I.	$L/min/m^2$	C.I. ($L/min/m^2$) = C.O. (L/min)/BSA (m^2)
body surface area	BSA	m^2	BSA (m^2) = $Wt^{0.425}$ (kg) × $Ht^{0.725}$ (cm) × 0.007184
stroke volume	SV	ml	SV (ml) = 1000× C.O. (L/min)/HR (bpm)
stroke index	SVI	ml/m^2	SVI (ml/m^2) = SV (ml)/BSA (m^2)
systemic vascular resistance	SVR	DS/cm^5	SVR (DS/cm^5) = 79.96 × [PAMAP (mmHg) - CVP (mmHg)]/C.O. (L/min)
systemic vascular resistance index	SVRI	$DS•m^2/cm^5$	SVRI ($DS•m^2/cm^5$) = SVR (DS/cm^5) × BSA (m^2)

Calculated Parameters	Label	Unit	Formula
pulmonary vascular resistance	PVR	DS/cm^5	P VR (DS/cm^5) = 79.96 × [PAMAP (mmHg) - PAWP (mmHg)]/C.O. (L/min)
pulmonary vascular resistance index	PVRI	$DS•m^2/cm^5$	PVRI ($DS•m^2/cm^5$) = PVR (DS/cm^5)× BSA (m^2)
left cardiac work	LCW	kg•m	LCW (kg•m) = 0.0136 × PAMAP (mmHg) × C.O. (L/min)
left cardiac work index	LCWI	$kg•m/m^2$	LCWI ($kg•m/m^2$) = LCW (kg•m)/BSA (m^2)
left ventricular stroke work	LVSW	g•m	LVSW (g•m) = 0.0136 × PAMAP (mmHg) × SV (ml)
left ventricular stroke work index	LVSWI	$g•m/m^2$	LVSWI ($g•m/m^2$) = LVSW (g.m)/BSA (m^2)
right cardiac work	RCW	kg•m	R CW (kg•m) = 0.0136 × PAMAP (mmHg) × C.O. (L/min)
right cardiac work index	RCWI	$kg•m/m^2$	R CWI ($kg•m/m^2$) = RCW (kg.m)/BSA (m^2)
right ventricular stroke work	RVSW	g•m	R VSW (g•m) = 0.0136 × PAMAP (mmHg) × SV (ml)
right ventricular stroke work index	RVSWI	$g•m/m^2$	R VSWI ($g•m/m^2$) = RVSW (g•m)/BSA (m^2)
ejection fraction	EF	%	EF (%) = 100 × SV (ml)/EDV (ml)
End-diastolic volume index	EDVI	ml/m2	EDVI (ml/m^2) = EDV (ml)/BSA (m^2)
End-systolic Volume	ESV	ml	ESV (ml) = EDV (ml) –SV (ml)
End-systolic Volume index	ESVI	ml/m^2	ESVI (ml/m^2) = ESV (ml)/BSA (m^2)

20.5 Oxygenation Calculations

The monitor provides the oxygenation calculation function. The monitor can save the results of up to 10 calculations, which are displayed in groups.

20.5.1 Performing Oxygenation Calculations

To perform oxygenation calculations, follow this procedure:

1. Access oxygenation calculation by either of the following ways:
   - Select the **Calculations** quick key → **Oxygenation** tab.
   - Select the **Main Menu** quick key → from the **Calculations** column select **Oxygenation**.
2. Enter the known values. For a patient who is being monitored, the currently measured values are automatically taken.
3. Select **Calculate**.

   The calculated value greater than the normal upper limit is indicated by an up arrow "↑". The calculated value lower than the normal lower limit is indicated by a down arrow "↓".

In the **Oxygenation** page, you can also perform the following operations:

- Select **OxyCont Unit**, **Hb Unit**, and **Pressure Unit**. Then corresponding parameter values will be automatically converted and updated accordingly.
- Select **Range** to show the normal range of each parameter.

20.5.2 Input Parameters for Oxygenation Calculations

Input Parameter	Label	Unit
cardiac output	C.O.	L/min
percentage fraction of inspired oxygen	FiO_2	%
partial pressure of oxygen in the arteries	PaO_2	mmHg, kPa
partial pressure of carbon dioxide in the arteries	$PaCO_2$	mmHg, kPa
arterial oxygen saturation	SaO_2	%
partial pressure of oxygen in venous blood	PvO_2	mmHg, kPa
venous oxygen saturation	SvO_2	%
hemoglobin	Hb	g/L, g/dl, mmol/L
respiratory quotient	RQ	None
atmospheric pressure	ATMP	mmHg, kPa
height	Height	cm, inch
weight	Weight	kg, lb

20.5.3 Calculated Parameters and Formulas for Oxygenation Calculations

Calculated Parameters	Label	Unit	Formula
body surface area	BSA	m^2	BSA (m^2) = $Wt^{0.425}$ (kg) × $Ht^{0.725}$ (cm) × 0.007184
oxygen consumption	VO_2	ml/min	VO_2 (ml/min) = C(a-v)O_2 (ml/L)× C.O. (L/min))
arterial oxygen content	CaO_2	ml/L, ml/dL	CaO_2 (ml/L) = 10× (0.0134 × Hb (g/dl) × SaO_2 (%)) +0.031× PaO_2 (mmHg)
venous oxygen content	CvO_2	ml/L, ml/dL	CvO_2 (ml/L) = 10× (0.0134 × Hb (g/dl) × SvO_2 (%)) +0.031 × PvO_2 (mmHg)
arteriovenous oxygen content difference	C(a-v)O_2	ml/L, ml/dl	C(a-v)O_2 (ml/L) = CaO_2 (ml/L) - CvO_2 (ml/L)
oxygen extraction ratio	O_2ER	%	O_2ER (%) = 100×C(a-v)O_2 (ml/L)/CaO_2 (ml/L)
oxygen transport	DO_2	ml/min	DO_2(ml/min) = C.O. (L/min) × CaO_2(ml/L)
partial pressure of oxygen in the alveoli	PAO_2	mmHg, kPa	PAO_2 (mmHg) = [ATMP (mmHg) - 47 mmHg] × FiO_2 (%)/100 - $PaCO_2$ (mmHg) × [FiO_2 (%)/100 + (1 - FiO_2 (%)/100)/RQ]
alveolar-arterial oxygen difference	$AaDO_2$	mmHg, kPa	$AaDO_2$ (mmHg) = PAO_2 (mmHg) - PaO_2 (mmHg)
capillary oxygen content	CcO_2	ml/L, ml/dl	CcO_2 (ml/L) = Hb (g/L) × 1.34 + 0.031 × PAO_2 (mmHg)
venous admixture	QS/QT	%	QS/QT (%) = 100× [1.34 × Hb (g/L) × (1 - SaO2 (%)/100) + 0.031 × (PAO2 (mmHg) - PaO2 (mmHg))]/[1.34 × Hb (g/L) × (1 - SvO2 (%)/100) + 0.031× (PAO2 (mmHg) - PvO2 (mmHg))]
oxygen transport index	DO_2I	ml/min/m^2	DO2I (ml/min/m^2) = CaO2 (ml/L) × (C.O. (L/min)/ BSA (m^2))
oxygen consumption	VO_2I	ml/min/m^2	VO2I (ml/min/m^2) = C (a-v) O2 (ml/L) ×(C.O. (L/ min)/BSA (m^2))

20.6 Ventilation Calculations

The monitor provides the ventilation calculation function. The monitor can save the results of up to 10 calculations, which are displayed in groups.

20.6.1 Performing Ventilation Calculations

To perform ventilation calculations, follow this procedure:

1. Access ventilation calculation by either of the following ways:
   - Select the **Calculations** quick key → **Ventilation** tab.
   - Select the **Main Menu** quick key → from the **Calculations** column select **Ventilation**.
2. Enter the known values. For a patient who is being monitored, the currently measured values are automatically taken. If the anesthesia machine or ventilator is connected, measured values for ventilation calculation are also automatically taken.
3. Select **Calculate**.

   The calculated value greater than the normal upper limit is indicated by an up arrow "↑". The calculated value lower than the normal lower limit is indicated by a down arrow "↓".

On the **Ventilation** page, you can also perform the following operations:

- Select **Pressure Unit**. Then corresponding parameter values will be automatically converted and updated accordingly.
- Select **Range** to show the normal range of each parameter.

20.6.2 Input Parameters for Ventilation Calculations

Input Parameter	Label	Unit
percentage fraction of inspired oxygen	FiO_2	%
respiration rate	RR	rpm
partial pressure of mixed expiratory CO2	$PeCO_2$	mmHg, kPa
partial pressure of carbon dioxide in the arteries	$PaCO_2$	mmHg, kPa
partial pressure of oxygen in the arteries	PaO_2	mmHg, kPa
tidal volume	TV	ml
respiratory quotient	RQ	None
atmospheric pressure	ATMP	mmHg, kPa

20.6.3 Calculated Parameters and Formulas for Ventilation Calculations

Calculated Parameters	Label	Unit	Formula
partial pressure of oxygen in the alveoli	PAO_2	mmHg, kPa	PAO_2 (mmHg) = [ATMP (mmHg) - 47 mmHg] × FiO_2 (%)/100 - $PaCO_2$ (mmHg) × [FiO_2(%)/100 + (1 - FiO_2 (%)/100)/RQ]
alveolar-arterial oxygen difference	$AaDO_2$	mmHg, kPa	$AaDO_2$ (mmHg) = PAO_2 (mmHg) - PaO_2 (mmHg)
oxygenation ratio	Pa/FiO_2	mmHg, kPa	Pa/FiO_2(mmHg) = 100 × PaO_2 (mmHg)/FiO_2 (%)
arterial to alveolar oxygen ratio	a/AO_2	%	a/AO_2 (%) = 100 × PaO_2 (mmHg)/PAO_2 (mmHg)
minute volume	MV	L/min	MV (L/min) = [TV (ml) × RR (rpm)]/1000
volume of physiological dead space	Vd	ml	Vd (ml) = TV (ml) × [1 - $PeCO_2$ (mmHg)/$PaCO_2$ (mmHg)]

Calculated Parameters	Label	Unit	Formula
physiologic dead space in percent of tidal volume	Vd/Vt	%	Vd/Vt (%) = 100 × Vd (ml)/TV (ml)
alveolar volume	VA	L/min	VA (L/min) =[TV (ml) - Vd (ml)] × RR (rpm)/1000

20.7 Renal Calculations

The monitor provides the renal calculation function. The monitor can save the results of up to 10 calculations, which are displayed in groups.

20.7.1 Performing Renal Calculations

To perform renal calculations, follow this procedure:

1. Access renal calculation by either of the following ways:
   - Select the **Calculations** quick key → select the **Renal** tab.
   - Select the **Main Menu** quick key → from the **Calculations** column select **Renal**.
2. Enter the known values.
3. Select **Calculate**.

   The calculated value greater than the normal upper limit is indicated by an up arrow "↑". The calculated value lower than the normal lower limit is indicated by a down arrow "↓".

You can select **Range** to show the normal range of each parameter.

20.7.2 Calculated Parameters and Formulas for Renal Calculations

Input Parameter	Label	Unit
urine pstassium	URK	mmol/L
urinary sodium	URNa	mmol/L
urine	Urine	ml/24 hrs
plasm osmolality	Posm	mOsm/kgH_2O
urine osmolality	Uosm	mOsm/kgH_2O
serum sodium	SerNa	mmol/L
creatinine	Cr	μmol/L
urine creatinine	UCr	μmol/L
blood urea nitrogen	BUN	mmol/L
height	Height	cm
weight	Weight	kg

20.7.3 Calculated Parameters and Formulas for Renal Calculations

Calculated Parameters	Label	Unit	Formula
urine sodium excretion	URNaEx	mmol/24 hrs	URNaEx (mmol/24 hrs) = Urine (ml/24 hrs) × URNa (mmol/L)/1000
urine potassium excretion	URKEx	mmol/24 hrs	URKEx (mmol/24 hrs) = Urine (ml/24 hrs) × URK (mmol/L)/1000
sodium potassium ratio	Na/K	%	Na/K (%) = 100 × URNa (mmol/L)/URK (mmol/L)
clearance of sodium	CNa	ml/24 hrs	CNa (ml/24 hrs) = URNa (mmol/L) × Urine (ml/24 hrs)/SerNa (mmol/L)
creatinine clearance rate	Clcr	ml/min	Clcr (ml/min) = Ucr (µmol/L) × Urine (ml/24 hrs)/[Cr (µmol/L) × (BSA (m^2)/1.73) × 1440]
fractional excretion of sodium	FENa	%	FENa (%) = 100 × URNa (mmol/L) × Cr (µmol/L)/[SerNa (mmol/L) × Ucr (µmol/L)]
osmolar clearance	Cosm	ml/min	Cosm (ml/min) = Uosm (mOsm/kgH_2O) × Urine (ml/24 hrs)/(Posm (mOsm/kgH_2O) × 1440)
free water clearance	CH2O	ml/hr	CH2O (ml/hr) = Urine (ml/24 hrs) × [1 - Uosm (mOsm/kgH_2O)/Posm (mOsm/kgH_2O)]/24
urine to plasma osmolality ratio	U/P osm	None	U/P osm = Uosm (mOsm/kgH_2O)/Posm (mOsm/kgH_2O)
blood urea nitrogen creatinine ratio	BUN/Cr*	Mmol/L	BUN/Cr = 1000 × BUN (mmol/L)/Cr (µmol/L)
urine-serum creatinine ratio	U/Cr	None	U/Cr (mmol/L) = Ucr (µmol/L)/Cr (µmol/L)

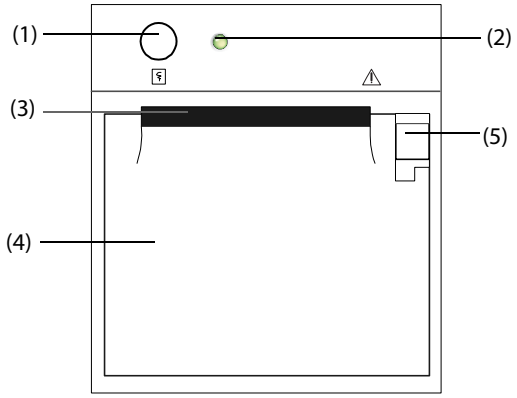
*: BUN/Cr is a ratio at mol unit system.

21 Recording

21.1 Recorder

The thermal recorder records patient information, measurement data, and up to three waveforms.

The monitor is configured with a built-in recorder.



(1) Start/Stop key: press to start a recording or stop the current recording.

(2) Module status indicator

- On: when the recorder works correctly.
- Off: when the monitor is switched off.
- Flashes: if an error occurred to the recorder.

(3) Paper outlet

(4) Recorder door

(5) Latch: pull it backward to open the recorder door.

21.2 Starting Recordings

Recordings can be started manually or automatically.

21.2.1 Manually Starting Recordings

To manually start a recording, you can either:

- Press the hardkey on the front of the recorder.
- Select on the current page.

21.2.2 Automatic Recordings

In the following conditions, you can set the recorder to automatically start recording:

- At a preset interval. For more information, see *21.5 Setting the Recorder*.
- When a parameter alarm is triggered. For more information, see *21.6 Enabling Auto Recording on Alarm*.

21.3 Stopping Recordings

Recordings can be stopped manually or automatically.

21.3.1 Stopping Recordings Manually

To manually stop a recording, choose either of the following method:

- Press the hardkey again.
- Select **Clear All Record Tasks** in the **Record Setup** menu.

21.3.2 Stopping Recordings Automatically

Recordings stop automatically in the following conditions:

- The recording is completed.
- The recorder runs out of paper.
- The recorder has an alarm condition.

21.4 Recording Related Flags

You can find the following flags on the recording reports:

- For automatically stopped recordings, there are two columns of asterisks "*" at the end of the report.
- For manually or abnormally stopped recordings, there is one column of asterisks "*" at the end of the report.

21.5 Setting the Recorder

To set the recorder, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **Record Setup**.
2. In the **Record Setup** menu, select the desired waveform for **Waveform 1**, **Waveform 2** and **Waveform 3** in turn. The recorder can record up to 3 waveforms at a time.
3. Switch on or off **IBP Overlap** to enable or disable IBP recordings in the overlapping format.
   - When the **IBP Overlap** is enabled: If two or more waveforms in the selected waveforms for recording are IBP waveforms, the IBP waveforms will be recorded in the overlapping format.
   - When the **IBP Overlap** is disabled: IBP waveforms will be recorded normally.
4. Select **Recording Duration** to set the duration of real-time recording.
5. Select **Interval** to set the time interval for automatic recording.
6. Select **Recorder Paper Speed** to set the speed for recording waveforms.

21.6 Enabling Auto Recording on Alarm

To initiate automatic recording via recorder when a parameter alarm is triggered, follow this procedure:

1. Access the **Alarm** menu for the desired parameter in one of the following ways:
   - Select the **Alarm Setup** quick key at the bottom of the screen.
   - Select the numerics area or waveform area of the desired parameter → select the **Alarm** tab.
   - Select the **Parameters Setup** quick key → select the desired parameter → select the **Alarm** tab.
2. Switch on **Alarm Outputs**.

NOTE

- **Auto recording on alarm happens only when Print on Alarm is set to Recorder. For more information, see *24.4.6 The Other Tab*.**

21.7 Clearing Recording Tasks

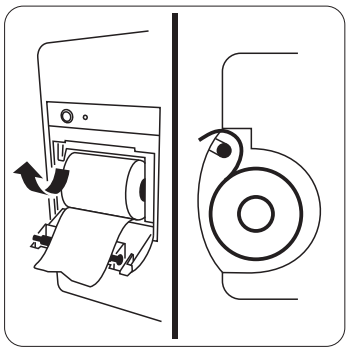
To clear recording tasks, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **Record Setup**.
2. In the **Record Setup** menu, select **Clear All Record Tasks**. This clears all queued recording tasks and stops the current recording.

21.8 Loading Paper

To load paper, follow this procedure:

1. Use the latch at the upper right of the recorder door to pull the door open.
2. Insert a new roll into the compartment as shown below. Feed the paper through and pull some paper out from the top of the roller.
3. Close the recorder door.



CAUTION

- **Use only specified thermal paper. Otherwise, it may cause damage to the recorder's printhead, the recorder may be unable to print, or poor print quality may result.**
- **Never pull the recorder paper with force when a recording is in process. Otherwise, it may cause damage to the recorder.**
- **Do not leave the recorder door open unless you reload paper or remove troubles.**

21.9 Removing Paper Jam

If the recorder works incorrectly or produces unusual sounds, check if there is a paper jam first. If a paper jam is detected, follow this procedure to remove it:

1. Open the recorder door.
2. Take out the paper and tear off the draped part.
3. Reload the paper and close the recorder door.

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22 Printing

The monitor can output patient reports via network printer or printer server.

22.1 Supported Printer

The monitor supports the following printer:

- HP LaserJet Pro M202dw
- HP LaserJet Enterprise M605
- HP LaserJet P4015n
- HP LaserJet Pro 400 M401n
- HP LaserJet 600 M602
- HP LaserJet Enterprise M608

NOTE

- **For more details about the printer, see the document accompanying the printer. With product upgrades, the monitor may support more printers and no prior notice will be given. If you have any doubt about the printer you have purchased, contact Mindray.**

22.2 End Case Reports

22.2.1 Printing the End Case Report

To print the end case report, choose one of the following ways:

- Select **Print** from the **End Case Report** menu.
- Select **Print End Case Report** when you discharge a patient
- Select the **End Case Report** quick key.

22.2.2 Setting a Report as An End Case Report

The following reports can be set as end case reports:

- Tabular Trends Report
- Graphic Trend Report
- Event Report
- 12-lead Interpretation
- Alarm Limits Report
- Realtime Report
- ECG Report

To set a report as an end case report, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **End Case Report**.
2. From the **Select Reports** page, select the checkbox before the desired report, for example **ECG Report**.

22.2.3 Setting the End Case Report

To set the end case report, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **End Case Report**.
2. From the **Report Setup** page, set the following end case reports:
   - Select the **Tabular Trends Report**, **Graphic Trends Report**, **Realtime Report**, and **ECG Report** tab, and set these end case report by referring to section *22.7 Viewing Printer Status*.
   - Select the **Event Report** tab, and select the event that needs to be printed.
   - Select the **12-Lead Interpretation** tab, and set the switch of **Median Complex**, **Measurements**, **Interpretation**, or **Interpretation Summary**. For other settings, refer to section *22.7 Viewing Printer Status*.

22.2.4 Setting the End Case Report Period

To set the end case report print period, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **End Case Report**.
2. From the **Select Reports** page, set the **Period**.

NOTE

- **End case report print period is calculated from the patient discharged time to the configured period.**
- **Period setting is applicable to all the end case report.**

22.3 Manually Starting a Printing Task

You can start a printing task manually.

22.3.1 Starting Printing from the Current Page

From the current page, select the  button, if available, to start printing.

22.3.2 Printing Realtime Reports

Select  to print a realtime report. You can also print a realtime report from the **Report Setup** page. For more information, see *22.3.3 Printing Normal Reports*.

22.3.3 Printing Normal Reports

Normal reports refer to the following types of reports:

- ECG Report
- Realtime Report
- Tabular Trends Report
- Graphic Trend Report.

To print normal reports, follow this procedure:

1. Select the **Main Menu** quick key →from the **Report** column select **Report Setup**.
2. Select the desired report tab.
3. Check the settings.
4. Select **Print**.

22.4 Automatically Printing Reports

When a parameter alarm switch is set to on and an alarm is triggered for this parameter, you can set a printer to start alarm printing automatically.

To do so, follow this procedure:

1. Access alarm related tabs such as the **Alarm** tab for a parameter in one of the following ways:
   - Select the **Alarm Setup** quick key.
   - Select the parameter or waveform area of the desired parameter → select the **Alarm** tab.
   - Select the **Parameters Setup** quick key at the bottom of the screen → select the desired parameter → select the **Alarm** tab.
2. Switch on **Alarm Outputs** for desired parameters.

22.5 Stopping a Printing Task

To stop a printing task, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **Print Queue**.
2. Select desired printing tasks and then select **Delete**. Selecting **Delete All** to stop all the printing tasks.

22.6 Setting Reports

This section focuses on how to set ECG reports, realtime reports, tabular trends reports, and graphic trends reports.

22.6.1 Setting ECG Reports

To set ECG reports, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **Report Setup**.
2. Select **ECG Report**.
3. Set the desired options. The following table only lists some of the options.

Menu item	Function	Description
Speed	Set the print speed of ECG waveforms	25 mm/sec: prints 25 mm of ECG waveform per second. 50 mm/sec: prints 50 mm of ECG waveform per second.
Auto Interval	Defines the spacing between the ECG waveforms on a printout	**On:** automatically adjusts the space between waveforms to avoid overlapping. **Off**: each waveform area has the same size on a printout.
	Note: This setting is only relevant when **12×1** is selected for **12-Lead Format**.	
12-Lead Format	Select the format of 12-lead ECG waveforms on a printout.	**12×1:** displays 12-lead ECG waveforms on one page in one column. **6×2**: displays 12-lead ECG waveforms on one page in two columns, with 6 lines in each column. **6×2+1**: displays 12-lead ECG waveforms on one page in two columns, with 6 lines in each column, and one rhythm lead waveform at the bottom. **3×4+1**: displays 12-lead ECG waveforms on one page in 4 columns, with 3 lines in each column, and one rhythm lead waveform at the bottom. **3×4+3**: displays 12-lead ECG waveforms on one page in 4 columns, with 3 lines in each column, and three rhythm lead waveforms at the bottom.

Menu item	Function	Description
Rhythm Lead 1 Rhythm Lead 2 Rhythm Lead 3	Select the lead that will be used as Rhythm Lead 1, 2, or 3.	I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6
	Note: This setting is only relevant when **6×2+1**,**3×4+1**, or **3×4+3** is selected for **12-Lead Format**.	
Format Sequence	Select the recording method of ECG report generated by auto measurement	**Sequential**: 12-lead ECG data are recorded sequentially and displayed in 3 lines and 4 columns with 2.5 seconds of ECG data for each column. **Simultaneous**: Record simultaneous 12-lead ECG data.

