BeneView T1

Patient Monitor

Operator's Manual

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⚠ WARNING

- **This equipment must be operated by skilled/trained clinical professionals.**
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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 chapters or sections.
- [ ] is used to enclose screen texts.
- → is used to indicate operational procedures.

FOR YOUR NOTES

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FOR YOUR NOTES

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

⚠ WARNINGS

- **This equipment is used for one patient at a time.**
- **The equipment is not intended for direct cardiac application.**
- **The equipment is not intended to be used within the magnetic resonance (MR) environment**
- **Store and use the equipment in specified environmental condition. The monitor and accessesories may not meet the performance specification due to aging, stored or used outside the specified temperature and humidity range.**
- **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, this equipment must only be connected to a supply mains with protective earth. If the installation does not provide for a protective earth conductor, disconnect it from the power line and operate it on battery power, if possible.**
- **To avoid explosion hazard, do not use the equipment in the presence of oxygen-rich atmospheres, flammable anesthetics, or other flammable agents (such as gasoline).**
- **Use and store the equipment in specified environmental condition. The monitor and accessesories may not meet the performance specification due to aging, stored or used outside the specified temperature and humidity range.**

⚠ WARNINGS

- **Do not open the equipment housings. All servicing and future upgrades must be carried out by the personnel trained and authorized by our company only.**
- **Do not come into contact with patients during defibrillation. Otherwise serious injury or death could result.**
- **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.**
- **The neutral electrode of the electrosurgical unit shall properly contact the patient. Otherwise, burns may result.**
- **Do not touch the equipment's metal parts or connectors when in contact with the patient; otherwise patient injury may result.**
- **Do not rely exclusively on the audible alarm system for patient monitoring. Adjustment of 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 different patient situations and always keeping the patient under close surveillance is the most reliable way for safe patient monitoring.**
- **The physiological data and alarm messages displayed on the equipment are for reference only and cannot be directly used for diagnostic interpretation.**
- **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 or strangulation by patients or personnel.**
- **Ensure that the patient monitor is supplied with continuous electric power during work. Sudden power failure leads to data loss.**
- **When disposing of the package material, be sure to observe the applicable waste control regulations and keep it out of children's reach.**
- **Remove the DC adapter from use in case of a damaged cable.**
- **Never mix patient electrode types or brands. Dissimilar metals or other incompatibilities may cause considerable baseline drift and may increase trace recovery time after defibrillation.**

1.1.2 Cautions

⚠ CAUTIONS

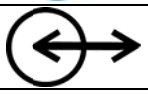
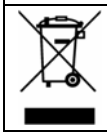
- **Use only parts and accessories specified in this manual.**
- **At the end of its service life, the equipment, as well as its accessories, must be disposed of in compliance with the guidelines regulating the disposal of such products. If you have any questions concerning disposal of the equipment, please contact us.**
- **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.**
- **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.**
- **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.**

1.1.3 Notes

NOTES

- **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 supply. Do not locate the equipment in a place difficult to operate the mains plug.**
- **In normal use, the operator shall stand in front of the equipment.**
- **Keep this manual in the vicinity of the equipment so that it can be obtained conveniently when needed.**
- **The software was developed in compliance with IEC60601-1-4. The possibility of hazards arising from software errors is minimized.**
- **This manual describes all features and options. Your equipment may not have all of them.**

1.2 Equipment Symbols

	ON/OFF for a part of equipment		Direct current
	Battery indicator		Network connector
	Multifunctional connector		Serial number
	Unlocking		Equipotentiality
	VGA connector		Direction and angle of rotation
	Lock; tighten		Alternating current
	DATE OF MANUAFACTURE		Symbol for "MANUFACTURER"
IPX1	Protected against vertically falling water drops per IEC 60529	IPX2	Protected against vertically falling water drops when ENCLOSURE tilted up to 15° per IEC 60529
	DEFIBRILLATION-PROOF TYPE CF APPLIED PART		DEFIBRILLATION-PROOF TYPE BF APPLIED PART
	Non-ionizing electromagnetic radiation		Refer to instruction manual/booklet
	General warning sign		Input/output
CE 0123	The product bears CE mark indicating its conformity with the provisions of the Council Directive 93/42/EEC concerning medical devices and fulfils the essential requirements of Annex I of this directive. Note: The product complies with the Council Directive 2011/65/EU.		
EC REP	Authorised representative in the European Community		
	Dispose of in accordance to your country's requirements		