NOTE

- **When Lead Set is set to 3-Lead, ECG report cannot be printed.**

22.6.2 Setting Realtime Reports

To set tabular realtime reports, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **Report Setup**.
2. Select **Realtime Report**.
3. Set the desired options. The following table only lists some of the options.

Menu item	Function	Description
Select Waveform	Select the desired waveform to print	**Current Waveforms**: prints the realtime report for current waveforms. **Selected Waveforms**: prints the realtime report for the selected waveforms.

22.6.3 Setting Tabular Trends Reports

To set tabular trends reports, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **Report Setup**.
2. Select **Tabular Trends Report**.
3. Set the desired options. The following table only list some of the options.

Menu Item	Function	Description
Period	Select the period during which a tabular trends report will be printed.	**Auto**: one page of a tabular trends before the current time will be printed at the selected **Interval**. **All**: all stored tabular rends will be printed at the selected **Interval**. **30 min** to **96 hrs**: 30 min to 96 hrs of tabular trends before the selected **Time** will be printed at the selected **Interval**.
Interval	Select the resolution of the tabular trends printed on a report.	**NIBP**, **C.O.**: at an interval of acquiring the values of selected parameter. **Auto**: using the **Interval** setting of the **Tabular Trends** review page. **5 sec** to **3 hrs**: the tabular trends will be printed at the selected **Interval**.
Report Format	Select the printing principle.	**Parameter Oriented**: parameter values are listed vertically and trend time is listed horizontally.. **Time Oriented**: trend time is listed vertically and parameter values are listed horizontally.

22.6.4 Setting Graphic Trends Reports

To set graphic trends reports, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select Report Setup.
2. Select the **Graphic Trends Report** tab.
3. Set the desired options.

Menu Item	Function	Description
Period	Select the period during which a graphic trends report will be printed.	**Auto**: one page of a graphic trends before the current time will be printed. **All**: all stored graphic rends will be printed.. **30 min** to **96 hrs**: 30 min to 96 hrs of graphic trends before the selected **Time** will be printed.

22.7 Viewing Printer Status

You can view the status of the recent ten printing tasks in the **Print Queue** window. To view the status of printing tasks, select the **Main Menu** quick key, from the **Report** column select **Print Queue**.

Each printing task includes the following information:

- Print time
- Report title
- Printer name (when using the printer server) or IP address (when using the network printer)
- Printing status, for example, printing, failed, retrying, and waiting.

22.8 Printer Out of Paper

When the printer runs out of paper, the print request will not be responded. If there are too many print jobs that are not responded, a printer error may occur. In these cases, you need to install paper and then re-send the print request. Restart the printer if necessary.

Therefore, you'd better ensure that there is enough paper in the printer before sending a print request.

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23 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.

23.1 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.

23.2 Controlling the Timer

The timer provides the following controls:

- **Start**: starts the timer.
- **Pause**: pauses the timer.
- **Resume**: resumes the timer.
- **Reset**: clears the timer and end this timer episode.

WARNING

- **Do not use the timers to schedule critical patient-related tasks.**

23.3 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.**

24 User Maintenance Settings

User maintenance enables you to customize your equipment to best meet your needs. Accessing the **Maintenance** menu is password protected.

This chapter describes the settings and functions in the **Maintenance** menu.

CAUTION

- **The maintenance settings can only be changed by authorized personnel. Contact your department manager or biomedical engineering department for the passwords used at your facility.**

24.1 Accessing the Maintenance Menu

To perform user maintenance, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select ↵.
2. Select desired tab.

24.2 The Device Location Settings

Menu Item	Default Setting	Description
Monitor Name	/	/
Facility		
Department		
Location	Fixed	• **Fixed**: the **Patient Management** menu displays Bed No. and Room No., but you cannot change them. • **Unfixed**: you can change Bed No. and Room No. from the **Patient Management** menu. Bed No. and Room No. are cleared each time you discharge a patient.
Room No.	/	/
Bed No.		
Auto Obtain Bed No.	Off	**On**: if the monitor is connected to the wired network, the monitor automatically sets the patient's bed number according to the bed number information bonded to the bedside network connector. The Auto Obtain Bed No. function is available only when the switch connected to the monitor supports the LLDP or CDP protocol, and the corresponding protocol is enabled.

24.3 The Patient Management Settings

24.3.1 The Field Tab

Menu Item	Default Setting	Description
Room No	Unselected	Selects which items can be displayed and edited from the **Patient Management** menu.
Visit Number	Unselected	
Patient ID	Selected	
Race	Unselected	
Age	Selected	
Custom Field 1- Custom Field 4	Unselected	

24.3.2 The Discharge Tab

Menu Item	Default Setting	Description
Auto Discharge When Power Off	Never	Automatically discharges the patient when the monitor is turned off for the designated period of time. **Never**: not discharge a patient no matter for how long the monitor has been switched off.
Auto delete discharged patients when storage space is full	On	/
Prompt on patient auto deleted	On	**On**: an alarm is issued when the monitor automatically deletes earlier discharged patients.
Alarm on storage is nearly full	Med	Selects whether an alarm is issued when the monitor memory is very low and the priority of this alarm.
Clear All Patient Data	/	Deletes all patient information and data. Clearing patient data will discharge the current patient.

24.3.3 The Location Tab

Menu Item	Default Setting	Description
Location 1 - Location 10	/	Selects where the patient goes after patient monitoring stops.

24.3.4 The Display Tab

Menu Item	Default Setting	Description
Primary Screen Display Full Name	On	Selects whether patient name is displayed in the patient information area on the primary display.
Remote View Display Full Name	On	Selects whether patient name is displayed in the patient information area on the remote monitors when this monitor is viewed by other monitors.
Remote View Bedlist Display Full Name	On	Defines whether patient name is displayed in beds list on the remote monitors when this monitor is viewed by other monitors.

24.4 The Alarm Settings

24.4.1 The Audio Tab

Menu Item	Default Setting	Description
Minimum Alarm Volume	2	/
Alarm Sound	ISO	Defines the alarm tone pattern to distinguish the heart beat tone, pulse tone, and keystroke tone by frequency.
High Alarm Interval	10 sec	Defines the interval between alarm tones for the ISO mode.
Med Alarm Interval	20 sec	
Low Alarm Interval	20 sec	
Auto Increase Volume	2 Steps	• **2 Steps**: if an alarm is not reset within the designated delay time after the alarm occurs, the alarm volume automatically increases by two levels. • **1 Step**: if an alarm is not reset within the designated delay time after the alarm occurs, the alarm volume automatically increases by one level. • **Off**: if an alarm is not reset within the designated delay time after the alarm occurs, the volume of the alarm tone does not change.
Increase Volume Delay	20 sec	Defines the delay time of alarm volume escalation

NOTE

- **The alarm volume escalation function is not applied to the latched alarms.**
- **The monitor provides the same alarm tone pattern for the remote device alarms as those for your monitor alarms.**

24.4.2 The Pause/Reset Tab

Section	Menu Item	Default Setting	Description
Pauses	Pause	Alarm Pause	Selects the pause function. • **Alarm Pause**: pauses alarms. • **Audio Pause**: pauses alarm tones.
	Pause Time	2 min	Selects the alarm pause time. The alarm pause time can be set to **1 min**, **2 min**, **3 min**, or **Permanent**.
	Pause Priority	All	Selects alarms of what priority can be paused. • **All**: pressing the **Alarm Pause** quick key pauses all alarms. • **Med & Low**: pressing the **Alarm Pause** quick key pauses alarms of medium and low priority. The high priority alarms will not be paused. • **Disabled**: the **Alarm Pause** quick key is disabled.
	Pause 5 min	Off	Selects how long the alarm can be paused if switched on.
	Pause 10 min	Off	
	Pause 15 min	Off	
Alarm Reset	Alarm Light	On When Reset	• **On When Reset**: when the alarm system is reset, the alarm tones of the current alarms are switched off, but the alarm lamp remains flashing. • **Off When Reset**: when the alarm system is reset, both the alarm tone and alarm lamp of the current alarms are switched off.
Reminder Tone	Alarm Reset Reminder	On	Selects the reminder tone rule when the alarm volume is set to zero, or the alarm is reset or switched off. • **On**: the monitor issues reminder tones at a designated interval. • **Re-alarm**: if the alarm condition persists, the alarms marked with "√" will be regenerated after the designated reminder tone interval. • **Off**: the monitor does not issue reminder tones at a designated interval. The alarms marked with "√" will be silenced.
	Alarm Off Reminder	On	• /
	Reminder Interval	5 min	• **10 min**: the monitor issues reminder tones every 10 minutes. • **5 min**: the monitor issues reminder tones every five minutes. • **3 min**: the monitor issues reminder tones every three minutes. • **2 min**: the monitor issues reminder tones every two minutes. • **1 min**: the monitor issues reminder tones every one minute.

24.4.3 The Latching Tab

Menu Item		Default Setting	Description
Lethal	Visible	Unselected	Selects alarm latching rules: • If **Visible** is selected, you can separately latch visual alarm signal. • Latching audible alarm signal simultaneously latches visual signal. • Selecting alarms of lower priority simultaneously latches higher priority alarms.
	Audible		
High	Visible		
	Audible		
Med	Visible		
	Audible		
Low	Visible		
	Audible		

24.4.4 The Remote View Tab

Menu Item	Default Setting	Description
Reset Remote Bed Alarms	Off	Selects whether you can reset alarms occurring to the remote devices from your monitor. **On**: the **Alarm Reset** button appears on the bottom left of the **Remote View** screen.
Alarm Reset By Other Bed	On	**On**: alarms on your monitor can be reset by remote devices.
Alarm Reminder	Visible+Audible	Selects what alarm indicators are necessary for the remote devices. • **Visible+Audible**: the monitor provides visual alarm indication, and continuous audible alarm indication if the alarm persists at the remote device. • **Visible+Single Tone**: the monitor provides visual alarm indication, and a single tone when the alarm occurs at the remote device. • **Visible Only**: the monitor only provides visual alarm indication.
Alarm Priority	All	Selects what priority of remote device alarms are presented for audible notification • **All**: the monitor sounds if an alarm occurs. • **High & Med**: the monitor sounds if a high or medium priority alarm occurs. • **High Only**: the monitor sounds only if a high priority alarm occurs.
Alarm Sound	ISO	Selects the alarm tone pattern for the remote device alarms.
Remote Disconnected Alarm	On	Selects whether an alarm is issued if a remote device is disconnected.

24.4.5 The Nurse Call Tab

Menu Item	Default Setting	Description
Signal Type	Continuous	• **Pulse**: the nurse call signal is a pulse signal and each pulse lasts one second. When multiple alarms simultaneously occur, only one pulse signal is outputted. If an alarm occurs but the previous one is not cleared, a new pulse signal will also be outputted. • **Continuous**: the nurse call signal lasts until the alarm ends. That is to say the duration of a nurse call signal is equal to that of the alarm condition.
Contact Type	Normally Open	Selects the work mode of the nurse call relay
Alarm Priority	High Only	Selects the priority of alarms sent to the nurse call system
Alarm Type	Physiological Only	Selects the type of alarms sent to the nurse call system.
Receive Call Help	On	Receives the calling signal if a monitor in the same department calls for help.

NOTE

- **The call help function works only when the monitor is connected to the network.**
- **The call help sound may disturb patients in the same department.**

24.4.6 The Other Tab

Section	Menu Item	Default Setting	Description
Alarm Priority	ECG Lead Off	Low	Selects the priority of the ECG lead off alarm.
	SpO2 Sensor Off	Low	Selects the alarm level for SpO_2 sensor off alarm.
	IBP No Sensor	Med	Selects the alarm level for IBP No Sensor alarm.
Alarm Delay	Alarm Delay	6 sec	• **1 sec ~15 sec**: for continuously measured parameters, an alarm is not presented if the alarm condition is resolved within the designated delay time. • **Off**: an alarm is always presented. The setting of **Alarm Delay** is not applied to the apnea alarms and the ST alarms.
	ST Alarm Delay	30 sec	The monitor does not present the ST alarm if the alarm condition is resolved within the delay time.

Section	Menu Item	Default Setting	Description
Other	Lethal Arrhy Alarms Off	Disable	Selects whether lethal arrhythmia alarms can be switched off. • **Disable**: lethal arrhythmia alarms cannot be switched off. • **Enable**: lethal arrhythmia alarms can be switched off from the **ECG** menu.
	SPO2 Desat Alarm Off	Disable	Selects whether the SpO_2 Desat alarm can be switched off. • **Disable**: the SpO_2 Desat alarm cannot be switched off. • **Enable**: the SpO_2 Desat alarm can be switched off.
	Apnea Alarm Off	Disable	Selects whether the apnea alarm can be switched off. • **Disable**: the apnea alarm cannot be switched off. • **Enable**: the apnea alarm can be switched off.
	Arrhy Shield Time	2 min	Alarm light and alarm tone will be disabled for designated period of time when certain arrhythmia alarms are detected. **0**: disables this function.
	Intubation Mode Period	2 min	Selects the time for intubation.
	Print on Alarm	Printer	**Printer**: enables automatic printing via printer when a parameter alarm is triggered. **Recorder**: enables automatic recording via recorder when a parameter alarm is triggered.

24.5 The Module Settings

24.5.1 The ECG Tab

Menu Item	Default Setting	Description
ECG Standard	AHA	Selects the ECG standard according to the leadwires you are using.
QTc Formula	Hodges	Selects the QTc formula used to correct the QT interval for heart rate. • **Hodges**: $QTc = QT + 1.75 \times (HearRate - 60)$ • **Bazett**: • $QTc = QT \times \left(\frac{HearRate}{60}\right)^{\frac{1}{2}}$ • **Fridericia**: $QTc = QT \times \left(\frac{HeartRate}{60}\right)^{\frac{1}{3}}$ • **Framingham**: $QTc = QT + 154 \times \left(1 - \frac{60}{HeartRate}\right)$
12-Lead Order	No	Selects whether to send the order of 12-lead interpretation report to the hospital information system while saving the report.
Calibration	/	Select this button to calibrate the ECG module.

24.5.2 The CO_2 Tab

Menu Item	Default Setting	Description
Zero Recovery For 30s	On	After the zero calibration is completed, the CO_2 module reacquires the CO_2 readings. • **On**: During the reacquisition period, "**Zero Recovering**" is displayed in the CO_2 numeric area. • **Off**: During the reacquisition period, "**Zero Recovering**" is not displayed in the CO_2 numeric area.
Zero	/	Select this button to start zeroing the CO_2 module.

24.5.3 The AG Tab

Menu Item	Default Setting	Description
Zero Recovery For 30s	On	After the zero calibration is completed, the AG module reacquires the AG readings. • **On**: During the reacquisition period, "**Zero Recovering**" is displayed in the AG numeric area. • **Off**: During the reacquisition period, "**Zero Recovering**" is not displayed in the AG numeric area.
Types of Gas Measurement	All	Selects what gases are detected. If any gas is deselected, it will not be displayed or used for calculating the MAC value. When the concentration of the unselected gas is equal to or greater than 1%, you will be prompted to select the gas to enable the measurement (**Set XX measurement to On**).
Zero	/	Select this button to start zeroing the AG module.

24.5.4 The Other Tab

Menu Item	Default Setting	Description
IBP Filter	12.5 Hz	/
PAWP Timeout	15 min	The measurements become outline fonts after a preset time. This avoids older values being misinterpreted as current measurements.
C.O. Timeout	15 min	
NIBP Timeout	15 min	
CO2 Flow Rate (for Sidestream CO_2 Module Without O_2)	90 ml/min	Selects flow rate when using the sidestream CO_2 without the O_2 monitoring function.
Outline Font for Suspected Values	Off	Selects whether unreliable HR and SpO_2 measurements are displayed in outline font. This prevents unreliable measurements from being misinterpreted as normal measurements,

24.6 The Review Settings

24.6.1 The Tabs Tab

Menu Item	Default Setting	Description
Tabular Trends	Selected	Hides the trends you do not need to review if deselected.
Graphic Trends		
Events		
Full Disclosure		
12-Lead ECG		
ST		

24.6.2 The Event Tab

Menu Item		Default Setting	Description
Lethal	Lock	Selected	Selects what kind of events will be locked. Locked events will not be deleted.
High		Unselected	
Med			
Low			
Rename Event		On	Selects whether arrhythmia events can be renamed.

24.6.3 The Arrhy Mark Tab

From the **Arrhy Mark** page, you can define whether the compressed ECG waveform segments for arrhythmia events are marked with a specific background color.

24.7 The Print Settings

24.7.1 The Printer Tab

Menu Item	Default Setting	Description
Connection Type	Printer	Selects you want to output patient reports via the print server or a network printer.
Printer IP Address	0.0.0.0	For printer only.
Paper Size	A4	
Printer Resolution	300 dpi	
Print Server Address	/	For print server only.
Print Server IP Address	/	
Port	6603	

Menu Item		Default Setting	Description
General Report (For print server only)	Print Action	Paper	Selects the media of the reports.
	Printer	/	Selects the default printer (for paper report only).
	Printer Resolution	/	Selects the resolution for the default printer (for paper report only).
	PDF Resolution	600 dpi	Selects the resolution for the default printer (for PDF report only).
End Case Report (For print server only)	Print Action	Paper	Selects the media of the reports.
	Printer	/	Selects the default printer (for paper report only).
	Printer Resolution	/	Selects the resolution for the default printer (for paper report only).
	PDF Resolution	600 dpi	Selects the resolution for the default printer (for PDF report only).
Print on Alarm Report (For print server only)	Print Action	Paper	Selects the media of the reports.
	Printer	/	Selects the default printer (for paper report only).
	Printer Resolution	/	Selects the resolution for the default printer (for paper report only).
	PDF Resolution	600 dpi	Selects the resolution for the default printer (for PDF report only).
Print Test Page		/	Tests whether the printer works properly.

NOTE

- **General reports refer to the reports other than the end case report and realtime alarm report.**

24.7.2 The Report Layout Tab

Menu Item	Default Setting	Description
Report Layout	/	Selects the contents and location of the patient information included in non-ECG reports. **N/A**: refers to no information. Patient information configured in the Report Layout page is not applied to ECG reports.

24.7.3 The ECG Report Tab

Menu Item	Default Setting	Description
Patient Name	/	Selects the patient information you want to display on ECG reports.
Age		
Gender		
Patient ID	Selected	
Visit Number	Unselected	
DOB		
Race		
Medication		
Class		
Physician		
Technician		
Department		
Room No		
Bed No		
12-Lead Order		

24.7.4 The PDF File Name Tab

Menu Item	Default Setting	Description
PDF File Name	/	Selects the name of PDF files. **N/A**: refers to no information.

24.7.5 The Other Tab

Menu Item	Default Setting	Description
Second Mark (Printer)	On	Selects whether to show second marks on the report output by the printer.
Arrhy Setting(Recorder)	Off	Selects whether to include arrhythmia thresholds and QRS thresholds in the report output by the recorder.

24.8 The Unit Settings

Menu Item	Default Setting	Description
Height Unit	cm	Selects measurement unit for each parameter.
Weight Unit	kg	
ST Unit	mV	
CVP Unit	cmH2O	
ICP Unit	mmHg	
CO2 Unit	mmHg	
O2 Unit	%	
Temp Unit	℃	
Pressure Unit	mmHg	

24.9 The Time Settings

24.9.1 The Time Synchronization Tab

Section	Menu Item	Default Setting	Description
Nighttime	From	22:00	Selects the nighttime for heart rate statistics.
	To	06:00	
/	Start NTP Time Sync	Off	**On**: enables synchronizing the monitor time with the NTP server time.
	Interval	1 hr	Select the time interval for synchronizing the monitor time with the NTP server time.
	Time Server Address	/	The domain name of the time server.
	Time Server	/	The IP address of the time server.
	Network Test	/	Tests whether the NTP server is properly connected.

24.9.2 The Daylight Savings Time Tab

Menu Item	Default Setting	Description
Auto Daylight Savings Time	Off	**On**: auto starts the daylight saving time.

24.10 The Other Settings

Menu Item	Default Setting	Description
Barometric Pressure	760 mmHg	For the mainstream CO2 module, enter the value of barometric pressure to which the patient monitor is exposed to. Be sure to set the barometric pressure properly. Improper settings will result in erroneous measurements.
Notch Frequency	50 Hz	Selects notch filter frequency according to the power line frequency of your country.
Mouse Sensitivity	5	/

Menu Item		Default Setting	Description
SpO2 Tone		Mode 1	Selects the SpO_2 tone mode. The monitor adjusts the QRS tone (pitch tone) according to the SpO2 values.
Language		/	/
Parameters On/Off Config Influenced		On	Selects whether the settings of parameter switches are influenced by configuration
Parameters On/Off Protected		Off	Selects whether setting parameter switches is password protected.
Parameters On/Off		/	Selects what parameters can be monitored.
Parameter Output Setup	Baud Rate	Off	Configures DIAP protocol parameters to realize communications between the monitor and third party devices.
	Parity Mode	None	
	Data Bits	8	
	Stop Bits	1	

24.11 The Authorization Setup Settings

Section	Menu Item	Default Setting	Description
/	Retention Time	20 sec	Selects timeout period of the password for accessing the Maintenance menu, alarm settings and arrhythmia settings. If there is no operation after the specified timeout period is reached, you need to re-enter the password.
Maintenance	User Maintenance	Local Password	Selects the password for accessing the monitor's **Maintenance** menu. • **Local Password**: the monitor's password for accessing the **Maintenance** menu is required.
	Modify Local Password	/	Changes the monitor's password for accessing the **Maintenance** menu.
Other	Alarm Setup	No Password	Selects the password for changing alarm settings. • **No Password**: changing alarm settings is not password protected. • **Local Password**: changing alarm switch, alarm limit, and alarm priority is password protected. The monitor's password for changing alarm settings is required.
	Arrhythmia	No Password	Selects the password for changing arrhythmia settings. • **No Password**: changing arrhythmia settings is not password protected. • **Local Password**: changing arrhythmia switch, alarm priority, and arrhythmia threshold is password protected. The monitor's password for changing arrhythmia settings is required.
	Modify Local Password	/	Changes the monitor's password for accessing alarm settings and arrhythmia settings.

24.12 The Version Settings

Tab	Default Setting	Description
Version	/	Displays system software version, module hardware and software version, and firmware version.

24.13 The Battery Information Settings

Tab	Default Setting	Description
Battery	/	Displays battery information.

24.14 The Scanner Settings

24.14.1 The 2D Barcode Tab (for the Mindray Custom 2D Barcode Reader)

Tab	Default Setting	Description
2D Barcode	/	Establishes the relationship between the monitor data and barcode data for selectable patient demographics.

24.14.2 The 1D Barcode Tab

Menu Item	Default Setting	Description
Content Fill to	Patient ID	/

24.14.3 The Scanner Information Tab

Menu Item	Default Setting	Description
Scanner Type	2D Scanner	• **1D Scanner**: select this option when you are using a 1D scanner or a 2D scanner other than the Mindray custom 2D scanner. • **2D Scanner**: select this option when you are using the Mindray custom scanner.
Data Encoding Type	UTF8	When you set **Scanner Type** to **2D Scanner**, default settings are applied to **Data Encoding Type** and **Data Parse Mode**. You do not need to change these settings.
Data Parse Mode	Local	

24.14.4 The Identify Scanner Tab (for the non-Mindray Custom 2D Barcode Reader)

Tab	Default Setting	Description
Identify Scanner	/	When you are using barcode readers other than HS-1R or HS-1M, you should select the barcode reader from the USB device list, so that the monitor can identify the barcode reader. From the USB device list, select the barcode reader you are using.

24.14.5 The Field Tab (for the Mindray Custom 2D Barcode Reader)

Menu Item	Default Setting	Description
Patient ID	Selected	Selects desired patient information to be output by the barcode reader.
First Name		
Last Name		
Patient Category		
Gender		
DOB		
Visit Number	Unselected	
Room No		
Bed No		
Age		
Department		
Custom Field 1 - Custom Field 4		

24.15 The Network Setup Settings

24.15.1 The Network Type Tab

Menu Item	Default Setting	Description
Monitor	Auto	Selects what kind of network your monitor will use. **Auto**: the monitor automatically identify your network type.

24.15.2 The LAN1 IP Tab

Menu Item	Default Setting	Description
Obtain IP Address Automatically	Selected	Automatically gets the IP address.
Use the Following Address	Unselected	**IP Address**, **Subnet Mask**, and **Gateway** are required.
IP Address	0.0.0.0	
Subnet Mask	0.0.0.0	
Gateway	0.0.0.0	
Obtain DNS address automatically	Selected	Automatically gets the DNS address
Using the Following DNS Address	Unselected	IP addresses of **Preferred DNS Server** and **Alternate DNS Server** are required.
Preferred DNS Server	0.0.0.0	
Alternate DNS Server	0.0.0.0	

24.15.3 The WLAN Tab

Menu Item	Default Setting	Description
Add WLAN	/	Add wireless network and set the network in the pop-up menu.

Menu Item		Default Setting	Description
WLAN	Name	/	Input the name of the wireless network.
	SSID	/	/
	Security	WEP OFF	Selects the security method.
	Password	/	Input the password for entering the wireless network.
WLAN IP	Obtain IP Address Automatically	On	Selects whether to enable the function of automatically getting the IP address.
	Use the Following Address	Off	Select whether inputting the **IP Address**, **Subnet Mask**, and **Gateway** is required.
	IP Address	0.0.0.0	
	Subnet Mask	0.0.0.0	
	Gateway	0.0.0.0	
	Obtain DNS address automatically	On	Selects whether to enable the function of automatically getting the DNS address.
	Using the Following DNS Address	Off	Select whether inputting the IP address of **Preferred DNS Server** and **Alternate DNS Server** is required.
	Preferred DNS Server	0.0.0.0	
	Alternate DNS Server	0.0.0.0	
WLAN Setup	WLAN Band	Auto	**Auto**: automatically identifies the WLAN band.
	2.4G Channel	All	Selects the 2.4G channels.
	5G Channel	All	Selects the 5G channels.
Network Test		/	Tests whether the wireless network is properly connected.
Certificate Management	Local	/	**Delete**: delete the selected certifications.
	USB Drive	/	Select certifications you want to import from the USB memory, and then select **Import**: import the desired certifications from the USB memory.

24.15.4 The Device Discover Tab

Multicast helps device discovery between monitors and between monitors. Devices in the same multicast group can be mutually discovered.

Menu Item	Default Setting	Description
Multicast TTL	1	/
Multicast Address	225.0.0.8	
Master Server Address	/	/
Master Server IP Address	0.0.0.0	
Connected Status	Disconnected	
Network Test	/	Tests whether the master server is properly connected.

24.15.5 The QoS Tab

Menu Item	Default Setting	Description
QoS Level For Realtime Monitoring	0	Selects the service quality of network connection for realtime monitoring, for example parameter measurements and waveforms, alarms, and so on
QoS Level For Others	0	Selects the service quality of network connection for non-realtime monitoring, for example history data, printing, and as on.

24.15.6 The Information Security Tab

Menu Item	Default Setting	Description
Encryption Connection Type	Only Private Encryption	• **Only Private Encryption**: Mindray private encryption is used to encrypt the transmitted data. You cannot connect devices supporting SSL (secure sockets layer) encryption. • **SSL Encryption Priority**: for devices supporting SSL encryption, SSL encryption is used when connecting the devices. For devices not supporting SSL encryption, private encryption is used when connecting the devices.
Broadcast Patient Demographics	On	• **On:** when viewing other patients, device location and patient information of remote devices are displayed in the remote device list. • **Off**: patient information does not display in the remote device list.

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25 Battery

25.1 Battery Introduction

This monitor is designed to operate battery power when the external power supply is not available. The monitor uses mains power as primary power source. In case of mains power failure, the monitor automatically runs on the battery power.

NOTE

- **If the power input fails and the monitor runs on the battery power, the display brightness automatically lowers to the dimmest. You can manually adjust the display brightness as required.**

25.2 Battery Safety Information

WARNING

- **Keep batteries out of children's reach.**
- **Use only specified battery. Use of a different battery may present a risk of fire or explosion.**
- **Keep the batteries in their original package until you are ready to use them.**
- **Do not expose batteries to liquid.**
- **Do not crush, drop or puncture the battery. Mechanical abuse can lead to internal damage and internal short circuits. If a battery has been dropped or banged against a hard surface, whether damage is externally visible or not, remove the battery from use and dispose of it properly.**
- **If the battery shows signs of damage or signs of leakage, replace it immediately.**
- **Batteries should be charged only in this monitor.**
- **Extremely high ambient temperature may cause battery overheat protection, resulting in monitor shutdown.**
- **The lithium-ion battery has a service life of three years. Replace your battery when it reaches the end of its service life. Failure to replace the battery may cause serious damage to your equipment from battery overheating.**
- **Do not open batteries, heat batteries above 60 °C, incinerate batteries, or short battery terminals. They may ignite, explode, leak or heat up, causing personal injury.**

CAUTION

- **When the monitor runs on battery power, the monitor may automatically shutdown due to high power consumption if too many external modules are connected.**
- **Remove the battery before shipping the equipment or if it will not be used for an extended period of time.**

25.3 Battery Preparation

The monitor can be configured with the non-smart and smart batteries based on your needs. Before installing the battery, you should get familiar with battery specifications. For more information, see *A.4.2 Battery Specifications*.

WARNING

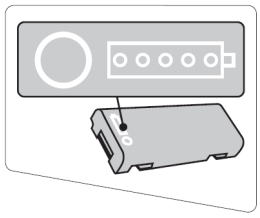
- **Lithium batteries replaced by inadequately trained personnel could result in a hazard (such as excessive temperatures, fire or explosion).**
- **Only the smart rechargeable lithium-Ion battery can be installed in the external battery compartment.**
- **Ensure that compatible batteries are used for your monitor. For more information, see *25.3.1 Identifying the Battery Type*. Otherwise, the monitor may be damaged or cannot work properly.**

25.3.1 Identifying the Battery Type

The smart battery label  is used to distinguish the battery type. The smart battery has this label, while the non-smart battery does not have it.

Not all the battery types are applicable for your monitor. You can only use a smart battery if the smart battery label is available on the back of the battery compartment and a non-smart battery if the smart battery label is not available.

The following figure shows the smart battery label on the back of the battery compartment



25.3.2 Installing the Battery in a Built-in Battery Compartment

No battery is installed when the monitor leaves the factory. The battery must only be installed by service personnel trained and authorized by Mindray. To install the battery, contact your service personnel.

To install the battery, follow this procedure:

1. Turn off the monitor. Disconnect the power cable and other cables.
2. Open the battery door as indicated below.

3. Turn the latch aside.

4. Insert the battery into the battery compartment with the battery terminal inwards.
5. Turn the latch back to the middle position.

6. Close the battery door.

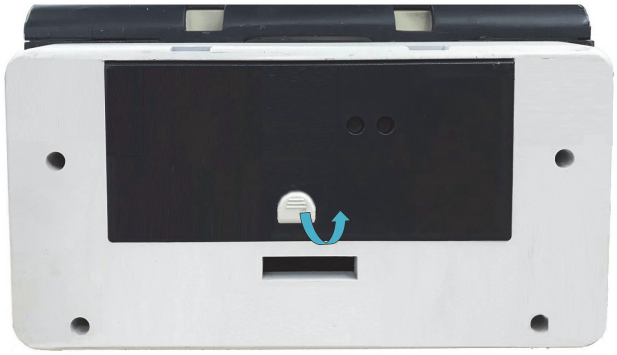
25.3.3 Installing the Battery in a External Battery Compartment

Besides the built-in battery compartment, you can also use a smart battery by connecting an external battery compartment.

The external battery compartment must only be installed by service personnel trained and authorized by Mindray. To install the battery, contact your service personnel.

To install the smart battery into the external battery compartment, follow this procedure:

1. Turn off the monitor. Disconnect the power cable and other cables.
2. Place the monitor on the worktable with monitor face down.
3. Pull up the battery door to open the battery compartment as indicated below.



4. Insert the battery into the battery compartment. Push the battery downwards till the battery terminal is plugged into the battery connector.
5. Close the battery door.

25.4 Battery Indications

The battery LED, on-screen battery power indicator and related alarm messages indicate the battery status.

25.4.1 Battery LED

The battery LED indications are as follows:

- Green: the battery is fully charged.
- Yellow: the battery is being charged.
- Green and flashing: the monitor runs on battery power.
- Off: no battery is installed, or the battery malfunctions, or the AC mains is not connected when the monitor is powered off.

25.4.2 Battery Power Indicators

The on-screen power indicator indicates the battery status as follows:

-  indicates that the battery works correctly. The green portion represents the remaining charge.
-  indicates that the battery power is low and needs to be charged.
-  indicates that the battery is almost depleted and needs to be charged immediately. Otherwise, the monitor will soon automatically shut down.
-  indicates that the battery is being charged.
-  indicates that no battery is installed or the battery fails.

25.4.3 Battery-related Alarms

The capacity of the battery is limited. When the battery is low, the monitor presents the **Low Battery** alarm, the alarm lamp flashes, and the monitor produces an alarm sound.

If the battery is almost depleted, the monitor presents the **Critically Low Battery** alarm. In this case, immediately connect the AC mains to power the monitor and charge the battery. Otherwise, the monitor will automatically shut down soon.

For more information on battery-related alarms, see *D Alarm Messages*.

25.5 Charging the Battery

The battery is recharged automatically when the monitor is connected to the external power supply.

25.6 Maintaining the Battery

25.6.1 Conditioning the Battery

The performance of batteries deteriorates over time. You should condition the batteries every three months.

If the battery is not conditioned for a prolonged time, its charge indication may not be accurate and you may wrongly evaluate the remaining battery runtime.

To condition a battery, follow this procedure:

1. Disconnect the equipment from the patient and stop all monitoring and measuring procedures.
2. Allow the battery to be charged uninterruptedly till it is fully charged.
3. Allow the equipment to run on the battery until the battery is completely depleted and the equipment automatically shuts down.
4. Fully charge the battery again for use or charge it to 40 – 60% for storage.

NOTE

- **Do not use the equipment to monitor the patient during battery conditioning.**
- **Do not interrupt battery conditioning.**

25.6.2 Checking Battery Performance

The performance of a rechargeable battery deteriorates over time. You should check the battery performance every three months or if you doubt that the battery may fail.

See steps 1 to 3 of *25.6.1 Conditioning the Battery* to check battery performance. The operating time of the batteries reflects their performance directly. If the operating time of a battery is noticeably shorter than that stated in the specifications, the battery may reach its service life or malfunction.If the battery performance meets the requirement, fully charge the battery again for use or charge it to 40 – 60% for storage.

NOTE

- **Battery operating time depends on equipment configuration and operation. For example, high display brightness or measuring NIBP repeatedly will shorten the battery operating time.**

25.7 Storing Batteries

When storing batteries, make sure that the battery terminals do not come into contact with metallic objects. If batteries are stored for an extended period of time, place the batteries in a cool place with a partial charge of 40% to 60% capacity.

Condition the stored batteries every three months. For more information, see *25.6.1 Conditioning the Battery*.

NOTE

- **Remove the battery from the equipment if the equipment is not used for a prolonged time (for example, several weeks). Otherwise the battery may overdischarge.**
- **Storing batteries at high temperature for an extended period of time will significantly shorten their life expectancy.**
- **The battery storage temperature is between -5 °C and 35 °C. Storing batteries in a cool place can slow the aging process. Ideally the batteries should be stored at 15 °C.**

25.8 Recycling Batteries

Discard a battery in the following situations:

- The battery has visual signs of damage.
- The battery fails.
- The battery is aged and its runtime significantly less than the specification.
- The battery service life is reached.

Properly dispose of batteries according to local regulations.

WARNING

- **Do not open batteries, heat batteries above 60 °C, incinerate batteries, or short the battery terminals. They may ignite, explode, leak or heat up, causing personal injury.**

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26 Care and Cleaning

26.1 Care and Cleaning Introduction

In this chapter we only describe cleaning and disinfection of the monitor, modules and certain accessories. For the cleaning and disinfection of other reusable accessories, refer to their instructions for use.

26.2 Care and Cleaning Safety Information

WARNING

- **Use only Mindray approved cleaners, disinfectants and methods listed in this chapter to clean or disinfect your equipment or accessories. Warranty does not cover damage caused by unapproved substances or methods.**
- **Do not mix disinfecting solutions, as hazardous gases may result.**
- **We make no claims regarding the efficacy of the listed chemicals or methods as a means for controlling infection. For the method to control infection, consult your hospital's infection control officer or epidemiologist.**
- **Be sure to turn off the system and disconnect all power cables from the outlets before cleaning the equipment.**
- **The responsible hospital or institution shall carry out all cleaning and disinfection procedures specified in this chapter.**

CAUTION

- **Never immerse any part of the equipment or accessories in liquids or allow liquid to enter the interior.**
- **Any contact of cleaners or disinfectants with connectors or metal parts may cause corrosion.**
- **Do not pour or spray any liquid directly on the equipment or accessories or permit fluid to seep into connections or openings.**
- **If you spill liquid on the equipment or accessories, disconnect the power supply, dry the equipment, and contact your service personnel.**
- **Never use abrasive materials (such as steel wool or silver polish), or erosive cleaners (such as acetone or acetone-based cleaners).**
- **Dilute and use the cleaners or disinfectants according to the manufacturer's instructions.**
- **Check the equipment after cleaning and disinfecting. If there is any sign of damage, remove it from use.**

26.3 Cleaning the Monitor/Module

Clean your equipment on a regular basis. Before cleaning the equipment, consult your hospital's regulations for cleaning the equipment.

To clean the equipment, follow this procedure:

1. Dampen a soft lint-free cloth with water or ethanol (70%).
2. Wring excess liquid from the cloth.
3. Wipe the display screen of the monitor.
4. Wipe the external surface of the monitor and modules with the damp cloth, avoiding the connectors and metal parts.
5. Dry the surface with a clean cloth. Allow the equipment air dry in a ventilated and cool place.

CAUTION

- **During the cleaning procedure, disable the touch operation by switching off the monitor or locking the touchscreen.**
- **Any contact of cleaners or disinfectants with connectors or metal parts may cause corrosion.**

26.4 Disinfecting the Monitor/Module

Disinfect the equipment as required in your hospital's servicing schedule. Cleaning the equipment before disinfecting is recommended. Always dilute and use disinfectants according to the manufacturer's instructions. The following table lists approved disinfectants:

Product Name	Product Type	Manufacturer
Alpet® D2 Surface Sanitizing Wipes	Wipes	BEST SANITIZERS INC™.
CIDEX® OPA	Liquid	Gilag GmbH International Advanced Sterilization products
Clorox Dispatch® Hospital Cleaner Disinfectant Towels with Bleach	Wipes	Clorox professional products company
Clorox Healthcare® Bleach Germicidal Wipes	Wipes	Clorox professional products company
Clorox Healthcare® Hydrogen Peroxide Cleaner Disinfectant Wipes	Wipes	Clorox professional products company
Diversey Oxivir® TB Wipes	Wipes	Diversey Inc
Metrex CaviCide1™	Liquid, spray	METERX® RESEARCH
Metrex CaviWipes™	Wipes	METERX® RESEARCH
PDI Sani-Cloth® AF3 Germicidal Disposable Wipe	Wipes	PDI Inc.
PDI Sani-Cloth® Bleach Germicidal Disposable Wipe	Wipes	PDI Inc.
PDI Sani-Cloth® HB Germicidal Disposable Wipe	Wipes	PDI Inc.
PDI Sani-Cloth® Plus Germicidal Disposable Cloth	Wipes	PDI Inc.
PDI Super Sani-Cloth® Germicidal Disposable Wipe	Wipes	PDI Inc.
VIRAGUARD® Hospital Surface Disinfectant Towelettle	Wipes	VERIDIEN corporation
Virex® II 256 (1:256)	Liquid	Diversey Inc
Virex® TB	Liquid, spray	Diversey Inc
JIAN ZHI SU Disinfectant Tablets	Tablet	Beijing ChangJiangMai Medical Science Technology Co. Ltd
JIAN ZHI SU Surface Disinfectant Spray	Liquid, spray	Beijing ChangJiangMai Medical Science Technology Co. Ltd
JIAN ZHI SU Disinfectant, Double-chain Quaternary Ammonium	Liquid	Beijing ChangJiangMai Medical Science Technology Co. Ltd

Product Name	Product Type	Manufacturer
DIAN'ERKANG Surface Wipes	Wipes	Shanghai Likang Disinfectant Hi-Tech Co., Ltd
DIAN'ERKANG Surface Disinfectant	Liquid	Shanghai Likang Disinfectant Hi-Tech Co., Ltd
DIAN'ERKANG Disinfectant Spray	Liquid, spray	Shanghai Likang Disinfectant Hi-Tech Co., Ltd
Clinell® Universal Wipes	Wipes	GAMA Healthcare Ltd
Clinell ® Sporicidal Wipes	Wipes	GAMA Healthcare Ltd
Tristel Duo™	Liquid, foam	Tristel solutions Limited
Tristel Jet	Liquid, spray	Tristel solutions Limited
Tristel Fuse For Surfaces, 196ppm	Liquid	Tristel solutions Limited
Surfanios Premium, 0.25%	Liquid	ANIOS LABORATORIES
Surfa 'safe	Liquid, spray	ANIOS LABORATORIES
Wip' Anios premium	Wipes	ANIOS LABORATORIES
Aniosurf ND premium, 0.25%	Liquid	ANIOS LABORATORIES
Mikrobac® Tissues	Wipes	BODE Chemie GmbH
Cleanisept® Wipes	Wipes	Dr. Schumacher GmbH
mikrozid® PAA Wipes	Wipes	Schülke & Mayr GmbH
mikrozid® Sensitive Wipes	Wipes	Schülke & Mayr GmbH
Ecolab Incidin® OxyWipe S	Wipes	Ecolab Deutschland GmbH
Glutaraldehyde, 2%	Liquid	/
*Ethanol, 70%	Liquid	/
*Isopropanol, 70%	Liquid	/
*Sodium hypochlorite bleach, 0.5%	Liquid	/
*Hydrogen peroxide, 3%	Liquid	/
*Rely+On™ Virkon® High Level surface Disinfectant, 1%	Powder	Antec International Ltd
*1-Propanol, 50%	Liquid	/
*Descosept® forte	Liquid	Dr. Schumacher GmbH
*Descosept® AF	Liquid	Dr. Schumacher GmbH
*Dismozon® plus, 0.4%	Powder	BODE Chemie GmbH
*mikrozid® AF Wipes	Wipes	Schülke & Mayr GmbH
*Terralin® Liquid	Liquid	Schülke & Mayr GmbH

Product Name	Product Type	Manufacturer
*Perform® Classic Concentrate OXY, 0.5%	Powder	Schülke & Mayr GmbH

NOTE

- **For equipment with the symbol , all the listed cleaners and disinfectants are available for use. For equipment without this symbol, only the cleaners and disinfectants marked with "*" are available for use.**

26.5 Cleaning and Disinfecting the Accessories

For the NIBP air hose, Mindray SpO_2 cable, Masimo SpO_2 cable, Nellcor SpO_2 cable, you should clean and disinfect them using the cleaners and disinfectants and methods listed in this section. For other accessories, you should consult the instructions delivered with the accessories.

CAUTION

- **Fluids entering the NIBP air hose can damage the equipment. When cleaning or disinfecting the NIBP air hose, prevent liquid from entering the hose.**
- **Periodically inspect the NIBP air hose and connector for signs of wear or deterioration after cleaning or disinfecting the NIBP air hose. Replace the NIBP air hose if you detect a leak. Dispose of damaged NIBP air hose according to local laws for disposal of hospital waste.**
- **Never immerse or soak the accessories in any liquid.**
- **Never clean or disinfect the connectors and metal parts.**
- **Use only Mindray approved cleaners and disinfectants and methods listed in this section to clean or disinfect the accessories. Warranty does not cover damage caused by unapproved substances or methods.**
- **To avoid long term damage, the accessories should be disinfected only when necessary as determined by your hospital's policy.**

26.5.1 Cleaning the Accessories

You should clean the accessories (NIBP air hose, Mindray SpO_2 cable, Masimo SpO_2 cable, Nellcor SpO_2 cable) on a regular basis. Before cleaning the accessories, consult your hospital's regulations for cleaning the accessories.

To clean the accessories, follow this procedure:

1. Clean the accessories with a soft cloth moistened with water or ethanol (70%).
2. Wipe off all the cleaner residue with a dry cloth.
3. Allow the accessories to air dry.

26.5.2 Disinfecting the Accessories

We recommend that the accessories (NIBP air hose, Mindray SpO_2 cable, Masimo SpO_2 cable, Nellcor SpO_2 cable) should be disinfected only when necessary as determined by your hospital's policy. Cleaning the accessories before disinfecting is recommended.

26.5.2.1 Disinfectants for the NIBP Air Hose

The following table lists approved disinfectants for the NIBP air hoses:

Product Name	Product Type	Manufacturer
Alpet® D2 Surface Sanitizing Wipes	Wipes	BEST SANITIZERS INC™.
CIDEX® OPA	Liquid	Gilag GmbH International Advanced Sterilization products
Clorox Dispatch® Hospital Cleaner Disinfectant Towels with Bleach	Wipes	Clorox professional products company
Metrex CaviCide1™	Liquid, spray	METERX® RESEARCH
Metrex CaviWipes™	Wipes	METERX® RESEARCH
PDI Sani-Cloth® AF3 Germicidal Disposable Wipe	Wipes	PDI Inc.
PDI Sani-Cloth® Plus Germicidal Disposable Wipe	Wipes	PDI Inc.
PDI Super Sani-Cloth® Germicidal Disposable Wipe	Wipes	PDI Inc.
VIRAGUARD® Hospital Surface Disinfectant Towelettle	Wipes	VERIDIEN corporation
Virex® TB	Liquid, spray	Diversey Inc
Clinell® Universal Wipes	Wipes	GAMA Healthcare Ltd
Surfa 'safe	Liquid, spray	ANIOS LABORATORIES
Aniosurf ND premium, 0.25%	Liquid	ANIOS LABORATORIES
mikrozid® Tissues	Wipes	Schülke & Mayr GmbH
Glutaraldehyde, 2%	Liquid	/
Ethanol, 70%	Liquid	/
Isopropanol, 70%	Liquid	/
Rely+On™ Virkon® High Level surface Disinfectant, 1%	Powder	Antec International Ltd
1-Propanol, 50%	Liquid	/

26.5.2.2 Disinfectants for the SpO_2 Cable

The following table lists approved disinfectants for the Mindray and Nellcor SpO_2 cables:

Product Name	Product Type	Manufacturer
CIDEX® OPA	Liquid	Gilag GmbH International Advanced Sterilization products
Clorox Dispatch® Hospital Cleaner Disinfectant Towels with Bleach	Wipes	Clorox professional products company
Clorox Healthcare® Bleach Germicidal Wipes	Wipes	Clorox professional products company

Product Name	Product Type	Manufacturer
Clorox Healthcare® Hydrogen Peroxide Cleaner Disinfectant Wipes	Wipes	Clorox professional products company
Diversey Oxivir® TB Wipes	Wipes	Diversey Inc
PDI Super Sani-Cloth® Germicidal Disposable Wipe	Wipes	PDI Inc.
VIRAGUARD® Hospital Surface Disinfectant Towelettle	Wipes	VERIDIEN corporation
Virex® TB	Liquid, spray	Diversey Inc
Glutaraldehyde, 2%	Liquid	/
Ethanol, 70%	Liquid	/
Isopropanol, 70%	Liquid	/
Sodium hypochlorite bleach, 0.5%	Liquid	/
Hydrogen peroxide, 3%	Liquid	/
Rely+On™ Virkon® High Level surface Disinfectant, 1%	Powder	Antec International Ltd
1-Propanol, 50%	Liquid	/

The following table lists approved Masimo SpO_2 cable cleaning and disinfecting agents:

Product Name	Product Type	Manufacturer
Isopropanol	Liquid	Isopropanol 70%

26.6 Sterilization

Sterilization is not recommended for this monitor, related products, accessories, or supplies unless otherwise indicated in the Instructions for Use that accompany the products, accessories or supplies.