NOTE

- **Some symbols may not appear on your equipment.**

2 The Basics

2.1 Monitor Description

2.1.1 Intended Use

This patient monitor is intended to be used for monitoring, displaying, reviewing, storing and transferring of multiple physiological parameters including ECG, respiration (Resp), temperature (Temp), SpO_2, pulse rate (PR), non-invasive blood pressure (NIBP), invasive blood pressure (IBP), continuous cardiac output (CCO), and carbon dioxide (CO_2) of single patient. This patient 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.

The monitor is intended to be used in a hospital environment including, but not limited to, ICU, CCU, PICU, NICU, RICU, emergency room, operating room, and postoperative observation ward, and etc. It can also be used during patient transport both inside the hospital and with an ambulance. For patient transport with an ambulance, only ECG, HR, Resp, Temp, SpO2, PR, NIBP, and IBP can be monitored. The monitor is not intended for helicopter transport or home use.

This patient monitor can be used in two ways:

- As a stand-alone patient monitor, or
- As a multi-parameter module (MPM) for Mindray BeneView series or BeneVision N series patient monitors, hereafter referred to as "the host monitor".

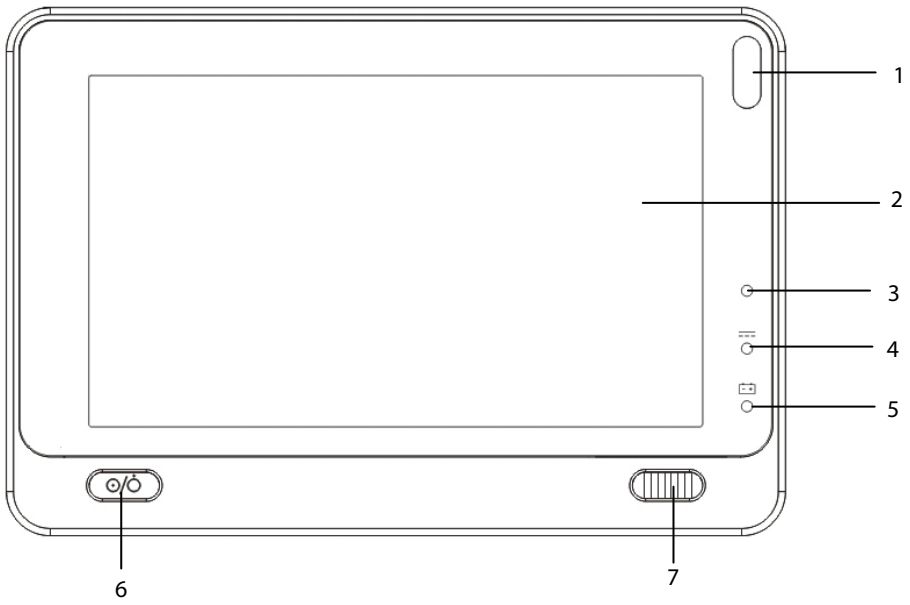
In this manual, the BeneView T1 is generally referred to as "the patient monitor" except in the situation describing its use with a host monitor, where it is referred to as "the T1" to distinguish it from the host monitor.

2.1.2 Applied Parts

- The applied parts of the equipment are:
- ECG electrode and leadwire
- SpO2 sensor and cable
- NIBP tubing and cuff
- Temp probe and cable
- IBP/ICP transducer and cable
- CO2 watertrap, mask, and sampling line
- PiCCO sensor

2.2 Main Unit

2.2.1 Front View



1. Alarm lamp

   The Alarm lamp flashes in different color and frequency to match the alarm level2

2. Display Screen

3. Ambient light sensor

   When [**Brightness**] is set to [**Auto**], the system automatically adjusts screen brightens according to the strength of ambient light.

4. External power supply indicator

   - On: when external DC power supply is connected.
   - Off: when external DC power supply is not connected.

5. Battery indicator

   - On: when the battery is installed and the external DC power supply is connected.
   - Off: when no battery is installed, or the installed battery is malfunction, or no external DC power supply is connected when the patient monitor is power off.
   - Flash: when the patient monitor operates on battery power.

6. Power On/Off Switch

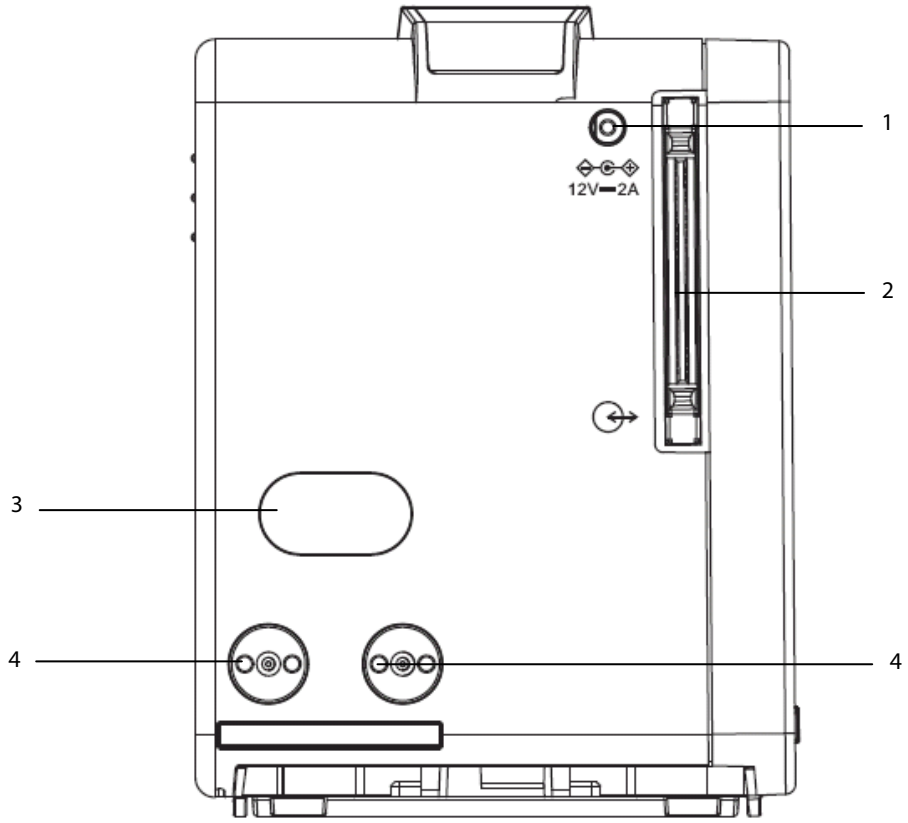
   - Pressing this switch turns the patient monitor on.
   - When the monitor is on, pressing and holding this switch turns the monitor off.

   An indicator is built in this switch. It turns on when the patient monitor is on and turns off when the patient monitor is off.

7. Sliding switch:

   - When the T1 is not connected with the external display, sliding this switch rightwards can lock/unlock the touch screen.
   - When the T1 is connected to the external display, sliding this switch rightwards switches screen display between T1 and the external display.