26.7 Cleaning the Thermal Print Head

Dirty print head deteriorates printing quality. Check the printout to ensure the printing is legible and dark. Light printing may indicate a dirty print head.

To clean the thermal print head, follow this procedure:

1. Take measures against the static electricity, such as the wrist strap.
2. Remove the recorder module from the module rack.
3. Open the recorder door and remove the recording paper.
4. Gently wipe the print head with cotton swabs dampened with ethanol to remove the dust and foreign particles.
5. Wipe off excess moisture with dry cotton swabs.
6. Allow the print head air dry.
7. Reload the recording paper and close the recorder door.

CAUTION

- **Do not use anything that may destroy the thermal element.**
- **Do not add unnecessary force to the thermal head.**
- **The thermal print head gets hot when recording. Do not clean the print head immediately after recording.**

26.8 Impact of Improper Cleaning

Using cleaners other than those recommended may have the following impact:

- Product discoloration
- Metal part corrosion
- Brittle and breaking wires, connectors, and equipment housing
- Reduced cable and leadwire life
- Overall system performance degradation
- Equipment malfunction or failure

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27 Maintenance

27.1 Maintenance Introduction

Regular maintenance is essential to ensure that the equipment functions properly. This chapter contains information on periodic testing and maintenance.

27.2 Maintenance Safety Information

WARNING

- **Failure on the part of the responsible individual hospital or institution using this equipment to implement a recommended maintenance schedule may cause undue equipment failure and possible health hazards.**
- **No modification of this equipment is allowed.**
- **This equipment contains no user serviceable parts.**
- **The safety checks or maintenance involving any disassembly of the equipment should be performed by professional service personnel. Otherwise, undue equipment failure and possible health hazards could result.**
- **Do not open batteries, heat batteries to above 60 °C, incinerate batteries, or short the battery terminals. Batteries may ignite, explode, leak or heat up, causing personal injury.**
- **The service personnel must be properly qualified and thoroughly familiar with the operation of the equipment.**

CAUTION

- **The equipment and accessories shall not be served or maintained while in use with a patient.**
- **If you discover a problem with any of the equipment, contact your service personnel or Mindray.**
- **Use and store the equipment within the specified temperature, humidity, and altitude ranges.**
- **When disposing of the packaging material, be sure to observe the applicable waste control regulations and keep it out of children's reach.**
- **At the end of its service life, the equipment, as well as its accessories, must be disposed of in compliance with the guidelines regulating the disposal of such products. If you have any questions concerning disposal of the equipment, please contact Mindray.**

NOTE

- **If needed, contact the manufacture for circuit diagrams, component part lists, descriptions, calibration instructions, or other information concerning the repair of the equipment.**

27.3 Maintenance and Testing Schedule

Follow the maintenance and testing schedule or local regulations to perform testing and maintenance. Make sure to clean and disinfect the equipment before taking any tests and maintenance

The following table lists the maintenance and testing schedule:

Test/Maintenance Item		Recommended Frequency
Performance Tests		
Visual inspection		Every day, before first use.
Measurement module performance test and calibration		1. If you suspect that the measurement values are incorrect. 2. Follow any repairs or replacement of relevant module. 3. Once a year for CO_2 and AG tests. 4. Once every two years for other parameter module performance tests.
Analog output test		If you suspect that the analog output function does not work properly.
Defibrillation synchronization test		If you suspect that the defibrillation synchronization function does not work properly.
Nurse call test		If you suspect that the nurse call function does not work properly.
Electrical Safety Tests		
Electrical safety tests		Once every two years.
Other Tests		
Power-on test		Before use.
Recorder check		1. When the recorder is used for the first time. 2.Follow any repair or replacement of the recorder.
Network printer tests		1. When first installed. 2.Followany repair or replacement of the printer.
Battery check	Functionality test	1. When first installed. 2. When battery is replaced.
	Performance test	Every three months or if the battery runtime reduced significantly.

27.4 Testing Methods and Procedures

Except the following maintenance tasks, all other test and maintenance tasks should be performed by Mindray-qualified service personnel only.

- Regular check, including visual inspection and power-on test
- Printer and recorder tests
- Battery check

If your equipment needs a safety test and performance test, contact the service personnel.

27.4.1 Performing Visual Inspection

Visually inspect the equipment before its first used every day. If you find any signs of damage, remove your equipment from use and contact the service personnel.

Verify that the equipment meets the following requirements:

- Environment and power supply specifications are met.
- The monitor housing and display screen are free from cracks or other damages
- The power cord is not damaged and the insulation is in good condition.

- Connectors, plugs, and cables are not damaged and kinked.
- Power cord and patient cables are securely connected with the equipment and modules.

27.4.2 Performing Power-on Test

The equipment automatically performs a selftest at startup. Check the following items for the power-on test:

- The equipment powers on properly.
- The alarm system works properly.
- The equipment displays properly.

27.4.3 Testing the Recorder

To test the recorder, follow this procedure:

1. Start a recording task to print waveforms and reports.
2. Check that the recorder functions correctly.
3. Check that the printout is clear without missing dots.

27.4.4 Testing the Network Printer

To check the printer, follow this procedure:

1. Start a printing task to print waveforms and reports.
2. Check that the printer is properly connected and functions correctly.
3. Check that the printout is clear without missing dots.

27.4.5 Checking the Battery

For information on battery check, see *25.6.2 Checking Battery Performance*.

27.5 Disposing of the Equipment

Dispose of the monitor and its accessories when its service life is reached. Follow local regulations regarding the disposal of such products.

WARNING

- **For disposal of parts and accessories, where not otherwise specified, follow local regulations regarding disposal of hospital waste.**

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28 Accessories

The accessories listed in this chapter comply with the requirements of IEC 60601-1-2 when in use with the patient monitor. The accessory material that contacts the patients has undertaken the bio-compatibility test and is verified to be in compliance with ISO 10993-1. For details about the accessories, refer to the instructions for use provided with the accessory.

WARNING

- **Use accessories specified in this chapter. Using other accessories may cause damage to the monitor or not meet the claimed specifications.**
- **Single use accessories are not designed to be reused. Reuse may cause a risk of contamination and affect the measurement accuracy.**

CAUTION

- **The accessories may not meet the performance specifications if stored or used outside the specified temperature and humidity ranges. If accessory performance is degraded due to aging or environmental conditions, contact your service personnel.**
- **Check the accessories and their packages for any sign of damage. Do not use them if any damage is detected.**
- **Use the accessories before the expiry date if their expiry date is indicated.**
- **The disposable accessories shall be disposed of according to hospital's regulations.**

28.1 ECG Accessories

28.1.1 ECG Electrodes

Model	PN	Description
31499224	0010-10-12304	Electrode Kendall, 10 pcs/package
SF06	040-002711-00	Electrode, 5 pcs/package
EB6903	9101-20-58104	Alligator clip

28.1.2 12-Pin Separable Trunk Cables

Model	PN	Description
EV6201	0010-30-42719 009-004728-00	ECG cable,12-pin, 3/5-lead, defibrillation-proof AHA/IEC
EV6202	0010-30-42720	ECG cable,12-pin, 3-lead, defibrillation-proof, AHA/IEC
EV6211	0010-30-42723	ECG cable, 12-pin, 3/5-lead, ESU-proof, AHA/IEC
EV6212	0010-30-42724	ECG cable, 12-pin, 3-lead, ESU-proof, AHA/IEC
EV6222	040-000754-00	ECG cable, 12-pin, 3-lead, defibrillation-proof, DIN connector
EV6206	009-005266-00	ECG cable, defibrillation-proof, 3.1 m, T/N series
EV6216	009-005268-00	ECG cable, ESU-proof, 3.1 m, T/N series

28.1.3 12-Pin Integrative Trunk Cables

Model	PN	Description
EA6251B	040-000961-00	ECG cable,12-pin, 5-lead, AHA, snap
EA6252B	040-000963-00	ECG cable,12-pin, 5-lead, IEC, snap
EA6251A	040-000960-00	ECG cable,12-pin, 5-lead, AHA, clip
EA6252A	040-000962-00	ECG cable,12-pin, 5-lead, IEC, clip
EA6231B	040-000965-00	ECG cable,12-pin, 3-lead, AHA, snap
EA6232B	040-000967-00	ECG cable,12-pin, 3-lead, IEC, snap
EA6231A	040-000964-00	ECG cable,12-pin, 3-lead, AHA, clip
EA6232A	040-000966-00	ECG cable,12-pin, 3-lead, IEC, clip

28.1.4 3-lead ECG Leadwires

Model	PN	Description	Length
EL6305A	0010-30-42896	ECG leadwires, 3-lead, AHA, clip, long	1 m
EL6306A	0010-30-42897	ECG leadwires, 3-lead, IEC, clip, long	1 m
EL6303A	0010-30-42731	ECG leadwires, 3-lead, AHA, clip, long	1 m
EL6304A	0010-30-42732	ECG leadwires, 3-lead, IEC, clip, long	1 m
EL6301B	0010-30-42734	ECG leadwires, 3-lead, AHA, snap, long	1 m
EL6302B	0010-30-42733	ECG leadwires, 3-lead, IEC, snap, long	1 m
EL6311B	040-000146-00	ECG leadwires, 3-lead, AHA, snap, long, disposable	1 m
EL6312B	040-000147-00	ECG leadwires, 3-lead, IEC, snap, long, disposable	1 m
EL6311A	040-000148-00	ECG leadwires, 3-lead, AHA, snap, long, disposable	1 m
EL6312A	040-000149-00	ECG leadwires, 3-lead, IEC, snap, long, disposable	1 m
EL6302A	0010-30-42725	ECG leadwires, 3-lead, IEC, clip	0.6 m
EL6301A	0010-30-42726	ECG leadwires, 3-lead, AHA, clip	0.6 m
EL6307A	0010-30-42898	ECG leadwires, 3-lead, AHA, clip	0.6 m
EL6308A	0010-30-42899	ECG leadwires, 3-lead, IEC, clip	0.6 m
EL6307B	0010-30-42900	ECG leadwires, 3-lead, AHA, snap	0.6 m
EL6308B	0010-30-42901	ECG leadwires, 3-lead, IEC, snap	0.6 m

28.1.5 5-lead ECG Leadwires

Model	PN	Description	Length
EL6503A	0010-30-42729	ECG leadwires, 5-lead, AHA, clip, long	1m to 1.4m
EL6504A	0010-30-42730	ECG leadwires, 5-lead, IEC, clip, long	1m to 1.4m
EL6501B	0010-30-42735 009-004729-00	ECG leadwires,5-lead, AHA, snap	1m to 1.4m
EL6502B	0010-30-42736 009-004730-00	ECG leadwires, 5-lead, IEC, snap	1m to 1.4m
EL6501A	0010-30-42727	ECG leadwires, 5-lead, AHA, clip	0.6 m

Model	PN	Description	Length
EL6502A	0010-30-42728	ECG leadwires, 5-lead, IEC, clip	0.6 m

28.1.6 6-lead ECG Leadwires

Model	PN	Description	Length
EY6601B	009-004794-00	ECG leadwires, 6-lead, AHA, snap, 24 inch	24 inch
EY6602B	009-004795-00	ECG leadwires, 6-lead, AHA, snap, 36 inch	36 inch
EY6603B	009-004796-00	ECG leadwires, 6-lead, IEC, snap, 24 inch	24 inch
EY6604B	009-004797-00	ECG leadwires, 6-lead, IEC, snap, 36 inch	36 inch
EY6601A	009-004798-00	ECG leadwires, 6-lead, AHA, clip, 24 inch	24 inch
EY6602A	009-004799-00	ECG leadwires, 6-lead, AHA, clip, 36 inch	36 inch
EY6603A	009-004800-00	ECG leadwires, 6-lead, IEC, clip, 24 inch	24 inch
EY6604A	009-004801-00	ECG leadwires, 6-lead, IEC, clip, 36 inch	36 inch

28.2 SpO_2 Accessories

Wavelength emitted by the sensors is between 600 nm and 1000 nm. The maximum photic output consumption of the sensor is less than 18 mW.

The information about the wavelength range and maximum photic output consumption can be especially useful to clinicians, for example, when photodynamic therapy is performed.

28.2.1 Extension Cables

Model	Part No.	Description
562A	0010-20-42710 009-004600-00	7-pin, Mindray
572A	0010-20-42712	8-pin, Nellcor
582A	040-000332-00	8-pin, Masimo

Note: If you need to purchase Masimo sensors, please contact Masimo.

28.2.2 Mindray SpO_2 Sensors

Model	PN	Description
551B	115-036221-00	Reusable SpO2 sensor

28.2.3 Nellcor SpO_2 Sensors

Model	PN	Description
V-SAT	9101-10-58134	Reusable SpO2 sensor

28.3 Temp Accessories

28.3.1 Temp Cable

Model	Part No.	Description
MR421	0010-30-43056	TEMP adapter cable (2-pin to audio)

28.3.2 Temp Probes

Model	Part No.	Description
MR403B	125-000142-00	Reusable temperature probe, skin (for large animal)
MR401B	125-000143-00	Reusable temperature probe, esophageal (for large animal)
MR404B	125-000144-00	Reusable temperature probe, skin (for small animal)
MR402B	125-000145-00	Reusable temperature probe, esophageal (for small animal)

28.4 NIBP Accessories

28.4.1 NIBP Hoses

Model	Part No.	Description
CM1901	6200-30-11560	Reusable NIBP hose
CM1903	6200-30-09688 115-012522-00	Reusable NIBP hose

28.4.2 Cuffs

Model	Part No.	Description	Limb Circumference (cm)	Bladder Width (cm)
CM1500A	125-000051-00	NIBP cuff, single patient use, size 1, 20 pcs/box	3.1 to 5.7	2.2
CM1500B	125-000052-00	NIBP cuff, single patient use, size 2, 20 pcs/box	4.3 to 8.0	2.9
CM1500C	125-000053-00	NIBP cuff, single patient use, size 3, 20 pcs/box	5.8 to 10.9	3.8
CM1500D	125-000054-00	NIBP cuff, single patient use, size 4, 20 pcs/box	7.1 to 13.1	4.8
CM1500E	125-000055-00	NIBP cuff, single patient use, size 5, 20 pcs/box	8 to 15	5.4
CM1500A	001B-30-70677	NIBP cuff, single patient use, size 1, 20 pcs/box	3.1 to 5.7	2.2
CM1500B	001B-30-70678	NIBP cuff, single patient use, size 2, 20 pcs/box	4.3 to 8.0	2.9
CM1500C	001B-30-70679	NIBP cuff, single patient use, size 3, 20 pcs/box	5.8 to 10.9	3.8
CM1500D	001B-30-70680	NIBP cuff, single patient use, size 4, 20 pcs/box	7.1 to 13.1	4.8

Model	Part No.	Description	Limb Circumference (cm)	Bladder Width (cm)
CM1500E	001B-30-70681	NIBP cuff, single patient use, size 5, 20 pcs/box	8 to 15	5.4
CM1501	001B-30-70682	NIBP cuff, single patient use, 10 pcs/box	10 to 19	7.2
CM1502	001B-30-70683	NIBP cuff, single patient use, 10 pcs/box	18 to 26	9.8

28.5 IBP Accessories

28.5.1 IBP Accessories

Model	Part No.	Description
IM2202	001C-30-70757	12-pin IBP cable, Argon
DT-4812	6000-10-02107	IBP transducer, disposable, Argon
682275	0010-10-12156	Transducer/Manifold Mount, Argon
IM2201	001C-30-70759	12 Pin IBP cable, ICU Medical
42584	0010-10-42638	IBP transducer, disposable, ICU Medical
42602	M90-000133---	Steady Rest for IBP Transducer and Clamp, ICU Medical
42394	M90-000134---	Steady Rest for IBP Transducer and Clamp, ICU Medical
IM2211	0010-21-12179	12 Pin IBP cable, for Edwards, reusable

28.5.2 ICP Accessories

Model	Part No.	Description
82-6653	040-002336-00	ICP sensor kit, disposable
CP12601	009-005460-00	12-pin ICP cable

28.6 C.O. Accessories

Model	Part No.	Description
CO7702	0010-30-42743	12-pin C.O. cable
131HF7	6000-10-02183	Dilution hose, Edwards
12 ml	040-005992-00	12 mm control syringe W/1 cc stop W/rotator, disposable

28.7 CO_2 Accessories

28.7.1 Sidestream CO_2 Accessories

Model	Part No.	Description
60-15200-00	115-043017-00	Airway sampling line, disposable (for large animal)
60-15300-00	115-043018-00	Airway sampling line, disposable (for small animal)
60-14100-00	115-043020-00	Airway adapter, straight, disposable
040-001187-00	115-043019-00	Airway adapter, disposable
60-14200-00	115-043021-00	Airway adapter, elbow, disposable
100-000080-00	115-043024-00	Watertrap, DRYLINE II, reusable (for large animal)
100-000081-00	115-043025-00	Watertrap, DRYLINE II, reusable (for small animal)

28.7.2 Microstream CO_2 Accessories

Model	Part No.	Description
XS04620	0010-10-42560	Disposable airway sampling line
XS04624	0010-10-42561	Disposable airway sampling line, humidified
006324	0010-10-42562	Disposable airway sampling line, humidified
007768	0010-10-42563	Disposable airway sampling line, long

28.7.3 Mainstream CO_2 Accessories

Model	Part No.	Description
6934	0010-10-42667	Cable management straps
1036698	6800-30-50760	CO2 sensor

28.8 AG Accessories

Model	Part No.	Description
60-15200-00	115-043017-00	Airway sampling line, disposable (for large animal)
60-15300-00	115-043018-00	Airway sampling line, disposable (for small animal)
60-14100-00	115-043020-00	Airway adaptor, straight, disposable
040-001187-00	115-043019-00	Airway adapter, disposable
60-14200-00	115-043021-00	Airway adaptor, elbow, disposable
100-000080-00	115-043024-00	Watertrap, DRYLINE II, reusable (for large animal)
100-000081-00	115-043025-00	Watertrap, DRYLINE II, reusable (for small animal)

28.9 Mount and Mounting Accessories

Part No.	Description
045-003428-00	Rolling stand with quick release mount
045-003424-00	Quick release mount for rolling stand and wall mount
045-003427-00	M series wall mount with quick release mount
045-000924-00	iPM/iMEC rolling stand
045-000953-00	iPM/iMEC trolley tray kit
045-000931-00	iPM/iMEC wall mount bracket
045-003255-00	N12 roll stands (With iPM/iMEC adapter)
8000-30-90169	Bedrail hook

28.10 Miscellaneous Accessories

Part No.	Description
009-001075-00	Power cord, 250 V, 10 A, 3 m, Brazil
009-001791-00	Power cord, 250 V, 16 A, 3 m, South Africa
009-002636-00	Power cord, 10 A, 1.5 m, Australia standard
009-007190-00	Power cord, 3 m, India
009-007191-00	Power cord, 1.8 m, Switzerland
509B-10-05996	Power cord, 10 A, 250 V, 1.6 m, China
DA8K-10-14452	Power cord, USA
DA8K-10-14453	Power cord, UK
DA8K-10-14454	Power cord, Europe
1000-21-00122	Grounding cable
022-000383-00	Lithium-ion battery, 10.95 V, 2600 mAh, LI13I001A
022-000382-00	Lithium-ion battery, 10.95 V, 4500 mAh, LI23S002A
022-000248-00	Smart Lithium-ion battery, 10.8 V, 5600 mAh, LI23I003A
023-000218-00	USB flash drive, 32 GB, USB3.0
023-001523-00	HP LaserJet Printer
115-008393-00	1D Barcode reader
023-001286-00	2D Barcode reader, HS-1M, JADAK
023-001288-00	2D Barcode reader, HS-1R, JADAK
023-001393-00	Remote controller
009-003116-00	Nurse call cable
009-003117-00	Analog output cable
009-003118-00	Synchronization cable
A30-000001---	Recording paper, 50 mm*20 m
009-003648-00	Cable protecting tube, 20cm&40cm
009-003903-00	Accessories management tape

28.11 External Modules

Module	Model	Comments
C.O. module	C.O.	Supports C.O. monitoring
IBP module	IBP	Supports IBP monitoring
Microstream CO_2 module	CO2-1	Supports CO2 monitoring
Mainstream CO_2 module	CO2-2	Supports CO2 monitoring
Sidestream CO_2 module	CO2-3	Supports CO2 monitoring
Sidestream CO_2 module	CO2-4	Supports CO2 monitoring, integrates O2 (paramagnetic) monitoring
AG module	AG-1	Supports AG monitoring
AG module	AG-3	Supports AG monitoring, integrates O_2 (paramagnetic) monitoring

A Product Specifications

A.1 Monitor Safety Specifications

The monitor is classified, according to IEC 60601-1:

Degree of protection against electrical shock	Type CF defibrillation proof for ECG, Resp, SpO_2, NIBP, Temp, IBP, C.O. Type BF defibrillation proof for CO_2, AG
Type of protection against electrical shock	Class I
Degree of protection against harmful ingress of water	IPX1(protected against harmful effects of vertically falling water drops)
Degree of safety of application in the presence of flammable anesthetic mixture with air or with oxygen or nitrous oxide	The equipment is not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide
Mode of operation	Continuous

A.2 Physical Specifications

Item	Maximum Weight (kg)	W × H × D (mm)	Comments
ePM 12M Vet main unit	5.5(standard configuration and recorder, excluding battery, accessories and modules)	310 × 289 × 169	4.8 kg (standard configuration, excluding battery, accessories, modules and recorder)
IBP module	0.26	136.5 × 40 × 102	/
C.O. module	0.25	136.5 × 40 × 102	/
Microstream CO_2 module	0.38	136.5 × 40 × 102	/
Mainstream CO_2 module	0.26	136.5 × 40 × 102	/
Sidestream CO_2 module	0.54	136.5 × 40 × 102	/
Sidestream CO_2 module	0.63	136.5 × 40 × 102	With build-in O_2 module
AG	1.03	136.5 × 80.5 × 102	/
AG	1.03	136.5 × 80.5 × 102	With built-in O_2 module

A.3 Environmental Specifications

WARNING

- **The monitor may not meet the performance specifications if stored or used outside the specified temperature and humidity ranges. If the performance of the equipment is degraded due to aging or environmental conditions, contact your service personnel.**
- **When the monitor and related products have differing environmental specifications, the effective range for the combined products is that range which is common to the specifications for all products.**

NOTE

- **The environmental specification of unspecified parameter modules are the same as those of the main unit.**

Main Unit			
Item	**Temperature (°C)**	**Relative humidity (noncondensing) (%)**	**Barometric**
Operating Condition	0 to 40 (0 to 35 configured with AG module)	15 to 95	427.5 to 805.5 mmHg (57 to 107.4 kPa)
Storage Condition	-20 to 60	10 to 95	120 to 805.5 mmHg (16 to 107.4 kPa)
Microstream CO_2 Module			
Item	**Temperature (°C)**	**Relative humidity (noncondensing) (%)**	**Barometric**
Operating Condition	0 to 40	15 to 95	430 to 790 mmHg (57.3 to 105.3 kPa)
Storage Condition	-20 to 60	10 to 95	430 to 790 mmHg (57.3 to 105.3 kPa)
Sidestream CO_2 Module			
Item	**Temperature (°C)**	**Relative humidity (noncondensing) (%)**	**Barometric**
Operating Condition	5 to 40	15 to 95	430 to 790 mmHg (57.3 to 105.3 kPa)
Storage Condition	-20 to 60	10 to 95	430 to 790 mmHg (57.3 to 105.3 kPa)
Mainstream CO_2 Module			
Item	**Temperature (°C)**	**Relative humidity (noncondensing) (%)**	**Barometric (mmHg)**
Operating Condition	0 to 40	10 to 90	427.5 to 805.5 mmHg (57.0 to 107.4 kPa)
Storage Condition	-20 to 60	10 to 90	400 to 805.5 mmHg (53.3 to 107.4 kPa)
AG Module			
Item	**Temperature (°C)**	**Relative humidity (noncondensing) (%)**	**Barometric**
Operating Condition	10 to 40	15 to 95	525 to 805.5 mmHg (70 to 107.4 kPa)
Storage Condition	-20 to 60	10 to 95	525 to 805.5 mmHg (70 to 107.4 kPa)