2.2.2 Left View

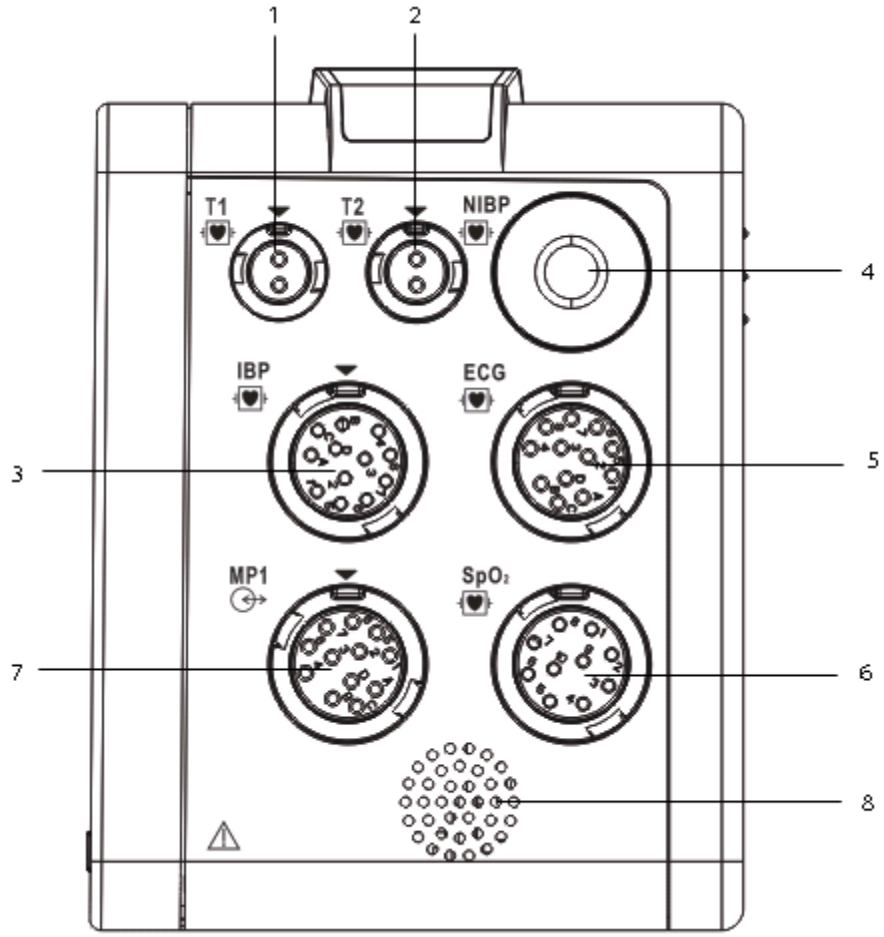


1. External DC power supply connector
2. Main unit multi-pin connector: connects T1 to the T1 handle or T1 docking station.
3. Infrared filter: used for communication between the T1 and host monitor.
4. Contact

NOTE

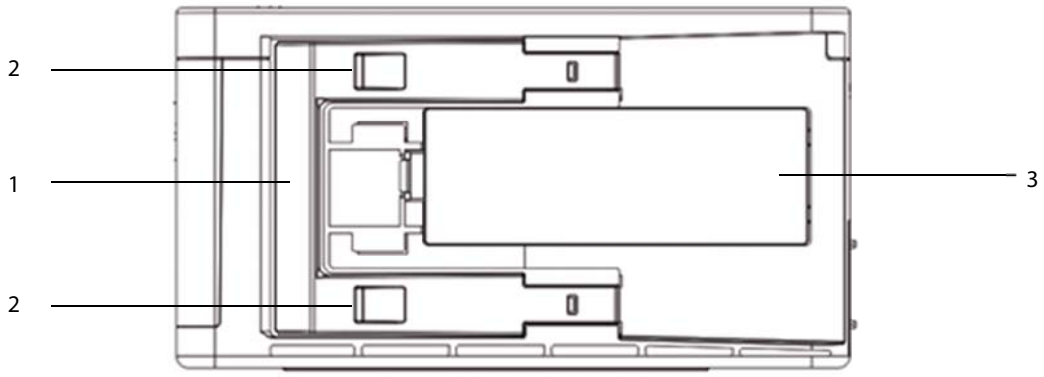
- **To ensure a good contact, clean the contacts regularly, as dust and dirt may collect on them. When cleaning the contacts, wipe them with cotton, dampened with alcohol. (using forceps is recommended)**

2.2.3 Right View



1. Connector for Temp probe 1
2. Connector for Temp probe 2
3. Connector for IBP cable
4. Connector for NIBP cuff
5. Connector for ECG cable
6. Connector for SpO_2 cable
7. Multifunctional connector: outputting analog and defib synchronization signal.
8. Speaker

2.2.4 Bottom View

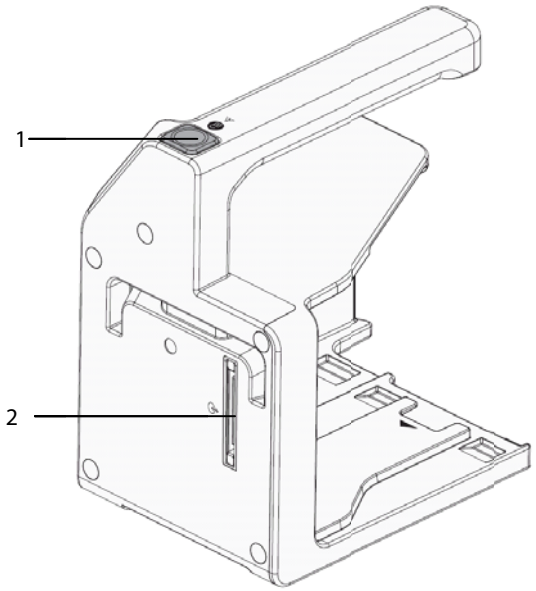


1. Latch: locks T1 when T1 is in use with the host monitor, T1 docking station or T1 handle. Pressing here releases T1 so that you can remove T1 from the host monitor, T1 docking station, or T1 handle.
2. Clip: fasten T1 when is in use with the host monitor, T1 docking station or T1 handle.
3. Battery door

2.3 T1 handle

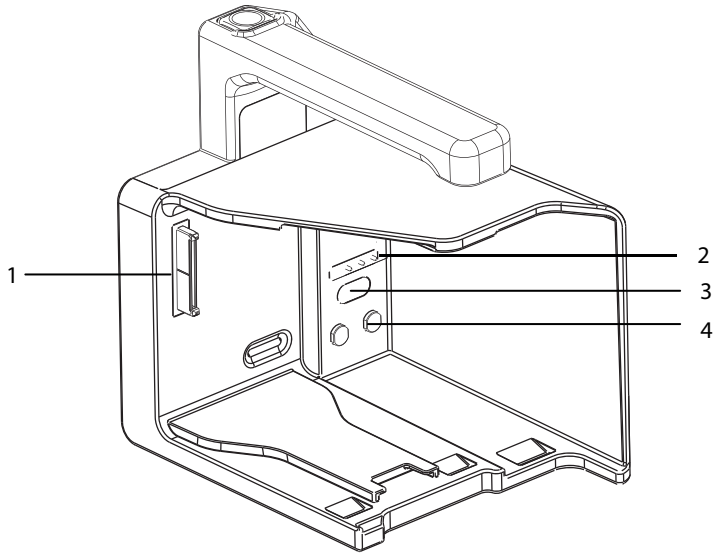
T1 handle is used for connecting a T1 and an external parameter module.

2.3.1 Left View



1. Release button: pressing this button releases the T1 handle from the T1 docking station.
2. T1 handle multi-pin connector 1: connects the T1 handle and T1 docking station.

2.3.2 Right View



1. T1 handle multi-pin connector 2: connects the T1 handle and T1.
2. Pogo pins: used for communication between the T1 handle and external parameter module.
3. Infrared filter: used for communication between the T1 handle and external parameter module.
4. Contact: power input connector of the external parameter module.

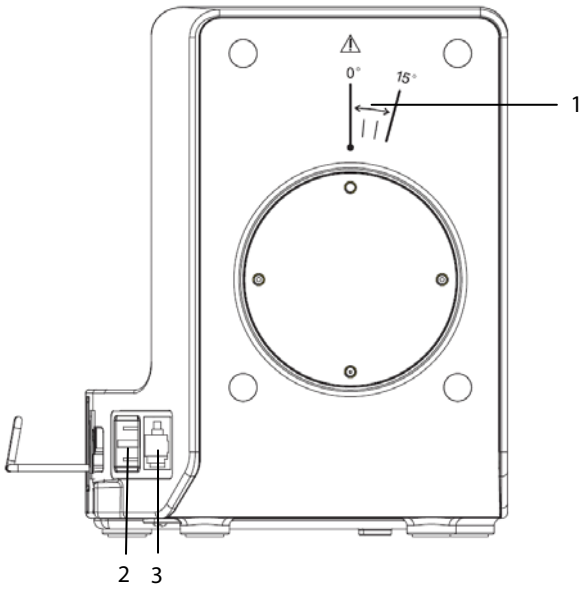
2.4 T1 Docking Station

T1 docking station is used to connect the T1 or T1 handle.