A.4 Power Supply Specifications

A.4.1 External Power Supply Specifications

AC Power	
Input voltage	100 to 240 VAC (±10%)
Input current	2.0 to 0.9 A
Frequency	50/60 Hz (± 3 Hz)

A.4.2 Battery Specifications

Battery LI13I001A	Type	Rechargeable lithium-Ion battery (non-smart battery)
	Voltage	10.95V
	Capacity	2600 mAh
Battery LI23S002A	Type	Rechargeable lithium-Ion battery (non-smart battery)
	Voltage	10.95V
	Capacity	4500 mAh
Battery LI23I003A	Type	Smart rechargeable lithium-Ion battery (smart battery)
	Voltage	10.8V
	Capacity	5600 mAh
Maximum number of batteries configured	at most two batteries can be connected at the same time, including one battery built inside, the other one connected from an external battery compartment.	
Run time	Battery LI13I001A (one battery connected): ≥ 2 hours Battery LI23S002A (one battery connected): ≥ 4 hours Battery LI23I003A (one battery connected): ≥ 4.5 hours Battery LI23I003A (two batteries connected): ≥ 9 hours when the monitor is powered by a new fully-charged battery at 25 ºC±5 ºC with 5-lead ECG and SpO_2 cable connected, auto NIBP measurements at an interval of 15 minutes, and screen brightness set to 1. Shutdown delay: at least 15 minutes after the low battery alarm first occurs.	
Charge time	Battery LI13I001A (one battery connected)	• No more than 2.5 hours to 90% when the monitor is off • No more than 5 hours to 90% when the monitor is on
	Battery LI23S002A (one battery connected)	• No more than 5 hours to 90% when the monitor is off • No more than 10 hours to 90% when the monitor is on
	Battery LI23I003A (one battery connected)	• No more than 5 hours to 90% when the monitor is off • No more than 10 hours to 90% when the monitor is on
	Battery LI23I003A (two batteries connected)	• No more than 10 hours to 90% when the monitor is off • No more than 20 hours to 90% when the monitor is on

A.5 Display Specifications

Screen type	Capacitive, multi-point color touchscreen
Screen Size (diagonal)	12.1 inches
Resolution	1280 x 800 pixels

A.6 Recorder Specifications

Method	Thermal dot array
Horizontal resolution	16 dots/mm (25 mm/s paper speed)
Vertical resolution	8 dots/mm
Paper width	50 mm±1mm
Paper length	20 m
Paper speed	25 mm/s, 50 mm/s Accuracy: ±5%
Number of waveform channels	A maximum of 3

A.7 LEDs

Alarm lamp	1 or 2 (three color-coded: red, yellow, and cyan)
Power-on LED	1 (green)
AC power LED	1 (green)
Battery LED	1 (two color-coded: yellow and green)

A.8 Audio Indicator

Speaker	Give alarm tones (45 to 85 dB), reminder tones, key tones, QRS tones; support PITCH TONE and multi-level tone modulation

A.9 Monitor Interface Specifications

AC power input	1
Network connector	1, standard RJ45 connectors, 100 Base-TX, IEEE 802.3
USB connector	2, USB 2.0
Module rack	1
Multifunctional connector	1
Video output connector	1, 15-pin D-sub
Equipotential grounding terminal	1

A.10 Signal Outputs Specifications

ECG Analog Output	
Bandwidth (-3dB; reference frequency: 10Hz)	Diagnostic mode: 0.05 to 150 Hz Monitor mode: 0.5 to 40 Hz Surgical mode: 1 to 20 Hz ST mode: 0.05 to 40 Hz
Maximum QRS delay	25 ms (in diagnostic mode, and non-paced)
Gain (reference frequency 10Hz)	1V/mV (±5%)
Pace enhancement	Signal amplitude: V_{oh}≥2.5V Pulse width: 10ms±5% Signal rising and falling time: ≤100μs
IBP Analog Output	
Bandwidth (-3dB; reference frequency:1Hz)	0 to 40 Hz
Maximum transmission delay	30 ms
Gain (reference frequency 1 Hz)	1 V/100 mmHg, ±5%
Nurse Call Signal	
Amplitude	High level: 3.5 to 5 V, ±5%, providing a minimum of 10 mA output current; Low level: < 0.5 V, receiving a minimum of 5 mA input current.
Rising and falling time	≤1 ms
Defib Sync Pulse	
Output impedance	≤100 ohm
Maximum time delay	35 ms (R-wave peak to leading edge of pulse)
Amplitude	High level: 3.5 to 5 V, ±5%, providing a maximum of 10 mA output current; Low level: < 0.5 V, receiving a maximum of 5 mA input current.
Pulse width	100 ms ±10%
maximum rising and falling time	1 ms
Alarm Output	
Alarm delay time from the monitor to remote equipment	The alarm delay time from the monitor to remote equipment is ≤2 seconds, measured at the monitor signal output connector.
Alarm signal sound pressure level range	45 db(A) to 85 db(A) within a range of one meter

A.11 Data Storage

Trends	• Standard-capacity internal card: up to 120 hours of trend data with the resolution no less than 1 minute, or up to 1200 hours of trend data with the resolution no less than 10 minutes. • High-capacity internal card: up to 240 hours of trend data with the resolution no less than 1 second, or up to 2400 hours' trend data with the resolution no less than 10 minutes.
Events	• Standard-capacity internal card: 1000 events, including parameter alarms, arrhythmia events, technical alarms, and so on. • High-capacity internal card: 2000 events, including parameter alarms, arrhythmia events, technical alarms, and so on.

NIBP measurements	• Standard-capacity internal card: 1000 sets. • High-capacity internal card: 3000 sets.
Interpretation of resting 12-lead ECG results	20 sets
Full-disclosure waveforms	• Standard-capacity internal card: up to 48 hours for one waveform. The specific storage time depends on the waveforms stored and the number of stored waveforms. • High-capacity internal card: up to 48 hours for all parameter waveforms.
ST view	A maximum of 120 hours of ST segment waveforms. One group of ST segment waveforms is stored every minute.

A.12 Wi-Fi Specifications

A.12.1 Wi-Fi Technical Specifications (MSD45N)

Protocol	IEEE 802.11a/b/g/n
Modulation mode	BPSK, QPSK, 16QAM, 64QAM
Operating frequency	2.4 GHz to 2.495GHz 5.15 GHz to 5.25 GHz, 5.725 GHz to 5.85 GHz
Channel spacing	IEEE 802.11b/g: 5 MHz IEEE 802.11n (at 2.4 G): 5 MHz IEEE802.11a: 20 MHz IEEE802.11n (at 5 G): 20 MHz
Wireless baud rate	IEEE 802.11b: 1 Mbps to 11 Mbps IEEE 802.11g: 6 Mbps to 54 Mbps IEEE 802.11n: 6.5 Mbps to 72.2 Mbps (MCS0-MCS7) IEEE 802.11a: 6 Mbps to 54 Mbps
Output power	<20dBm (CE requirement, detection mode: RMS) <30dBm (FCC requirement: detection mode: peak power)
Operating mode	As station, access AP for data transmission
Data security	Standards: WPA-PSK, WPA2-PSK, WPA-Enterprise,WPA2-Enterprise EAP method: EAP-FAST, EAP-TLS, EAP-TTLS, PEAP-GTC, PEAP- MSCHAPv2, PEAP-TLS, LEAP Encryption: TKIP, AES

A.12.2 Wi-Fi Technical Specifications (SX-SDMAC-2832S+)

Protocol	IEEE 802.11a/b/g/n
Modulation mode	BPSK, QPSK, 16QAM, 64QAM
Operating frequency	2412 MHz to 2472 MHz 5180 MHz to 5320 MHz, 5500 MHz to 5700 MHz, 5745 MHz to 5825 MHz **WARNIGN: SX-SDMAC-2832S+ supports the DFS channels. When using the DFS channels, Wi-Fi performance stability and roaming time can be undermined due to avoiding interfering with Radar systems. DFS channels are disabled by default and not recommended. The operator should comprehensively assess the risk before using the DFS channels.**
Channel spacing	IEEE 802.11b/g: 5 MHz IEEE 802.11n (at 2.4 GHz): 5 MHz IEEE802.11a: 20 MHz IEEE802.11n (at 5 GHz): 20 MHz

Wireless data rate	IEEE 802.11b: 1 Mbps to 11 Mbps IEEE 802.11g: 6 Mbps to 54 Mbps IEEE 802.11n: MCS0 - MCS7 IEEE 802.11a: 6 Mbps to 54 Mbps
Output power	<20 dBm (CE requirements, detection mode: RMS) <30 dBm (FCC requirements, detection mode: peak power)
Operating mode	As station, access AP for data transmission
Data security	Standards: WPA-PSK, WPA2-PSK, WPA-Enterprise, WPA2-Enterprise EAP method: EAP-FAST, EAP-TLS, EAP-TTLS, PEAP-GTC, PEAP-MSCHAPv2, PEAP-TLS, LEAP Encryption: TKIP, AES

A.12.3 Wi-Fi Performance Specifications

WARNING

- **Do perform all network functions of data communication within an enclosed network.**

A.12.3.1 System Capacity and Resistance to Wireless Interference

Meets the following requirements:

- All the monitors do not encounter communication loss.
- The total delay of data transmission from one monitor to the other: ≤ 2 seconds.
- The delay for the monitor to reset alarms of another to be effective: ≤ 2 seconds.

Testing conditions are as follows:

- Number of the monitors supported by a single AP: ≤ 16.
- Two monitors are used to view other monitors.
- Only one monitor can transmit history data.
- The weakest strength of the AP signal where the monitor is located is not less than -65 dBm.
- The distance between the interfering devices and the monitor is greater than 20 cm. A Wi-Fi interference (no greater than -85 dBm) in the same channel and a Wi-Fi interference (no greater than -50 dBm) in an adjacent-channel are presented synchronously. The interfering devices include, but are not limited to, 2.4 G wireless devices, cellular mobile networks, microwave ovens, interphones, cordless phones, and ESU equipment. The interfering devices do not include Wi-Fi devices.

A.12.3.2 Wi-Fi Network Stability

12 of the 16 monitors connected to the network roam for 30 times.

Testing conditions are as follows:

- Number of the monitors supported by a single AP: ≤ 16.
- Two monitors are used to view other monitors.
- Only one monitor can transmit history data.
- The weakest strength of the AP signal where the monitor is located cannot be less than -65 dBm.

A.12.3.3 Distinct Vision Distance

The distinct vision distance between the monitor and the AP is no less than to 50 meters.

A.13 Measurement Specifications

The adjustable range of alarm limits is the same with the measurement range of signals unless otherwise specified.

A.13.1 ECG Specifications

ECG	
Lead set	3-lead: I, II, III 5-lead: I, II, III, aVR, aVL, aVF, V 6-lead: I, II, III, aVR, aVL, aVF, Va, Vb 12-lead I, II, III, aVR, aVL, aVF, V1 to V6
ECG standard	AHA, IEC
Display sensitivity	1.25 mm/mV (×0.125), 2.5 mm/mV (×0.25), 5 mm/mV (×0.5), 10 mm/mV (×1), 20 mm/mV (×2), 40 mm/mV (×4), Auto, less than 5% error
Sweep speed	6.25 mm/s, 12.5 mm/s, 25 mm/s, 50 mm/s, less than 5% error
Bandwidth (-3dB)	Diagnostic mode: 0.05 to 150 Hz Monitor mode: 0.5 to 40 Hz Surgical mode: 1 to 20 Hz ST mode: 0.05 to 40 Hz High Freq Cut-off (for 12-lead ECG analysis) 350 Hz, 150 Hz, 35 Hz, or 20 Hz, selectable
Common mode rejection ratio	Diagnostic mode: >90 dB Monitor mode: >105 dB (with notch filter on) Surgical mode: >105 dB (with notch filter on) ST mode: >105 dB (with notch filter on)
Notch filter	50/60 Hz Monitor, surgical, and ST mode: notch filter turns on automatically Diagnostic mode and High Freq Cut-off: notch filter is turned on/off manually
Differential input impedance	≥5 MΩ
Input signal range	±10 mV (peak-to-peak value)
Accuracy of signal reproduction	Use A and D methods based on IEC 60601-2-25 to determine frequency response.
Electrode offset potential tolerance	±800 mV
Lead-off detection current	Measuring electrode: <0.1 μA Drive electrode: <1 μA
Input offset current	≤0.1 μA, (drive lead≤1μA)
Defibrillation protection	Enduring 5000V (360 J) charge without data loss or corruption Baseline recovery time: <5 s (after defibrillation) Polarization recovery time: <10 s Defibrillation energy absorption: ≤10% (100Ω load)
Patient leakage current	<10 uA
Calibration signal	1mV (peak-to-peak value) ±5%
ESU protection	Cut mode: 300 W Coagulate mode: 100 W Recovery time: ≤10 s In compliance with the requirements in clause 202.6.2.101 of IEC 60601-2-27
Pace Pulse	

Pace pulse markers	Pace pulses meeting the following conditions are labelled with a PACE marker: Amplitude: ±2 to ±700 mV Width: 0.1 to 2 ms Rise time: 10 to 100 µs (no greater than 10% of pulse width) No overshoot
Pace pulse rejection	When tested in accordance with the IEC 60601-2-27: 201.12.1.101.13, the heart rate meter rejects all pulses meeting the following conditions. Amplitude: ±2 to ±700 mV Width: 0.1 to 2 ms Rise time: 10 to 100 µs (no greater than 10% of pulse width) No overshoot
HR	
Measurement range	15 to 350 bpm
Resolution	1 bpm
Accuracy	±1 bpm or ±1%, whichever is greater.
Sensitivity	200 µV (lead II)
HR averaging method	In compliance with the requirements in Clause 201.7.9.2.9.101 b) 3) of IEC 60601-2-27, the following method is used: If the last 3 consecutive RR intervals are greater than 1200 ms, the 4 most recent RR intervals are averaged to compute the HR. Otherwise, heart rate is computed by subtracting the maximum and minimum ones from the most recent 12 RR intervals and then averaging them. The HR value displayed on the monitor screen is updated no more than one second.
Response to irregular rhythm	In compliance with the requirements in Clause 201.7.9.2.9.101 b) 4) of IEC 60601-2-27, the heart rate after 20 seconds of stabilization is displayed as follows: Ventricular bigeminy (waveform A1): 80±1 bpm Slow alternating ventricular bigeminy (waveform A2): 60±1 bpm Rapid alternating ventricular bigeminy (waveform A3): 120±1 bpm Bidirectional systoles (waveform A4): 90±2 bpm
Response time to heart rate change	Meets the requirements of IEC 60601-2-27: Clause 201.7.9.2.9.101 b) 5). From 80 to 120 bpm: less than 11 s From 80 to 40 bpm: less than 11 s
Time to alarm for tachycardia	Meets the requirements in Clause 201.7.9.2.9.101 b) 6) of IEC 60601-2-27. Waveform B1h-range: <11 s B1-range: <11 s B1d-range: <11 s B2h-range: <11 s B2-range: <11 s B2d-range: <11 s
Tall T-wave rejection capability	When the test is performed based on Clause 201.12.1.101.17 of IEC 60601-2-27, the heart rate calculation is not affected for QRS of 1 mV amplitude and 100 ms duration, T-wave duration of 180 ms and amplitude lower than 1.2 mV, and QT interval of 350 ms.
Arrhythmia Analysis Classifications	Asystole, V-Fib/V-Tach, V-Tach, Vent Brady, Extreme Tachy, Extreme Brady, Vent Rhythm, PVCs/min, Pauses/min, Couplet, Bigeminy, Trigeminy, R on T, Run PVCs, PVC, Tachy, Brady, Missed Beat, Pacer Not Pacing, Pacer Not Capture, Multiform PVC, Nonsus V-Tach, Pause, Irr Rhythm
ST Segment Analysis	
Measurement range	-2.5 to 2.5 mV RTI

Accuracy	-0.8 to 0.8 mV: ±0.02 mV or ±10%, whichever is greater. Beyond this range: Not specified.	
Resolution	0.01mV	
QT/QTc Analysis		
Measurement range	QT: 200 to 800 ms QTc: 200 to 800 ms QT-HR: 15 to 180 bpm	
Accuracy	QT: ±30 ms	
Resolution	QT: 4 ms QTc: 1 ms	
12-lead ECG Interpretation		
Sampling rate	1000 samples/s (A/D) 500 samples/s (ECG algorithm)	
Amplitude quantisation	24 bits	
Alarm limit	**Range**	**Step**
HR High	HR≤40bpm: (low limit + 2 bpm) to 40 bpm HR > 40 bpm: (low limit + 5 bpm) to 295 bpm	HR≤40bpm: 1 bpm HR > 40 bpm: 5 bpm
HR Low	HR≤40bpm: 16 bpm to (high limit - 2 bpm) HR > 40 bpm: 40 bpm to (high limit - 5 bpm)	
ST High	(low limit + 0.2 mV) to 2.0 mV (ST alarm mode: Absolute) 0 mV to 2.0 mV (ST alarm mode: Relative)	0.05 mV
ST Low	-2.0 mV to (high limit - 0.2 mV) (ST alarm mode: Absolute) -2.0 mV to 0 mV (ST alarm mode: Relative)	
QTc High	200 to 800 ms	10 ms
ΔQTc High	30 to 200 ms	

A.13.2 Resp Specifications

Technique	Trans-thoracic impedance
Lead	Options are lead I, II and Auto.
Respiration excitation waveform	<300 μA RMS, 62.8 kHz (±10%)
Minimum respiration impedance threshold	0.3Ω
Baseline impedance range	200 to 2500Ω (using an ECG cable with 1kΩ resistance)
Differential input impedance	>2.5 MΩ
Bandwidth	0.2 to 2.5 Hz (-3 dB)
Sweep speed	3mm/s, 6.25 mm/s, 12.5 mm/s, 25 mm/s or 50 mm/s, less than 10% error
Recovery time	<15 s (after defibrillation)
Respiration Rate	
Measurement range	0 to 150 rpm
Resolution	1 rpm
Accuracy	0 to 120 rpm: ±1 rpm 121 to 150 rpm: ±2 rpm

Apnea alarm time	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s	
Alarm limit	**Range (rpm)**	**Step (rpm)**
RR High	(low limit + 2) to 150	1
RR Low	0 to (high limit - 2)	

A.13.3 SpO_2 Specifications

Alarm limit	**Range (%)**	**Step (%)**
SpO_2 High	(low limit + 2) to 100	1
SpO_2 Low	(Desat+1) to (high limit - 2)	
SpO_2 Desat Low	0 to (low limit - 1)	

Mindray SpO_2 Module

Measurement range	0 to 100%
Resolution	1%
Response time	< 30 s (normal perfusion, no disturbance, SpO_2 value sudden changes from 70% to 100%)
Accuracy	70 to 100%: ±3% 0% to 69%: Not specified.
Refreshing rate	≤1 s
Sensitivity	High, Medium, Low
Recovery time	<15 s (after defibrillation)
PI	
Measurement range	0.05 to 20%
Resolution	0.05%~9.99%: 0.01% 10.0%~20.0%: 0.1%

Nellcor SpO_2 Module

Measurement range	0 to 100%
Resolution	1%
Refreshing rate	≤1 s
Response time	≤30 s (normal perfusion, no disturbance, SpO2 value sudden change from 70% to 100%)
Recovery time	<15 s (after defibrillation)
Accuracy	70 to 100%: ±3% 0% to 69%: Not specified

Masimo SpO_2 Module

Measurement range	1 to 100%
Resolution	1%
Response time	≤20 s (normal perfusion, no disturbance, SpO_2 value sudden changes from 70% to 100%)
Accuracy	70 to 100%: ±3% (measured without motion) 70 to 100%: ±3% (measured with motion) 1% to 69%: Not specified.
Refresh rate	≤ 1 s
SpO_2 averaging time	2-4 s, 4-6 s, 8 s, 10 s, 12 s, 14 s, 16 s
Low perfusion conditions	Pulse amplitude: >0.02% Light penetration: >5%
Low perfusion SpO_2 accuracy	±2%
PI measurement range	0.02 to 20%

A.13.4 PR Specifications

Alarm limit	Range	Step
PR High	PR≤40bpm: (low limit + 2 bpm) to 40 bpm PR > 40 bpm: (low limit + 5 bpm) to 295 bpm	PR≤40: 1 PR>40: 5
PR Low	PR≤40bpm: 16 bpm to (high limit - 2 bpm) PR > 40 bpm: 40 bpm to (high limit - 5 bpm)	

PR from Mindray SpO_2 Module

Measurement range	20 to 300 bpm
Resolution	1 bpm
Response time	<30 s (normal perfusion, no disturbance, PR value sudden changes from 25 to 220bpm)
Accuracy	±3 bpm
Refreshing rate	≤1 s

PR from Nellcor SpO_2 Module

Measurement range	20 to 300 bpm
Resolution	1 bpm
Response time	≤30 s (normal perfusion, no disturbance, PR value sudden change from 25 to 250 bpm)
Accuracy	20 to 250 bpm: ±3 bpm 251 to 300 bpm, not specified
Refreshing rate	≤1 s

PR from Masimo SpO_2 Module

Measurement range	25 to 240 bpm
Resolution	1 bpm

Response time	≤20 s (with normal perfusion, no disturbance, and a PR value transition from 25 to 220 bpm)
Accuracy	±3 bpm (measured without motion) ±5 bpm (measured with motion)
Refresh rate	≤1 s

PR from IBP Module

Measurement range	20 to 350 bpm
Resolution	1 bpm
Accuracy	±1 bpm or ±1%, whichever is greater

A.13.5 Temp Specifications

Technique	Thermal resistance	
Operating mode	Direct mode	
Measurement range	0 to 50 °C (32 to 122 °F)	
Resolution	0.1°C	
Accuracy	±0.1 °C or ±0.2 °F (excluding probe error)	
Refreshing rate	≤1 s	
Minimum time for accurate measurement	Body surface: <100 s Body cavity: <80 s	
Recovery time	<15 s (after defibrillation)	
Alarm limit	**Range**	**Step**
TXX High (XX refers to temperature site)	(low limit +1.0) to 50.0 °C (low limit +2.0) to 122.0 °F	0.1 °C 0.1 °F
TXX Low (XX refers to temperature site)	0.1 to (high limit - 1.0) °C 32.2 to (high limit - 2.0) °F	
ΔT High	0.1 to 50.0 °C 0.2 to 90.0 °F	

A.13.6 NIBP Specifications

Technique	Oscillometry			
Mode of operation	Manual, Auto, STAT, Sequence			
Auto mode repetition intervals	1, 2, 2.5, 3, 5, 10, 15, 20, 30, 60, 90, 120, 180, 240 or 480 min			
STAT mode cycle time	5 min			
Max measurement time	120 s			
Heart rate range	30 to 300 bpm			
Measurement ranges (mmHg)		Weight >23kg or >50 lb	Weight 10 to 23 kg or 21 to 50 lb	Weight <10 kg or <21 lb
	Systolic:	25~290	25~240	25~240
	Diastolic:	10~250	10~200	10~200
	Mean:	15~260	15~215	15~215