Caution

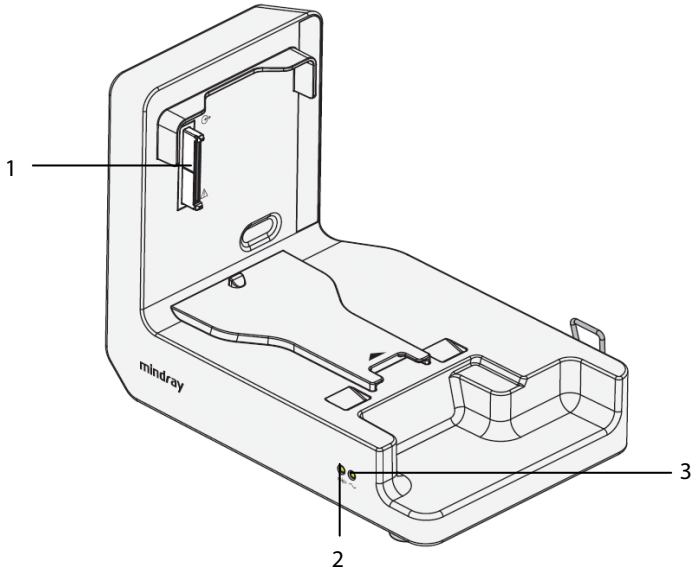
- **The T1 docking station is part of the equipment. Use only the specified docking station.**

2.4.1 Left View



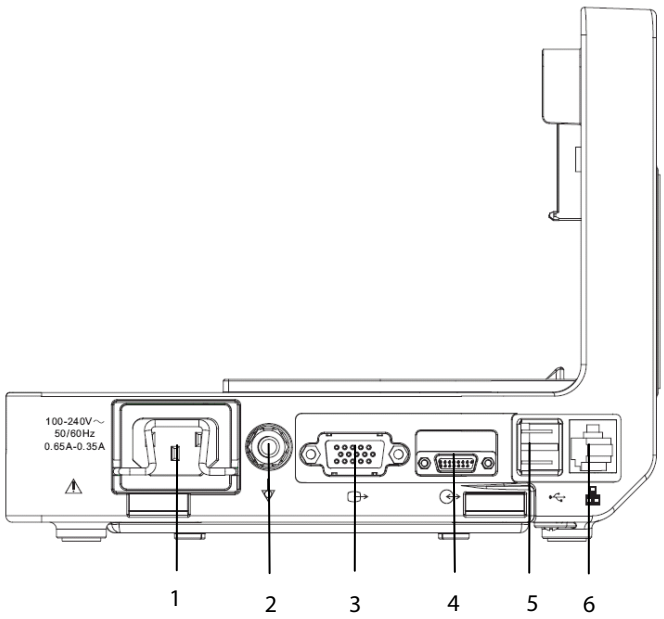
1. Symbol: indicates the direction and angle that T1 docking station can rotate when T1 docking station is fixed onto a transverse or a vertical rod.
2. USB connector: connects USB devices, including the USB drive, mouse and keyboard.
3. Network connector: a standard RJ45 connector that connects the patient monitor to the CMS or CIS.

2.4.2 Right View



1. T1 docking station multi-pin connector: power input and communication connector of T1
2. Connection status indicator: it is on when the T1 is properly connected to the T1 docking station.
3. External power supply indicator: it is on when the external AC power supply is connected.

2.4.3 Rear View



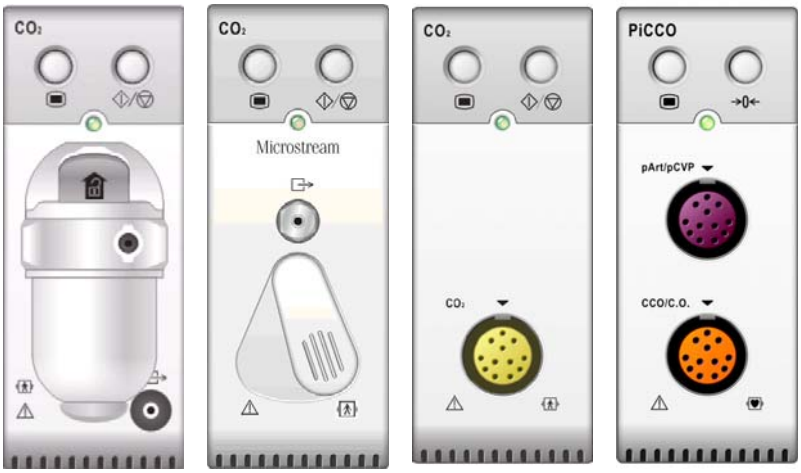
1. AC power input
2. Equipotential grounding terminal

   When using the monitor together with other devices, connect their equipotential grounding terminals together to eliminating the potential difference between them.
3. VGA connector: connects the external display
4. External device connector: connects T1 to the host monitor through a cable.
5. USB connector: connects USB devices, including the USB drive, mouse and keyboard.

6 Network connector: a standard RJ45 connector that connects the patient monitor to the CMS or CIS.

2.5 External Parameter Modules

The monitor can connect the following external parameter modules to perform CO_2 monitoring, and CCO monitoring through the T1 handle.



Sidestream CO_2 module

Microstream CO_2 module

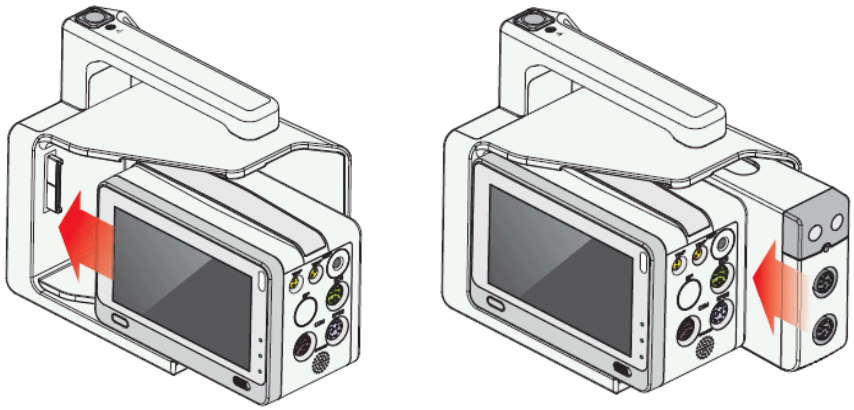
Mainstream CO_2 module

PiCCO module

2.6 Installation

T1 in Use with the T1 Handle

You can install the T1 and an external parameter module, if needed, to the T1 handle as indicated below:



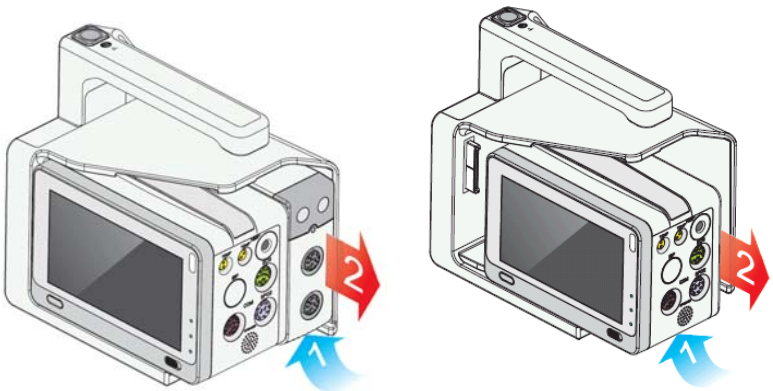
Firmly push T1 or the external module until you hear that the clip (refer to ***2.2.4 Bottom View***) engages the T1 handle. To ensure that T1 or the external module is properly connected, try to pull T1 or the external module outward. T1 or the external module properly engages the T1 handle if you cannot pull it out.