Accuracy	Max mean error: ±5 mmHg Max standard deviation: 8 mmHg	
Resolution	1mmHg	
Initial cuff inflation pressure range (mmHg)	Weight >23kg or >50 lb: 80 to 280 Weight 10 to 23 kg or 21 to 50 lb: 80 to 210 Weight <10 kg or <21 lb: 80 to 210	
Default initial cuff inflation pressure (mmHg)	Weight >23kg or >50 lb: 160 Weight 10 to 23 kg or 21 to 50 lb: 140 Weight <10 kg or <21 lb: 140	
Software overpressure protection	297±3 mmHg	
Static pressure measurement range	0 mmHg to 300 mmHg	
Static pressure measurement accuracy	±3 mmHg	
Recovery time	<15 s (after defibrillation)	
PR		
Measurement range	30 to300 bpm	
Resolution	1 bpm	
Accuracy	±3bpm or ±3%, whichever is greater	
Alarm limit	**Range (mmHg)**	**Step (mmHg)**
NIBP-S High	Weight >23kg or >50 lb: (low limit + 5) to 290 Weight 10 to 23 kg or 21 to 50 lb: (low limit + 5) to 240 Weight <10 kg or <21 lb: (low limit + 5) to 240	NIBP ≤ 50: 1 NIBP > 50: 5
NIBP-S Low	25 to (high limit - 5)	
NIBP-M High	Weight >23kg or >50 lb: (low limit + 5) to 260 Weight 10 to 23 kg or 21 to 50 lb: (low limit + 5) to 215 Weight <10 kg or <21 lb: (low limit + 5) to 215	
NIBP-M Low	15 to (high limit - 5)	
NIBP-D High	Weight >23kg or >50 lb: (low limit + 5) to 250 Weight 10 to 23 kg or 21 to 50 lb: (low limit + 5) to 200 Weight <10 kg or <21 lb: (low limit + 5) to 200	
NIBP-D Low	10 to (high limit - 5)	

A.13.7 IBP Specifications

Technique	Direct invasive measurement	
IBP		
Measurement range	-50 to 300 mmHg	
Resolution	1 mmHg	
Accuracy	±2% or ±1 mmHg, whichever is greater (excluding sensor error)	
Refreshing rate	≤1 s	
Recovery time	<10 s (after defibrillation)	
PPV		
Measurement range	0% ~ 50%	
Pressure transducer		
Excitement voltage	5 VDC, ±2%	
Sensitivity	5 μV/V/mmHg	
Zero adjustment range	±200 mmHg	
Impedance range	300 to 3000Ω	
Volume displacement	<0.04 mm^3 /100 mmHg	
Alarm limit	**Range (mmHg)**	**Step (mmHg)**
Sys High	(low limit + 2) to 300	1
Mean High		
Dia High		
Sys Low	-50 to (high limit - 2)	
Mean Low		
Dia Low		

A.13.8 C.O. Specifications

Measurement method	Thermodilution method	
Measurement range	C.O.: TB: TI:	0.1 to 20 L/min 23 to 43 ℃ 0 to 27 ℃
Resolution	C.O.: TB, TI:	0.1 L/min 0.1 ℃
Accuracy	C.O.: TB, TI:	±5% or ±0.1 L /min, whichever is greater ±0.1 ℃ (without sensor)
TB Operating mode	Direct mode	
Minimum time for accurate TB measurement	10 s	
Repeatability	C.O.:	±2% or ±0.1 L/min, whichever is greater
Alarm range	TB:	23 to 43 ℃
Recovery time	<15 s (after defibrillation)	
Alarm limit	**Range**	**Step**

TB High	(low limit + 1) to 43 °C (low limit + 2) to 109.4 °F	0.1 °C 0.1 °F
TB Low	23 to (high limit - 1) °C 73.4 to (high limit - 2) °F	

A.13.9 CO_2 Specifications

Measurement mode	Sidestream, microstream, mainstream	
Technique	Infrared absorption	
Apnea time	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s	
Alarm limit	**Range**	**Step**
$EtCO_2$ High	(low limit + 2) to 99 mmHg	1 mmHg
$EtCO_2$ Low	1 to (high limit - 2)mmHg	
$FiCO_2$ High	1 to 99 mmHg	
EtO_2 High	(low limit + 2%) to 100%	1%
EtO_2 Low	0% to (high limit - 2)%	
FiO_2 High	(low limit + 2%) to 100%	
FiO_2 Low	18% to (high limit - 2)%	

Sidestream CO_2 Module

CO_2 Measurement range	0 to 150 mmHg
CO_2 absolute accuracy*	Full accuracy mode: 0 to 40 mmHg: ± 2 mmHg 41 to 76 mmHg: ±5% of reading 77 to 150 mmHg: ±10% of reading ISO accuracy mode: add ±2mmHg to the full accuracy mode
Inaccuracy specifications are affected by the breath rate and I:E. The $EtCO_2$ accuracy is within specification for breath rate ≤ 60 rpm and I/E ratio ≤ 1:1, or breath rate ≤ 30 rpm and I/E ratio ≤ 2:1.	
CO_2 resolution	1 mmHg
Recovery time	<15 s (after defibrillation)
O_2 measurement range	0 to 100%
O_2 absolute accuracy	0≤O_2 concentration≤25%: ±1% 25<O_2 concentration≤80%: ±2% 80<O_2 concentration≤100%: ±3%
O_2 resolution	1%
Accuracy drift	Meet the requirement for measurement accuracy within 6 hours
Sample flowrate	For sidestream CO_2 module without O_2 monitoring function: Connected a DRYLINE II watertrap for large animal: 120 ml/min Connected a DRYLINE II watertrap for small animal: 90 ml/min or 70 ml/min For sidestream CO_2 module with O_2 monitoring function: Connected a DRYLINE II watertrap for large animal: 120 ml/min Connected a DRYLINE II watertrap for small animal: 90 ml/min
Sample flowrate tolerance	±15% or ±15 ml/min, whichever is greater.
Start-up time	Maximum: 90 s Typically: 20 s

Response time	For CO_2 measurement (without O_2 measurement): Measured with a DRYLINE II watertrap and a 2.5-meter sampling line for small animal: ≤5.0 s @ 70 ml/min ≤4.5 s @ 90 ml/min Measured with a DRYLINE II watertrap and a 2.5-meter sampling line for large animal: ≤5.0 s @ 120 ml/min For CO_2 measurement (with O_2 measurement): Measured with a DRYLINE II watertrap and a 2.5-meter sampling line for small animal: ≤4.5 s@90 ml/min. Measured with a DRYLINE II watertrap and a 2.5-meter sampling line for large animal: ≤5 s@120 ml/min For O_2 measurements: Measured with a DRYLINE II watertrap and a 2.5-meter sampling line for small animal: ≤4.5 s @ 90 ml/min Measured with a DRYLINE II watertrap and a 2.5-meter sampling line for large animal: ≤5 s@120 ml/min	
Rise time	For CO_2 measurement (without O_2 measurement): Measured with a DRYLINE II watertrap and a 2.5-meter sampling line for small animal: ≤250 ms@70 ml/min. ≤250 ms@90 ml/min. Measured with a DRYLINE II watertrap and a 2.5-meter sampling line for large animal: ≤300 ms@120 ml/min For CO_2 measurement (with O_2 measurement): Measured with a DRYLINE II watertrap and a 2.5-meter sampling line for small animal: ≤250 ms@90 ml/min. Measured with a DRYLINE II watertrap and a 2.5-meter sampling line for large animal: ≤300 ms@120 ml/min For O_2 measurements: Measured with a DRYLINE II watertrap and a 2.5-meter sampling line for small animal: ≤800 ms@90 ml/min. Measured with a DRYLINE II watertrap and a 2.5-meter sampling line for large animal: ≤750 ms@120 ml/min	
awRR measurement range	0 to 150 rpm	
awRR measurement precision	≤60 rpm: ±1 61 to 150 rpm: ±2	
awRR resolution	1 rpm	
Data sample rate	50 Hz	
Effect of interference gases on CO_2 measurements		
Gas	**Concentration (%)**	**Quantitative effect***

N_2O	≤60	±1 mmHg
Hal	≤4	
Sev	≤5	
Iso	≤5	
Enf	≤5	
Des	≤15	±2 mmHg
*: means an extra error should be added in case of gas interference when CO_2 measurements are performed between 0 to 40mmHg.		
Effect of interference gases on O_2 measurements		
Gas	**Quantitative effect**	
CO_2	0.2%	
N_2O	0.2%	
Hal, Des, Sev, Iso, Enf	1%	

Microstream CO_2 Module

CO_2 Measurement range	0 to 150 mmHg
Accuracy*	0 to 38 mmHg: ±2 mmHg 39 to 150 mmHg: ±5% of the reading (0.08% increased in error for every 1 mmHg if the reading is more than 38 mmHg)
Accuracy drift	Meet the requirement for measurement accuracy within 6 hours
Resolution	1 mmHg
Recovery time	<15 s (after defibrillation)
Sample flow rate	$50^{+15}_{-7.5}$ ml/min
Initialization time	30 s (typical) 180 s (maximum)
Response time	2.9 s (typical) (The response time is the sum of the rise time and the delay time when using a FilterLine of standard length) Rise time: <190 ms (10% to 90%) Delay time: 2.7 s (typical)
awRR measurement range	0 to 150 rpm
awRR measurement accuracy	0 to 70 rpm: ±1 rpm 71 to 120 rpm: ±2 rpm 121 to 150 rpm: ±3 rpm
awRR resolution	1 rpm
Data sample rate	40 Hz

Mainstream CO_2 Module

CO_2 Measurement range	0 to 150 mmHg
Accuracy	0 to 40 mmHg: ±2 mmHg 41 to 70 mmHg: ±5% of the reading 71 to 100 mmHg: ±8% of the reading 101 to 150 mmHg: ±10% of the reading

Accuracy drift	Meet the requirement for measurement accuracy within 6 hours
Resolution	1 mmHg
Recovery time	<15 s (after defibrillation)
Rise time	<60 ms
Data sample rate	100 Hz
awRR measurement range	0 to 150 rpm
awRR measurement accuracy	±1 rpm
awRR resolution	1 rpm

A.13.10 AG Specifications

Technique	Infrared absorption, paramagnetic properties for O_2 monitoring	
Recovery time	<15 s (after defibrillation)	
Warm-up time	Iso accuracy mode: Full accuracy mode:	45 s 10 min
Sample flow rate	Large animal: Small animal: Accuracy:	200 ml/min 120 ml/min ±10 ml/min or ±10%, whichever is greater
Measurement range	CO_2: O_2: N_2O: Des: Sev: Enf: Iso: Hal: awRR:	0 to 30% 0 to 100% 0 to 100% 0 to 30% 0 to 30% 0 to 30% 0 to 30% 0 to 30% 2 to 100 rpm
Resolution	CO_2: O_2: N_2O: Des: Sev: Enf: Iso: Hal: awRR:	0.1% 1% 1% 0.1% 0.1% 0.1% 0.1% 0.1% 1 rpm
Iso accuracy	As full accuracy specifications, but derated as follows: Add $\pm 0.3\%_{ABS}$ to accuracy for CO_2 Add $\pm 8\%_{REL}$ to accuracy for all anesthetic gases N_2O accuracy is $\pm(8\%_{REL}+2\%_{ABS})$	

Full accuracy	Gases	Range (%REL)1	Accuracy (%ABS)
	CO_2	$0 \le CO_2 \le 1$ $1 < CO_2 \le 5$ $5 < CO_2 \le 7$ $7 < CO_2 \le 10$ $CO_2 > 10$	±0.1 ±0.2 ±0.3 ±0.5 Not specified
	N_2O	0 - 20 20 - 100 (excluding 20)	±2 ±3
	O_2	0 - 25 25 - 80 (excluding 25) 80 - 100 (excluding 80)	±1 ±2 ±3
	Des	0 - 1 1 - 5 (excluding 1) 5 - 10 (excluding 5) 10 - 15 (excluding 10) 15 - 18 (excluding 15) >18	±0.15 ±0.2 ±0.4 ±0.6 ±1 Not specified
	Sev	0 - 1 1 - 5 (excluding 1) 5 - 8 (excluding 5) >8	±0.15 ±0.2 ±0.4 Not specified
	Enf, Iso, Hal	0 - 1 1 - 5 (excluding 1) >5	±0.15 ±0.2 Not specified
awRR	2 to 60 rpm >60 rpm		±1 rpm Not specified
Note[1]: The highest GAS LEVEL for a single halogenated anaesthetic gas in a gas mixture that is concealed when the anaesthetic concentration falls is 0.15/0.3% (Full/ISO accuracy).			
Accuracy drift	Meet the requirement for measurement accuracy within 6 hours		
Apnea alarm time	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s		
Refreshing rate	≤1 s		
Rise time (10% ~ 90%)	Gas sample flow rate 120ml/min, using a DRYLINE II watertrap and sampling line (2.5m) for small animal: CO_2 ≤250 ms N_2O ≤250 ms Hal, Iso, Sev, Des ≤300 ms Enf ≤350 ms O_2 ≤600 ms		
	Gas sample flow rate 200ml/min, using the DRYLINE II water trap and sampling line (2.5m) for large animal: CO_2 ≤250 ms N_2O ≤250 ms O_2 ≤500 ms Hal, Iso, Sev, Des ≤300 ms Enf ≤350 ms		
Delay time	<4 s		

Response time	Measured with a DRYLINE II watertrap and a 2.5-meter sampling line for small animal: 120 ml/min: CO_2: ≤4 s N_2O: ≤4.2 s O_2: ≤4 s Hal, Iso, Sev, Des, Enf: ≤4.4 s
	Measured with a DRYLINE II watertrap and a 2.5-meter sampling line for large animal: 200 ml/min: CO_2: ≤4.2s N_2O: ≤4.3s Hal, Iso, Sev, Des, Enf: ≤4.5s O_2: ≤4s
Anesthetic agent limit	Primary anesthetic agent In full accuracy mode: 0.15%,
	Secondary anesthetic agent: In full accuracy mode: 5% of primary agent if primary agent is greater than 10%, 0.3% if primary agent is less than or equal to 10%.
Data sample rate	25 Hz

Inaccuracy specifications are affected by the breath rate and I:E change. The end-tidal gas reading is within specification for breath rate below 15BPM and I:E ratio smaller than 1:1 relative to the gas readings without breath; Add ±6%REL to inaccuracy for HAL and O_2 for breath rate larger than 15 BPM; Add ±6%REL to inaccuracy for all gases for breath rate larger than 30 BPM (inaccuracy for HAL and O_2 are unspecified in this case); inaccuracy is unspecified for breath rate larger than 60 BPM.

Effect of interference gases on AG measurements

Gas	**Concentration (%)**	**Quantitative effect(%ABS)3)**			
		CO_2	**N_2O**	**Agent [1)]**	**O_2**
CO_2	/	/	0.1	0	0.2
N_2O	/	0.1	/	0.1	0.2
Agent [1) 2)]	/	0.1	0.1	0.1	1
Xenon	<100%	0.1	0	0	0.5
Helium	<50%	0.1	0	0	0.5
Ethanol	<0.1%	0	0	0	0.5
Acetone	<1%	0.1	0.1	0	0.5
Methane	<1%	0.1	0.1	0	0.5
Saturated Isopropanol vapour	/	0.1	0	0	0.5
Metered dose inhaler propellants,	/	Unspecified	Unspecified	Unspecified	Unspecified
O_2	/	0.2	0.2	1.0	/

1) Agent represents one of Des, Iso, Enf, Sev, and Hal.

2) Multiple agent interference on CO_2, N_2O and O_2 is typically the same as single agent interference.

3) For CO_2, N_2O and Agents, maximum interference from each gas at concentrations within specified accuracy ranges for each gas. The total interference of all gases is never larger than 5%REL.

Alarm limit	**Range**	**Step**

$EtCO_2$ High	(low limit + 2) to 99 mmHg	1 mmHg
$EtCO_2$ Low	1 to (high limit - 2)mmHg	
$FiCO_2$ High	1 to 99 mmHg	
EtO_2 High	(low limit + 2%) to 100%	1%
EtO_2 Low	0% to (high limit - 2)%	
FiO_2 High	(low limit + 2%) to 100%	
FiO_2 Low	18% to (high limit - 2)%	
EtN_2O High	(low limit + 2) to 100%	1%
EtN_2O Low	0 to (high limit - 2)%	
FiN_2O High	(low limit + 2) to 100%	
FiN_2O Low	0 to (high limit - 2)%	
EtHal/Enf/Iso High	(low limit + 0.2) to 5.0%	0.1%
EtHal/Enf/Iso Low	0 to (high limit - 0.2)%	
FiHal/Enf/Iso High	(low limit + 0.2) to 5.0%	
FiHal/Enf/Iso Low	0 to (high limit - 0.2)%	
EtSev High	(low limit + 0.2) to 8.0%	0.1%
EtSev Low	0 to (high limit - 0.2)%	
FiSev High	(low limit + 0.2) to 8.0%	
FiSev Low	0 to (high limit - 0.2)%	
EtDes High	(low limit + 0.2) to 18.0%	0.1%
EtDes Low	0 to (high limit - 0.2)%	
FiDes High	(low limit + 0.2) to 18.0%	
FiDes Low	0 to (high limit - 0.2)%	

B EMC and Radio Regulatory Compliance

B.1 EMC

The device meets the requirements of IEC 60601-1-2: 2014.

WARNING

- **Use of accessories, transducers and cables other than those specified or provided by the manufacturer of this equipment could result in increased electromagnetic emissions or decreased electromagnetic immunity of this equipment and result in improper operation.**
- **The non-ME EQUIPMENT (e.g. ITE) that is a part of an ME SYSTEM may be disrupted by the electromagnetic interference of nearby equipment. It may be necessary to take mitigation measures, such as re-orienting or relocating the non-ME EQUIPMENT or shielding the location.**
- **Use of this equipment adjacent to or stacked with other equipment should be avoided because it could result in improper operation. If such use is necessary, this equipment and the other equipment should be observed to verify that they are operating normally.**
- **This device is intended for use in professional healthcare facility environment and home healthcare environment. If it is used in special environment, such as magnetic resonance imaging environment, the equipment/system may be disrupted by the operation of nearby equipment.**
- **Portable RF communications equipment (including peripherals such as antenna cables and external antennas) should be used no closer than 30 cm (12 inches) to any part of the this device, including cables specified by the manufacturer. Otherwise, degradation of the performance of this equipment could result.**

Guidance and Declaration - Electromagnetic Emissions		
The device is intended for use in the electromagnetic environment specified below. The customer or the user of the device should assure that it is used in such an environment.		
Emission tests	**Compliance**	**Electromagnetic environment - guidance**
Conducted and radiated RF EMISSIONS CISPR 11	Group 1	The device uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
Conducted and radiated RF EMISSIONS CISPR 11	Class A	The device is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes
Harmonic distortion EMISSIONS IEC61000-3-2	Class A	
Voltage Fluctuations/Flicker EMISSIONS IEC 61000-3-3	Complies	

If the system is operated within the electromagnetic environment listed in Table Guidance and Declaration - Electromagnetic Immunity, the system will remain safe and provide the following essential performance:

- Operating mode
- Accuracy
- Function
- Accessories identification
- Data stored
- Alarm
- Detect for connection

NOTE

- **If the essential performance is lost or degraded, it may be necessary to take mitigation measures, such as re-orienting or relocating the ME EQUIPMENT or ME SYSTEM or shielding the location or stopping using the monitor and contact the service personnel.**
- **The device needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided below.**
- **Other devices may interfere with this device even though they meet the requirements of CISPR.**
- **When the inputted signal is below the minimum amplitude provided in technical specifications, erroneous measurements could result.**
- **The EMISSIONS characteristics of this device make it suitable for use in industrial areas and hospitals (CISPR 11 class A). If it is used in a residential environment (for which CISPR 11 class B is normally required) this device might not offer adequate protection to radio-frequency communication services. The user might need to take mitigation measures, such as relocating or re-orienting the device.**

Guidance and Declaration - Electromagnetic Immunity			
The device is intended for use in the electromagnetic environment specified below. The customer or the user of the device should assure that it is used in such an environment.			
Immunity test	**IEC60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	±8 kV contact ±15 kV air	±8 kV contact ±15 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	±2 kV for power supply lines ±1 kV for input/ output lines	±2 kV for power supply lines ±1 kV for input/ output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1 kV line(s) to line(s) ±2 kV line(s) to earth	±1 kV line(s) to line(s) ±2 kV line(s) to earth	
Voltage dips and voltage interruptions IEC 61000-4-11	0% U_T for 0.5 cycle: at 0°, 45°, 90°, 135°, 180°, 225°, 270° and 315° 0% U_T for 1 cycle and 70% U_T for 25/30 cycles: at 0° 0% U_T for 250/300 cycle	0% U_T for 0.5 cycle: at 0°, 45°, 90°, 135°, 180°, 225°, 270° and 315° 0% U_T for 1 cycle and 70% U_T for 25/30 cycles: at 0° 0% U_T for 250/300 cycle	Mains power quality should be that of a typical commercial or hospital environment. If the user of our product requires continued operation during power mains interruptions, it is recommended that our product be powered from an uninterruptible power supply or a battery.
RATED power frequency magnetic fields IEC 61000-4-8	30 A/m 50 Hz/60 Hz	30 A/m 50 Hz/60 Hz	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Note: U_T is the AC mains voltage prior to application of the test level.			

Guidance and Declaration - Electromagnetic Immunity			
The device is intended for use in the specified electromagnetic environment. The customer or the user of the device should assure that it is used in such an environment as described below.			
Immunity test	**IEC60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Conducted disturbances induced by RF fields IEC61000-4-6	3 Vrms 150 kHz to 80 MHz 80% AM at 1 kHz	3Vrms	Portable and mobile RF communications equipment should be used no closer to any part of the system, including cables, than the recommended separation distance calculated from the equation appropriate for the frequency of the transmitter. Recommended separation distances: $d = 1.2\sqrt{P}$
	6 Vrms in ISM bands between 0.15 MHz and 80 MHz 80% AM at 1 kHz	6 Vrms	
Radiated RF EM fields IEC61000-4-3	3 V/m 80 MHz to 2,7 GHz 80% AM at 1 kHz	3V/m	Recommended separation distances: 80 MHz to 800 MHz: $d = 1.2\sqrt{P}$ 800MHz - 2.7GHz: $d = 2.3\sqrt{P}$ Where, P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m)[b]. Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey[a] should be less than the compliance level in each frequency range[b]. Interference may occur in the vicinity of equipment marked with the following symbol: 
Proximity fields from RF wireless communications equipment IEC61000-4-3	27 V/m 385 MHz	27 V/m	
	28 V/m 810 MHz, 870 MHz, 930 MHz, 1720 MHz, 1845 MHz, 1970 MHz, 2450 MHz (pulse modulation)	28 V/m	
	28V/m 450 MHz (FM modulation)	28 V/m	
	9V /m 710 MHz, 745 MHz, 780 MHz, 5240 MHz, 5500 MHz, 5785 MHz	9 V/m	
Note 1: At 80 MHz to 800 MHz, the separation distance for the higher frequency range applies. **Note 2:** These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			
[a]: Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the **ME EQUIPMENT or ME SYSTEM** is used exceeds the applicable RF compliance level above, the **ME EQUIPMENT or ME SYSTEM** should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the **ME EQUIPMENT or ME SYSTEM**. [b]: Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3V/m.			

WARNING

- **The device is configured with a wireless network connector to receive wireless signal. Other devices may interfere with this device even though they meet the requirements of CISPR.**

Recommended separation distances between portable and mobile RF communications equipment and the device			
The device is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the device can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the device as recommended below, according to the maximum output power of the communications equipment.			
Rated maximum output power of transmitter (W)	**Separation distance in meters (m) according to frequency of the transmitter**		
	150 kHz to 80 MHz $d = 1.2\sqrt{P}$	80 MHz to 800 MHz $d = 1.2\sqrt{P}$	800 MHz to 2.7 GHz $d = 2.3\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.20	1.20	2.30
10	3.80	3.80	7.30
100	12.00	12.00	23.00
For transmitters rated at a maximum output power not listed above, the recommended separation distance d in metres (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer. **Note 1:** At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies. **Note 2:** These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			

B.2 Radio Regulatory Compliance

CE

The radio device used in this product is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EU.

This device complies with part 15 of the FCC Rules and with RSS-210 of Industry Canada. Operation is subject to the condition that this device does not cause harmful interference.

This device must accept any interference received, including interference that may cause undesired operation.

WARNING

- **Changes or modifications not expressly approved by the party responsible compliance could void the user's authority to operate the equipment.**

C Default Settings

C.1 Parameters Default Settings

C.1.1 ECG, Arrhythmia, ST and QT Default Settings

C.1.1.1 ECG Default Settings

Item		Default Setting
HR/PR	Alarm switch (On/Off)	On
	High limit	180 bpm
	Low limit	Canine: 50 bpm Feline: 90 bpm Other: 50 bpm
	Priority	Med
	Alarm Outputs	Off
Extreme Tachy	Alarm switch (On/Off)	On
	High limit	200 bpm
	Priority	High
	Alarm Outputs	Off
Extreme Brady	Alarm switch (On/Off)	On
	Low limit	Canine: 35 bpm Feline: 70 bpm Other: 35 bpm
	Priority	High
	Alarm Outputs	Off
Alarm Source		Auto
ECG1		II
ECG2 (5-lead, 6-lead, 12-lead)		V, Va, V1
Va (for 6-lead only)		Va
Vb(for 6-lead only)		Vb
ECG Gain		×2
Speed		25 mm/sec
Filter		Monitor
High Freq Cut-off (for 12-lead analysis)		35 Hz
Notch Filter		On
Lead Set		Auto
Smart Lead		On
Baseline Drift Removal (for 12-lead only)		On
Waveform Layout (for 12-lead only)		Standard

Item	Default Setting
CrozFusion	On
Display CrozFusion	Off
QRS Volume	2
QRS Threshold	0.16 mV
Paced	No
Pacer Reject	Off

C.1.1.2 Arrhythmia Default Settings

Arrhythmia Alarm Default Settings

Item	Alarm Switch	Priority	Alarm Outputs
Asystole	On	High, unadjustable	Off
V-Fib/V-Tach	On	High, unadjustable	Off
V-Tach	On	High, unadjustable	Off
Vent Brady	On	High, unadjustable	Off
Extreme Tachy	On	High, unadjustable	Off
Extreme Brady	On	High, unadjustable	Off
R on T	Off	Med	Off
Run PVCs	Off	Low	Off
Couplet	Off	Prompt	Off
Multiform PVC	Off	Med	Off
PVC	Off	Prompt	Off
Bigeminy	Off	Med	Off
Trigeminy	Off	Med	Off
Tachy	Off	Med	Off
Brady	Off	Med	Off
Pacer Not Capture	Off	Prompt	Off
Pacer Not Pacing	Off	Prompt	Off
Missed Beat	Off	Prompt	Off
Nonsus V-Tach	Off	Med	Off
Vent Rhythm	Off	Med	Off
Pause	Off	Low	Off
Irr Rhythm	Off	Prompt	Off
PVCs/min	Off	Med	Off
Pauses/min	Off	Med	Off

Arrhythmia Threshold Default Settings

Item	Default Setting
Asystole Delay	5 sec
Tachy	180 bpm
Brady	Canine: 50 bpm Feline: 90 bpm Other: 50 bpm
Extreme Tachy	200 bpm
Extreme Brady	Canine: 35 bpm Feline: 70 bpm Other: 35 bpm
Multif PVCs Window	15 beats
PVCs/min	10
Pauses/min	8
Pause Threshold	2.0 sec
Irr Rhy End Time	2 min
V-Tach Rate	130 bpm
V-Brady Rate	40 bpm
V-Tach PVCs	6
V-Brady PVCs	5

C.1.1.3 ST Default Settings

Item		Default Setting
ST Alarm Mode		Absolute
ST-I, ST-II, ST-III, ST-aVR, ST-aVL, ST-aVF, ST-V1, ST-V2, ST-V3, ST-V4, ST-V5,ST-V6, ST-Va, ST-Vb (ST Alarm Mode set to **Absolute**)	Alarm switch (On/ Off)	Off
	High limit	0.2 mV
	Low limit	-0.2 mV
	Priority	Med
	Alarm Outputs	Off
ST Single, ST Dual (ST Alarm Mode set to **Relative**)	Alarm switch (On/ Off)	Off
	High limit	0.1 mV
	Low limit	-0.1 mV
	Priority	Med
	Alarm Outputs	Off
ST Analysis		Off
ST Segment		Auto
Show Markers		Off
ST Point		J+60 ms
Auto Adjust		On
J		48

Item	Default Setting
ISO	-80

C.1.1.4 QT Default Settings

Item		Default Setting
QTc	Alarm switch (On/Off)	Off
	High limit	460
	Priority	Med
	Alarm Outputs	Off
ΔQTc	Alarm switch (On/Off)	Off
	High limit	60
	Priority	Med
	Alarm Outputs	Off
QT Analysis		Off
QT Leads		All

C.1.2 Respiration Default Settings

Item		Default Setting
RR	Alarm switch (On/Off)	On
	High limit	55
	Low limit	5
	Priority	Med
	Alarm Outputs	Off
Apnea	Alarm switch (On/Off)	On
	Priority	High, unadjustable
	Alarm Outputs	Off
Apnea Delay		15 sec
RR Source		Auto
Resp Lead		II
Gain		×2
Speed		6.25 mm/s
Auto Threshold Detection		On

C.1.3 SpO_2 Default Settings

Item		Default Setting
SpO2	Alarm switch (On/Off)	On
	High limit	100%
	Low limit	90%
	Priority	Med
	Alarm Outputs	Off
SpO2 Desat	Alarm switch (On/Off)	On
	Low limit	80%
	Priority	High
	Alarm Outputs	Off
Sat-Seconds (for Nellcor SpO_2)		Off
NIBP Simul		Off
Fast SAT (for Masimo SpO_2)		Off
Display SIQ (for Masimo SpO_2)		Off
Sensitivity (for Mindray SpO_2)		Med
Sensitivity (for Masimo SpO_2)		APOD
Averaging (for Masimo SpO_2)		8s
Display PI (for Mindray SpO_2, Masimo SpO_2)		On
Speed		25 mm/s
PR	Alarm switch (On/Off)	On
	High limit	180
	Low limit	Canine: 50 Feline: 90 Other: 50
	Priority	Med
	Alarm Outputs	Off
	Alarm Source	Auto
	PR Source	Auto
	QRS Volume	2
	Display PR	Off

C.1.4 Temperature Default Settings

Item		Default Setting
TXX (XX refers to temperature site)	Alarm switch (On/Off)	On
	High limit	40.0 ℃
	Low limit	36.0 ℃
	Priority	Med
	Alarm Outputs	Off

Item		Default Setting
ΔT	Alarm switch (On/Off)	On
	High limit	2.0 ℃
	Priority	Med
	Alarm Outputs	Off

C.1.5 NIBP Default Settings

Item		Default Setting
NIBP-S	Alarm switch (On/Off)	On
	High limit	• Weight >23kg or >50 lb: 160 mmHg • Weight 10 to 23 kg or 21 to 50 lb: 120 mmHg • Weight <10 kg or <21 lb: 120 mmHg
	Low limit	• Weight >23kg or >50 lb: 90 mmHg • Weight 10 to 23 kg or 21 to 50 lb: 70 mmHg • Weight <10 kg or <21 lb: 70 mmHg
	Priority	Med
	Alarm Outputs	Off
NIBP-D	Alarm switch (On/Off)	On
	High limit	• Weight >23kg or >50 lb: 90 mmHg • Weight 10 to 23 kg or 21 to 50 lb: 70 mmHg • Weight <10 kg or <21 lb: 70 mmHg
	Low limit	• Weight >23kg or >50 lb: 50 mmHg • Weight 10 to 23 kg or 21 to 50 lb: 40 mmHg • Weight <10 kg or <21 lb: 40 mmHg
	Priority	Med
	Alarm Outputs	Off
NIBP-M	Alarm switch (On/Off)	On
	High limit	• Weight >23kg or >50 lb: 110 mmHg • Weight 10 to 23 kg or 21 to 50 lb: 90 mmHg • Weight <10 kg or <21 lb: 90 mmHg
	Low limit	• Weight >23kg or >50 lb: 60 mmHg • Weight 10 to 23 kg or 21 to 50 lb: 50 mmHg • Weight <10 kg or <21 lb: 50 mmHg
	Priority	Med
	Alarm Outputs	Off
Weight Range		10 to 23 kg
Initial Pressure		• Weight >23kg or >50 lb: 160 mmHg • Weight 10 to 23 kg or 21 to 50 lb: 140 mmHg • Weight <10 kg or <21 lb: 140 mmHg
Initial Pressure		30 min
Interval		Clock
Start Mode		Off
NIBP End Tone		Auto
Venipuncture Pressure		Sys/Dia(Mean)

Item	Default Setting
Display Format	Off
Display Alarm Limits	Off

C.1.6 IBP Default Settings

Item		Default Setting
IBP-S	Alarm switch (On/Off)	On
	High limit	• Art/Ao/UAP/BAP/FAP/LV/P1/P2 arterial pressure: 160 mmHg • PA: 38 mmHg
	Low limit	• Art/Ao/UAP/BAP/FAP/LV/P1/P2 arterial pressure: 100 mmHg • PA: 5 mmHg
	Priority	Med
	Alarm Outputs	Off
IBP-D	Alarm switch (On/Off)	On
	High limit	• Art/Ao/UAP/BAP/FAP/LV/P1/P2 arterial pressure: 90 mmHg • PA: 4 mmHg
	Low limit	• Art/Ao/UAP/BAP/FAP/LV/P1/P2 arterial pressure: 50 mmHg • PA: -4 mmHg
	Priority	Med
	Alarm Outputs	Off
IBP-M	Alarm switch (On/Off)	On
	High limit	• Art/Ao/UAP/BAP/FAP/LV/P1/P2 arterial pressure Canine, Other: 130 mmHg Feline: 120 mmHg • PA:16 mmHg • RAP/LAP/UVP/P3/P4 venous pressure: 7 mmHg • ICP: 4 mmHg • CVP: 9.8 cmH_2O
	Low limit	• Art/Ao/UAP/BAP/FAP/LV/P1/P2 arterial pressure Canine, Other: 70 mmHg Feline: 60 mmHg • PA: 12 mmHg • ICP/RAP/LAP/UVP/P3/P4 venous pressure: 0 mmHg • CVP: 0 cmH_2O
	Priority	Med
	Alarm Outputs	Off
CPP	Alarm switch (On/Off)	On
	High limit	130 mmHg
	Low limit	50 mmHg
	Priority	Med
	Alarm Outputs	Off
Measure (for P1, P2)		All
Measure (for P3, P4)		Mean Only
Sensitivity		Med

Item		Default Setting
Speed		25 mm/sec
Scale	ICP/RAP/LAP/UVP venous pressure	0-20 mmHg
	Art/Ao/BAP/FAP/LV/P1/P2 arterial pressure	0-160 mmHg
	UAP/P3/P4 venous pressure	0-80 mmHg
	PA/CVP	PA: 0-30 mmHg CVP: 0-30 cmH_2O
PPV Measure		Off
PPV Source		Auto
PAWP	Reference Waveform 1	II
	Reference Waveform 2	Resp
	Speed	12.5 mm/sec
	PA Scale (mmHg)	0-30
Overlapping Waveform Setup	Left Scale (mmHg)	0-160
	Right Scale (mmHg)	0-20
	CVP Scale (cmH2O)	0-30
	ICP Scale (mmHg)	0-20
	PA Scale (mmHg)	0-30
	Speed	25 mm/sec
	Gridlines	Off
Display Format		Sys/Dia(Mean)
Display Alarm Limits		Off
Use PA-D as PAWP		Off

C.1.7 C.O. Default Settings

Item		Default Setting
TB	Alarm switch (On/Off)	On
	High limit	40.0 °C
	Low limit	36.0 °C
	Priority	Med
	Alarm Outputs	Off
Comp Const		0.542
Auto Start		Off
Auto TI		On

C.1.8 CO_2 Default Settings

C.1.8.1 General Settings

Item		Default Setting
EtCO2	Alarm switch (On/Off)	On
	High limit	60 mmHg
	Low limit	20 mmHg
	Priority	Med
	Alarm Outputs	Off
FiCO2	Alarm switch (On/Off)	On
	High limit	10 mmHg
	Priority	Med
	Alarm Outputs	Off
Apnea Delay		15 s
RR Source		Auto
Speed		6.25 mm/s
Scale		50 mmHg
Waveform Type		Draw

C.1.8.2 Sidestream CO_2 Default Settings

Item		Default Setting
EtO2	Alarm switch (On/Off)	On
	High limit	88%
	Low limit	18%
	Priority	Med
	Alarm Outputs	Off
FiO2	Alarm switch (On/Off)	On
	High limit	90%
	Low limit	18%
	Priority	Med
	Alarm Outputs	Off
BTPS Compensation		Off
AG Compensation		0%
N2O Compensation		0%
Auto Standby		60 min
Operating Mode		Measure

C.1.8.3 Microstream CO_2 Default Settings

Item	Default Setting
BTPS Compensation	Off
Maximum Hold	20 sec
Auto Standby	Off
Operating Mode	Measure

C.1.8.4 Mainstream CO_2 Default Settings

Item	Default Setting
Maximum Hold	10 sec
O2 Compensation	Off
Balance Gas	Room Air
AG Compensation	0%
Operating Mode	Measure

C.1.9 Gas Default Settings

Item		Default Setting
EtCO2	Alarm switch (On/Off)	On
	High limit	45 mmHg
	Low limit	30mmHg
	Priority	Med
	Alarm Outputs	Off
FiCO2	Alarm switch (On/Off)	On
	High limit	4 mmHg
	Priority	Med
	Alarm Outputs	Off
EtO2	Alarm switch (On/Off)	On
	High limit	88%
	Low limit	18%
	Priority	Med
	Alarm Outputs	Off
FiO2	Alarm switch (On/Off)	On
	High limit	90%
	Low limit	18%
	Priority	Med
	Alarm Outputs	Off

Item		Default Setting
EtN2O	Alarm switch (On/Off)	On
	High limit	55%
	Low limit	0%
	Priority	Med
	Alarm Outputs	Off
FiN2O	Alarm switch (On/Off)	On
	High limit	53%
	Low limit	0%
	Priority	Med
	Alarm Outputs	Off
EtAA/FiAA	Alarm switch (On/Off)	On
	High limit	30%
	Low limit	0.0%
	Priority	Med
	Alarm Outputs	Off
EtHal/EtEnf/EtIso	Alarm switch (On/Off)	On
	High limit	3.0%
	Low limit	0.0%
	Priority	Med
	Alarm Outputs	Off
FiHal/FiEnf/FiIso	Alarm switch (On/Off)	On
	High limit	2.0%
	Low limit	0.0%
	Priority	Med
	Alarm Outputs	Off
EtSev	Alarm switch (On/Off)	On
	High limit	6.0%
	Low limit	0.0%
	Priority	Med
	Alarm Outputs	Off
FiSev	Alarm switch (On/Off)	On
	High limit	5.0%
	Low limit	0.0%
	Priority	Med
	Alarm Outputs	Off

Item		Default Setting
EtDes	Alarm switch (On/Off)	On
	High limit	8.0%
	Low limit	0.0%
	Priority	Med
	Alarm Outputs	Off
FiDes	Alarm switch (On/Off)	On
	High limit	6.0%
	Low limit	0.0%
	Priority	Med
	Alarm Outputs	Off
Apnea Delay		15 sec
RR Source		Auto
Operating Mode		Measure
Auto Standby		Off
Speed		6.25 mm/sec
Scale		O2: 400 mmHg CO2: 50 mmHg N2O: 50% Hal, Enf, and Iso: 2.5% Sev: 4.0% AA and Des: 9.0%
Waveform Type		Draw (for CO_2only)
O2 Compensation		Off

C.2 Routine Default Settings

C.2.1 Alarm Default Settings

Item	Default Setting
Alarm Volume	2
High Alarm Volume	Alarm Volume+3
Reminder Volume	2
Apnea Delay	15 sec
Printing Duration On Alarm	20 sec
Auto Limits for New Patient	On

C.2.2 Review Default Settings

Item		Default Setting
Tabular Trends	Trend Group	Standard
	Interval	30 min
Graphic Trends	Trend Group	Standard
	Zoom	8 hrs
	Trends	5
Events	Filter	All
	Beat Anno:	Off
	Speed	25 mm/s
	Gain	×1
Full Disclosure	Display(Maximum: 3)	II
	Storage	II
	Duration	1 min
	Scale	×1
	Beat Anno:	Off
	Speed	25 mm/sec
	Gain	×1
12-Lead ECG	Speed	25 mm/sec
	Gain	×1
	Layout	3×4+1

C.2.3 Minitrends Default Settings

Item	Default Setting
Alarm Statistics	On
Alarm Statistics Duration	8 hrs
Minitrend Length	2 hrs
Routine Vital	Manual

Item	Default Setting
Time (for **Routine Vital** set to **Auto**)	08:00
Interval(for **Routine Vital** set to **Auto**)	8 hrs

C.2.4 Remote View Default Settings

Item	Default Setting
Rollup Alarm Beds	Off
Rollup Interval	Off
Alarm Priority	High Only

C.2.5 Display Default Settings

Item		Default Setting
Primary Screen	Choose Screen	Normal Screen
Display	Screen Lock Duration	Permanent
	Brightness	5
	Brightness On Battery	1
Night Mode	Brightness	1
	Alarm Volume	2
	QRS Volume	1
	Key Volume	0
	NIBP End Tone	Off
	Stop NIBP	Off

C.2.6 Report Default Settings

C.2.6.1 Report Setup

Item		Default Setting
ECG Report	Amplitude	10 mm/mV
	Speed	25 mm/sec
	Auto Interval	Off
	12-Lead Format	3×4+1
	Rhythm Lead 1	II
	Rhythm Lead 2	V2
	Rhythm Lead 3	V5
	Format Sequence	Sequential
Realtime Report	Speed	Auto
	Select Waveform	Current Waveforms

Item		Default Setting
Tabular Trends Report	Period	Auto
	Interval	Auto
	Report Format	Parameter Oriented
	Trend Group	Standard
Graphic Trends	Period	Auto
	Trend Group	Standard

C.2.6.2 Record Setup

Item	Default Setting
Waveform 1	I
Waveform 2	II
Waveform 3	Off
IBP Overlap	Off
Recording Duration	8 sec
Interval	Off
Recorder Paper Speed	25 mm/sec

C.2.7 Calculations Default Settings

Item			Default Setting
Drug	Calculator	Weight Based	Off
		Drug Amount	mcg
		Solution Volume	ml
		Dose	mcg/min
		Concentration	mcg/ml
		Infusion Time	hr
		Infusion Rate	ml/hr
	Titration Table	Dose Type	Dose/hr
		Interval	1
Oxygenation	OxyCont Unit		ml/L
	Hb Unit		g/dl
	Pressure Unit		mmHg
Ventilation	Pressure Unit		mmHg

C.2.8 System Time Default Settings

Item	Default Setting
Date Format	yyyy-mm-dd
24-Hour Time	On
Daylight Savings Time	Off

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D Alarm Messages

D.1 Physiological Alarm Messages

This section lists physiological alarms, their default priority, and the actions that can be taken when an alarm occurs.

D.1.1 General Physiological Alarm Messages

Alarm messages	Default priority	Cause and solution
XX High	Med	XX value has risen above the high alarm limit or fallen below the low alarm limit. Check the patient's condition and check if the patient category and alarm limit settings are correct.
XX Low	Med	

Note: XX represents a measurement or parameter label, such as HR, NIBP, PVCs, RR, SpO2, PR, and so on.

D.1.2 Arrhythmia Alarm Messages

Alarm message	Default priority
Asystole	High
V-Fib/V-Tach	High
V-Tach	High
Vent Brady	High
Extreme Tachy	High
Extreme Brady	High
PVCs/min	Med
Pauses/min	Med
R on T	Med
Bigeminy	Med
Trigeminy	Med
Tachy	Med
Brady	Med
Multiform PVC	Med
Vent Rhythm	Med
Nonsus V-Tach	Med
Run PVCs	Low
Pause	Low
Couplet	Prompt
PVC	Prompt
Irr Rhythm	Prompt
Pacer Not Pacing	Prompt
Pacer Not Capture	Prompt

Alarm message	Default priority
Missed Beat	Prompt

Note: When arrhythmia alarms occur, check the patient's condition and the ECG connections.

D.1.3 ST Physiological Alarm Messages

ST alarm mode	Alarm messages	Default priority	Cause and solution
Absolute	ST-XX High	Med	The ST value of respective ECG lead has risen above the high alarm limit or fallen below the low alarm limit. Check the patient's condition and check if the patient category and alarm limit settings are correct.
	ST-XX Low	Med	
Relative	ST Single	Med	ST value of any ECG leads has risen above the high alarm limit or fallen below the low alarm limit. Check the patient's condition and check if the patient category and alarm limit settings are correct.
	ST Dual	Med	ST values of two or more ECG leads have risen above the high alarm limit or fallen below the low alarm limit. Check the patient's condition and check if the patient category and alarm limit settings are correct.

Note: XX represents the ECG lead label.

D.1.4 Resp Physiological Alarm Messages

Alarm message	Default priority	Cause and solution
Resp Artifact	High	The patient's heartbeat has interfered with his respiration. Check the patient's condition and the Resp connections.
Apnea	High	The respiration signal was so weak that the monitor cannot perform respiration analysis. Check the patient's condition, module and patient connections.

D.1.5 SpO_2 Physiological Alarm Messages

Alarm message	Default priority	Cause and solution
SpO2 Desat	High	The SpO_2 value falls below the desaturation alarm limit. Check the patient's condition and check if the alarm limit settings are correct.

D.1.6 PR Physiological Alarm Messages

Alarm message	Default priority	Cause and solution
No Pulse	High	The pulse signal was so weak that the monitor cannot perform pulse analysis. Check the patient's condition, SpO2 sensor and measurement site.

D.1.7 CO_2 Physiological Alarm Messages

Alarm message	Default priority	Cause and solution
FiO2 Shortage	High	FiO_2 concentration is less than18%. Check the patient's condition, the ventilated O_2 content and the CO_2 connection.

D.1.8 AG Physiological Alarm Messages

Alarm message	Default priority	Cause and solution
FiO2 Shortage	High	Check the patient's condition, the ventilated O_2 content and the AG connections.
Mixed Agent and MAC ≥ 3	Med	The mixed anaesthetic gases concentration is too high. Adjust the anaesthetic gases concentration.
Apnea	High	The respiration signal was so weak that the monitor cannot perform respiration analysis. Check the patient's condition, module and patient connections.

D.2 Technical Alarm Messages

This section lists technical alarms, their default priority, indication on alarm reset, and the actions that can be taken when an alarm occurs.

Technical alarms give different alarm indicators when the alarm system is reset. In this section we classify the technical alarms into three categories for easy clarification:

- A: technical alarms are cleared. The monitor gives no alarm indications.
- B: technical alarms are changed to the prompt messages.
- C: the alarm is silenced and a √ appears before the alarm message.

In the following tables we will use A, B, and C to refer to the indications on alarm reset.

D.2.1 General Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
XX Module Error	High	C	XX module does not work properly. Replug the module, if the alarm persists, contact your service personnel.

Note: XX represents a measurement or parameter label, such as HR, RR, SpO_2, $EtCO_2$, and so on.

D.2.2 ECG Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
ECG Noisy	Low/Prompt	A	The ECG signal is noisy. Check for any possible sources of signal noise around the cable and electrode, and check the patient for excessive motion.
ECG Amplitude Too Small	Low	C	The ECG amplitude does not reach the detected threshold. Check for any possible source of interference around the cable and electrode.
ECG Lead Off	High, Med, or Low, configurable	B	The electrode has become detached from the patient or the lead wire has become disconnected from the adapter cable. Check the connections of the electrodes and leadwires.
ECG XX Lead Off	High, Med, or Low, configurable	B	The electrode has become detached from the patient or the lead wire has become disconnected from the adapter cable. Check the connections of the electrodes and leadwires.
ECG Signal Invalid	Low	A	Patient skin impedance is too high. Check ECG electrode application.

Alarm message	Default priority	Indication on alarm reset	Cause and solution
ECG Learning	Prompt	/	ECG learning is manually or automatically triggered.
Cannot Analyze QT	Prompt	/	/

Note: XX represents ECG lead name, for example RL, LL, V, Va, Vb, and so on.

D.2.3 Resp Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Resp Interference	Prompt	/	The respiration circuit is disturbed. Check for any possible sources of signal noise.
Electrode Poor Contact	Prompt	/	Check the electrode application. Reposition or replace the electrodes if necessary.

D.2.4 SpO_2 Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
SpO2 Sensor Off	High, Med, or Low, configurable	B	The SpO_2 sensor has become detached from the patient or the module. Check the sensor connection. If the alarm persists, replace the sensor.
SpO2 No Sensor	Low	A	The SpO_2 extension cable is detached from the SpO_2 module, or the SpO_2 sensor is detached from the SpO_2 extension cable. Check the SpO_2 cable and the sensor connection. If the alarm persists, replace the sensor.
SpO2 Excess Light	Low	C	Ambient light is too strong. Move the sensor to a place with lower level of ambient light or cover the sensor to minimize the ambient light.
SpO2 No Pulse	Low	C	The SpO_2 sensor failed to obtain pulse signal. Check the patient's condition and replace the sensor application site. If the alarm persists, replace the sensor.
SpO2 Sensor Incompatible	Low	C	Incompatible or an unspecified SpO_2 sensor is used. Use specified sensors.
SpO2 Low Signal Quality	Low	C	1. Check the sensor and sensor position. 2. Make sure the patient is not shivering or moving. 3. The patient's pulse may be too low to be measured.
SpO2 Interference	Low	C	The SpO_2 signal has been interfered. Check for any possible sources of signal noise and check the patient for excessive motion.
SpO2 Sensor Error	Low	C	Replace the sensor and measure again.
SpO2 Searching Pulse	Prompt	/	SpO_2 is searching for pulse.
SpO2 Low Perfusion	Prompt	/	The SpO_2 sensor is not properly placed or the patient's perfusion index is too low. 1. Check the sensor and sensor position. 2. Reposition the sensor if necessary.

D.2.5 Temp Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
T XX Sensor Off	Low	A	Check the sensor connection and reconnect the sensor.

Note: XX represents a temperature site, for example skin, core, T1, and so on.

D.2.6 NIBP Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
NIBP Cuff Loose	Low	A	There is a leak in the cuff or air tubing. Use a cuff of correct type based on the patient size. Apply the cuff and connect the air tubing as instructed in the manual.
NIBP Cuff or Airway Leak	Low	A	Check the NIBP cuff and pump for leakages.
NIBP Airway Error	Low	A	The air tubing may be occluded. Check the air tubing for an occlusion or kinking. If the alarm persists, contact your service personnel.
NIBP Weak Signal	Low	A	The patient's pulse is weak or the cuff is loose. Check the patient's condition and replace the cuff application site.
NIBP Overrange	Low	A	The measured NIBP value exceeds the module measurement range. Check the patient's condition.
NIBP Excessive Motion	Low	A	Check the patient's condition and reduce patient motion.
NIBP Cuff Overpressure	Low	A	The NIBP airway may be occluded. Check the airway and measure again. If the alarm persists, contact your service personnel.
NIBP Timeout	Low	A	The measurement time exceeds 120 seconds, and the BP value cannot be obtained. Check the patient's condition and NIBP connections, or replace the cuff and measure again.
NIBP Airway Leak	Low	A	Airway leakage is found during the NIBP leakage test. Check the NIBP cuff and pump for leakages.

D.2.7 IBP Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
XX Sensor Error	Med	C	The IBP sensor fails. Replace the sensor.
XX No Sensor	High, Med, or Low, configurable	A	The IBP patient cable and/or corresponding IBP sensor is not connected or detached. Check the cable and sensor connection.
XX No Pulse	Low	A	The catheter may be occluded. Please flush the catheter.
XX Disconnected	High	C	The liquid way is disconnected from the patient, or the three-way valve is open to the air. Check the connection of the liquid way, or check the valve is open to the patient. If the alarm persists, contact your service personnel.

Note: XX represents an IBP label, for example PA, CVP, FAP, P1, and so on.

D.2.8 C.O. Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
TB Sensor Off	Low	A	Check the sensor connection and reconnect the sensor.
TI Sensor Off	Low	A	Check the sensor connection and reconnect the sensor.

D.2.9 CO_2 Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
CO2 Module High Temp	Low	C	Ambient temperature is too high or there is a module failure. 1. Lower the operating temperature. 2. Replug the module. 3. If the alarm persists, the CO_2 module may fail, contact your service personnel.
CO2 Module Low Temp	Low	C	Ambient temperature is too low or there is a module failure. 1. Raise the operating temperature. 2. Replug the module. 3. If the alarm persists, the CO_2 module may fail, contact your service personnel.
CO2 Zero Failed	Low	C	For mainstream CO_2 module, check the connections between the adapter and CO_2 transducer. Wait till the sensor's temperature becomes stabilized, and then perform a zero calibration again. For sidestream CO_2 module, replug the module. If the alarm persists, contact your service personnel.
CO2 No Watertrap	Low	B	Check the watertrap connections.
CO2 High Airway Pressure	Low	C	1. Check the airway pressure settings of the ventilator/anesthesia machine. 2. Disconnect the module from the ventilator/ anesthesia machine. 3. Replug the module. 4. If the alarm persists, contact your service personnel.
CO2 Low Airway Pressure	Low	C	1. Check the airway pressure settings of the ventilator/anesthesia machine. 2. Disconnect the module from the ventilator/ anesthesia machine. 3. Replug the module. 4. If the alarm persists, contact your service personnel.

Alarm message	Default priority	Indication on alarm reset	Cause and solution
High Barometric	Low	C	The ambient pressure exceeds the operating pressure range or CO_2 module fails. 1. Make sure that the ambient pressure meets the specifications, and check for sources that affect the ambient pressure. 2. Replug the module. 3. If the alarm persists, contact your service personnel.
Low Barometric	Low	C	The ambient pressure exceeds the operating pressure range or CO_2 module fails. 1. Make sure that the ambient pressure meets the specifications, and check for sources that affect the ambient pressure. 2. Replug the module. 3. If the alarm persists, contact your service personnel.
CO2 Airway Occluded	Low	C	1. Check if the sample line is kinked or occluded. 2. Replace the sample line. 3. Replug the module. 4. If the alarm persists, contact your service personnel.
CO2 No Filterline	Low	A	Make sure that the filterline is connected.
CO2 Calibration Required	Low	C	Perform a calibration.
CO2 Airway Error	Low	C	1. Check if the sample line is kinked or occluded. 2. Replace the sample line. 3. Replug the module. 4. If the alarm persists, contact your service personnel.
CO2 Adapter Error	Low	A	Check, clean or replace the airway adapter. Perform a zero calibration.
CO2 No Sensor	Low	A	Make sure that the CO_2 transducer is connected.
CO2: Change Watertrap	Low	C	Replace the watertrap.
CO2: Change O2 Cell	Low	C	The oxygen sensor is depleted or fails. Replace the oxygen sensor.

D.2.10 AG Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
AG No Watertrap	Low	B	Check the connections of the watertrap and re-connect it.
AG: Change Watertrap	Low	C	Replace the watertrap.
AG Zero Failed	Low	C	There is external electromagnetic interference, airway occlusion or module failure. 1. Check for external inference sources. 2. Check for "AG Airway Occluded" alarm message. Remove the occlusion. 3. If the alarm persists, contact your service personnel.
Anesthetic Mixture	Low	C	Anesthetic mixture is detected.

Alarm message	Default priority	Indication on alarm reset	Cause and solution
AG Airway Occluded	Low	C	1. Check if the sample line is occluded. 2. Check the sample line. 3. Replug the module. 4. If the alarm persists, contact your service personnel.

D.2.11 Power Supply Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Low Battery	Med	C	Connect the monitor to the external power supply and allow the batteries to charge.
Critically Low Battery	High	C	Connect the monitor to the external power supply and allow the batteries to charge.
Power Board Comm Error	High	C	Restart the monitor. If the alarm persists, contact your service personnel.
Battery Error	High	C	The battery may fail. Contact your service personnel.
RT Clock Need Reset	High	C	Contact your service personnel.
RT Clock Not Exist	High	C	Contact your service personnel.
XX V Too High	High	C	There is a problem with the system power supply. Restart the monitor.
XX V Too Low	High	C	

Note: XX represents 2.5 V, 3.3 V,5 V, or 12 V.

D.2.12 Recorder Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Recorder Init Error	Low	A	An error occurred during the recorder initialization. If the alarm persists, contact your service personnel.
Recorder Comm Error	Low	A	Restart the monitor if not solved. If the alarm persists, contact your service personnel.
Recorder Head Hot: Please Wait	Low	C	The recorder has been working for too long time. Stop the recording and resume the recording till the recorder's print head cools down.
Recorder Initializing	Prompt	/	Wait until the recorder initialization is completed.
Recorder Out Of Paper	Prompt	/	The recorder paper is not loaded or the recorder door is not closed. Check the recorder, load the recorder paper or close the recorder door.
Recorder Busy	Prompt	/	The buffer queue for recording is full.

D.2.13 Printer Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Printer Buffer Full	Prompt	/	The printer buffer is full. Wait till the printer finishes the printing task.
Fail	Prompt	/	The printer runs out of paper or cannot be connected. Check the printer.
Printing Stopped	Prompt	/	Printing is manually stopped.
Printer Unavailable	Prompt	/	The printer may fail. Check the printer.
PDF storage space is nearly full	Prompt	/	Delete the files saved under the PDF file path to release storage space. Otherwise you cannot save new PDF files.
Error storing PDF file	Prompt	/	The PDF file path settings on the printer server and the PDFCreator are not consistent or the PDF storage space is full. Check the PDF file path settings for consistency, or delete the files saved under the PDF file path to release storage space.
Change the print server language to be consistent with this monitor	Prompt	/	Verify that the language settings of the printer server and the monitor are consistent, Otherwise you cannot perform printing.
Print Server Disconnected	Prompt	/	Check that the monitor is properly connected with the printer server.

D.2.14 Technical Alarm Messages Related to Networked Monitoring

Alarm message	Default priority	Indication on alarm reset	Cause and solution
View Bed XX YY-ZZ, Network Disconnected.	Low	A	The network is interrupted when the monitor is viewing the remote device. Check the network connection.
Viewed by Bed XX YY-ZZ, Network Disconnected.	Low	A	The network is interrupted when the monitor is viewed by another remote device. Check the network connection.
WLAN IP Address Conflict	Low	C	Wireless network IP network conflicts. Check the network settings.
LAN1 IP Address Conflict	Low	C	Wired network LAN1 IP network conflicts. Check the network settings.
Fail To Get WLAN IP Address	Low	C	Unable to automatically obtain the wireless network IP address. Check the network settings.
Fail To Get LAN1 IP Address	Low	C	Unable to automatically obtain the wired network LAN1 IP address. Check the network settings.

Note: XX refers to the department name, YY refers to the room number, and ZZ refers to the bed number.

D.2.15 Other System Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Storage Error	High	C	The storage card fails or files are damaged. Restart the monitor to format the storage card. If the alarm persists, contact your service personnel.
Loading Default Config Failed	Low	A	The default configuration is not correctly loaded. The monitor will restore to the factory default configuration for the current patient category.
XX Conflicts (XX refers to the module label)	Prompt	/	The same type of corresponding module being used exceeds the supported number. Remove the conflict module.
XX Measurement has been closed (XX refers to the module label)	Prompt	/	The parameter module is disabled. Switch on the module if you want to use it. For more information, see *3.11.1 Switching On or Off a Parameter*.
The display setup for XXX is disabled. (XX refers to the parameter label)	Prompt	/	The parameter of the newly inserted module is not displayed on the screen. Select a desired area to display the parameter numerics and waveforms. For more information, see *24.10 The Other Settings*.
The patient data storage space is nearly full. Please delete some discharged patients.	Med	B	Delete unnecessary earlier discharged patient.

E Electrical Safety Inspection

The following electrical safety tests are recommended as part of a comprehensive preventive maintenance program. They are a proven means of detecting abnormalities that, if undetected, could prove dangerous to either the patient or the operator. Additional tests may be required according to local regulations.

All tests can be performed using commercially available safety analyzer test equipment. These procedures assume the use of a 601PROXL International Safety Analyzer or equivalent safety analyzer. Other popular testers complying with IEC 60601-1 used in Europe, such as Fluke, Metron, or Gerb, may require modifications to the procedure. Please follow the instructions of the analyzer manufacturer.

The electrical safety inspection should be periodically performed every two years.The safety analyzer also proves to be an excellent troubleshooting tool to detect abnormalities of line voltage and grounding, as well as total current loads.

E.1 Power Cord Plug

Test Item		Acceptance Criteria
The power plug	The power plug pins	No broken or bent pin. No discolored pins.
	The plug body	No physical damage to the plug body.
	The strain relief	No physical damage to the strain relief. No plug warmth for device in use.
	The power plug	No loose connections.
The power cord		No physical damage to the cord. No deterioration to the cord.
		For devices with detachable power cords, inspect the connection at the device.
		For devices with non-detachable power cords, inspect the strain relief at the device.

E.2 Device Enclosure and Accessories

E.2.1 Visual Inspection

Test Item	Acceptance Criteria
The enclosure and accessories	No physical damage to the enclosure and accessories.
	No physical damage to meters, switches, connectors, etc.
	No residue of fluid spillage (e.g., water, coffee, chemicals, etc.).
	No loose or missing parts (e.g., knobs, dials, terminals, etc.).

E.2.2 Contextual Inspection

Test Item	Acceptance Criteria
The enclosure and accessories	No unusual noises (e.g., a rattle inside the case).
	No unusual smells (e.g., burning or smoky smells, particularly from ventilation holes).
	No taped notes that may suggest device deficiencies or operator concerns.

E.3 Device Labeling

Check the labels provided by the manufacturer or the healthcare facilities are present and legible.

- Main unit label
- Integrated warning labels

E.4 Protective Earth Resistance

1. Plug the probes of the analyzer into the device's protective earth terminal and protective earth terminal of the AC power cord.
2. Test the earth resistance with a current of 25 A.
3. Verify the resistance is less than limits.

LIMITS

For all countries, R = 0.2 Ω Maximum

E.5 Earth Leakage Test

Run an Earth Leakage test on the device being tested before performing any other leakage tests.

The following outlet conditions apply when performing the Earth Leakage test:

- normal polarity (Normal Condition),
- reverse polarity (Normal Condition),
- normal polarity with open neutral (Single Fault Condition),
- reverse polarity with open neutral (Single Fault Condition)

LIMITS

For UL60601-1,

- 300 µA in Normal Condition
- 1000 µA in Single Fault Condition

For IEC60601-1,

- 500 µA in Normal Condition
- 1000 µA in Single Fault Condition

E.6 Patient Leakage Current

Patient leakage currents are measured between a selected applied part and mains earth. All measurements have a true RMS only

The following outlet conditions apply when performing the Patient Leakage Current test.

- normal polarity (Normal Condition);
- reverse polarity (Normal Condition),
- normal polarity with open neutral (Single Fault Condition);
- reverse polarity with open neutral (Single Fault Condition).
- normal polarity with open earth (Single Fault Condition);
- reverse polarity with open earth (Single Fault Condition).

LIMITS

For CF  applied parts

- 10 µA in Normal Condition
- 50 µA in Single Fault Condition

For BF  applied parts

- 100 µA in Normal Condition
- 500 µA in Single Fault Condition

E.7 Mains on Applied Part Leakage

The Mains on Applied Part test applies a test voltage, which is 110% of the mains voltage, through a limiting resistance, to selected applied part terminals. Current measurements are then taken between the selected applied part and earth. Measurements are taken with the test voltage (110% of mains) to applied parts in the normal and reverse polarity conditions

The following outlet conditions apply when performing the Mains on Applied Part test.

- Normal Polarity;
- Reversed Polarity

LIMITS

- For CF  applied parts: 50 µA
- For BF  applied parts: 5000 µA

E.8 Patient Auxiliary Current

Patient Auxiliary currents are measured between any selected Applied Part connector and the remaining Applied Part connector s. All measurements may have a true RMS only response.

The following outlet conditions apply when performing the Patient Auxiliary Current test.

- normal polarity (Normal Condition);
- reverse polarity (Normal Condition),
- normal polarity with open neutral (Single Fault Condition);
- reverse polarity with open neutral (Single Fault Condition).
- normal polarity with open earth (Single Fault Condition);
- reverse polarity with open earth (Single Fault Condition).

LIMITS

For CF  applied parts,

- 10 µA in Normal Condition
- 50 µA in Single Fault Condition

For BF  applied parts,

- 100 µA in Normal Condition
- 500 µA in Single Fault Condition

NOTE

- **Make sure the safety analyzer is authorized comply with requirement of IEC60601-1.**
- **Follow the instructions of the analyzer manufacturer.**

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F Units, Symbols and Abbreviations

F.1 Units

Abbreviation	In Full
µA	microampere
µV	microvolt
µs	microsecond
A	ampere
Ah	ampere hour
bpm	beat per minute
bps	bit per second
°C	centigrade
cc	cubic centimeter
cm	centimeter
dB	decibel
DS	dyne second
°F	Fahrenheit
g	gram
GHz	gigahertz
GTT	gutta
h	hour
Hz	hertz
in	inch
k	kilo
kg	kilogram
kPa	kilopascal
L	litre
lb	pound
m	meter
mAh	milliampere hour
Mb	mega byte
mcg	microgram
mEq	milli-equivalents
mg	milligram
min	minute
ml	milliliter
mm	millimeter

Abbreviation	In Full
mmHg	millimeters of mercury
cmH2O	centimeters of water
ms	millisecond
mV	millivolt
mW	milliwatt
MΩ	megaohm
nm	nanometer
rpm	breaths per minute
s	second
V	volt
VA	volt ampere
Ω	ohm
W	watt

F.2 Symbols

Symbol	Explanation
–	minus
–	negative
%	percent
/	per; divide; or
~	to
+	plus
=	equal to
<	less than
>	greater than
≤	less than or equal to
≥	greater than or equal to
±	plus or minus
×	multiply
©	copyright

F.3 Abbreviations

Abbreviation	In Full
$AaDO_2$	alveolar-arterial oxygen gradient
AC	alternating current
AG	anaesthesia gas
AHA	American Heart Association
Ao	aortic pressure
Art	arterial
ATMP	barometric pressure
aVF	left foot augmented lead
aVL	left arm augmented lead
aVR	right arm augmented lead
awRR	airway respiratory rate
BAP	brachial arterial pressure
BL	baseline
BSA	body surface area
BT	blood temperature
BTPS	body temperature and pressure, saturated
CaO_2	arterial oxygen content
CE	Conformité Européenne
C.I.	cardiac index
CISPR	International Special Committee on Radio Interference
C.O.	cardiac output
CO_2	carbon dioxide
COHb	carboxyhemoglobin
Compl	compliance
COPD	chronic obstructive pulmonary disease
CVP	central venous pressure
DC	direct current
Des	desflurane
Dia	diastolic
dpi	dot per inch
DVI	digital video interface
DO_2	oxygen delivery
DO_2I	oxygen delivery index
ECG	electrocardiograph
EDV	end-diastolic volume
EEC	European Economic Community
EMC	electromagnetic compatibility

Abbreviation	In Full
EMI	electromagnetic interference
Enf	enflurane
ESU	electrosurgical unit
Et	end-tidal
EtAA	end-tidal anesthetic agent
EtDes	end-tidal anesthetic agent
EtEnf	
EtHal	
EtIso	
EtSev	
$EtCO_2$	end-tidal carbon dioxide
EtN_2O	end-tidal nitrous oxide
EtO	ethylene oxide
EtO_2	end-tidal oxygen
FAP	femoral arterial pressure
FCC	Federal Communication Commission
FDA	Food and Drug Administration
$FeCO_2$	Mixed Expired CO2 Concentration
Fi	fraction of inspired
FiAA	inspired anesthetic agent
FiDes	inspired anesthetic agent
FiEnf	
FiHal	
FiIso	
FiSev	
FiCO2	fraction of inspired carbon oxygen
FiN_2O	fraction of inspired nitrous oxide
FiO_2	fraction of inspired oxygen
Hal	halothane
Hb	hemoglobin
Hct	haematocrit
HR	heart rate
IABP	intra-aortic balloon pump
IBP	invasive blood pressure
ICP	intracranial pressure
ID	identification
I:E	inspiratory time: expiratory time ratio
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers

Abbreviation	In Full
IP	internet protocol
Iso	isoflurane
LA	left arm
LAP	left atrial pressure
LCD	liquid crystal display
LCW	left cardiac work
LCWI	left cardiac work index
LED	light emitting diode
LL	left leg
LVSW	left ventricular stroke work
LVSWI	left ventricular stroke work index
MAC	minimum alveolar concentration
MetHb	methemoglobin
MRI	magnetic resonance imaging
MV	minute volume
N/A	not applied
N2	nitrogen
N2O	nitrous oxide
NIBP	noninvasive blood pressure
NIF	negative inspiratory force
O_2	oxygen
O_2%	oxygen concentration
PA	pulmonary artery
PAWP	pulmonary artery wedge pressure
PEEP	positive end expiratory pressure
PEF	peak expiratory flow
PEP	pre-ejection period
PIF	peak inspiratory flow
PIP	peak inspiratory pressure
Pleth	plethysmogram
PPV	pulse pressure variation
PR	pulse rate
PVC	premature ventricular contraction
PVR	pulmonary vascular resistance
PVRI	pulmonary vascular resistance index
RA	right arm
RAP	right atrial pressure
Rec	record, recording
Resp	respiration

Abbreviation	In Full
RL	right leg
RQ	respiratory quotient
RR	respiration rate
Sev	sevoflurane
SpO_2	arterial oxygen saturation from pulse oximetry
SQI	signal quality index
SV	stroke volume
SVI	stroke volume index
SVR	systemic vascular resistance
SVRI	systemic vascular resistance index
Sync	synchronization
Sys	systolic pressure
TB	Blood Temperature
TD	temperature difference
Temp	temperature
TFC	thoracic fluid content
TI	injectate temperature
TP	total power
TV	tidal volume
UAP	umbilical arterial pressure
USB	universal serial bus
UVP	umbilical venous pressure
VAC	volts alternating current

G Declaration of Conformity

Declaration of Conformity V1.0

CE

Declaration of Conformity

Manufacturer:	Shenzhen Mindray Bio-Medical Electronics Co., Ltd. Mindray Building, Keji 12th Road South, Hi-tech Industrial Park, Nanshan, Shenzhen, 518057, P. R. China
EC-Representative:	Shanghai International Holding Corp. GmbH (Europe) Eiffestraße 80 20537 Hamburg, Germany
Product:	Portable Multi-Parameter Veterinary Monitor (Including Accessories)
Model:	ePM 12M Vet

We herewith declare under our sole responsibility that the above mentioned products meet the provisions of the Council Directive 2014/53/EU concerning radio equipment. All supporting documentation is retained under the premises of the manufacturer.

Standards Applied:

☒ EN 60601-1:2006 / A1:2013	☒ EN 60601-1-2:2015
☒ EN 62311:2008	☒ ETSI EN 301 489-1 V2.2.0
☒ EN 300 328 V2.1.1	☒ ESTI EN 301 893 V2.1.1

Start of CE-Marking: 2020-12-24

Place, Date of Issue: Shenzhen ,2020.12.24

Signature:

Name of Authorized Signatory: Mr. Wang Xinbing

Position Held in Company: Manager, Technical Regulation

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