Caution

- **To prevent T1 or the external module from falling off, after insert T1 or the external module into the T1 handle, always check that T1 or the external module properly engages the T1 handle.**
- **When the external module is properly installed, you should further fasten the module to the T1 handle with the lock at the bottom of the module to ensure the engagement.**

To remove the T1 or external parameter module:

1. Press and hold the latch at the bottom of the T1 or parameter module. If the external module is locked to the T1 handle, unlock it first.
2. Pull the T1 or parameter module out as indicated.

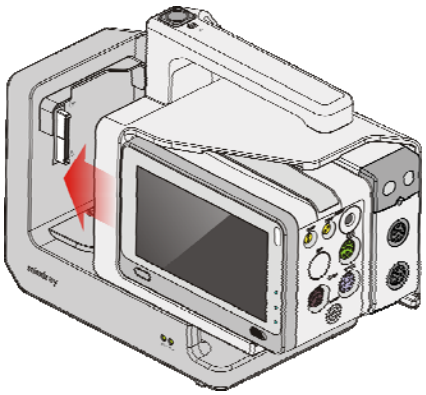


⚠ CAUTION

- **To prevent T1 from falling off, do not press the release button while transferring T1 with the T1 handle.**

T1 Handle in Use with the T1 Docking Station

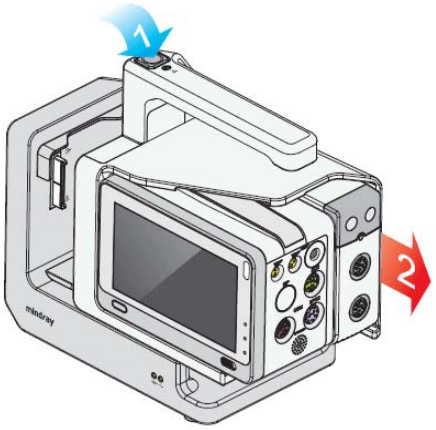
The T1 handle can be installed to the T1 docking station as indicated below:



You hear a click when the T1 handle is pushed into place.

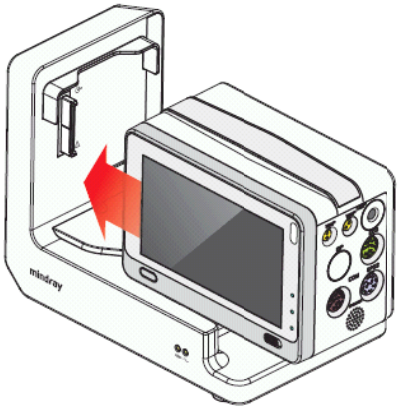
To remove the T1 handle:

1. Press and hold down the release button at the top of the T1 handle.
2. Pull the T1 handle out as indicated.



T1 in Use with the T1 Docking Station

You can also install T1 directly to the T1 docking station as shown below:



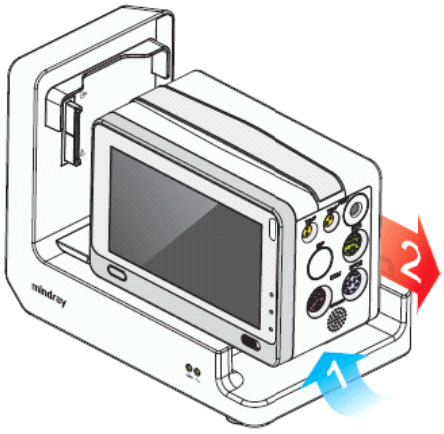
Firmly push T1 until you hear that the clip (refer to ***2.2.4 Bottom View***) engages the T1 docking station. To ensure that T1 is properly connected, try to pull T1 outward. T1 properly engages the T1 docking station if you cannot pull it out.

CAUTION

- **To prevent T1 from falling off, after insert T1 into the T1 docking station, always check that T1 properly engages the T1 docking station.**

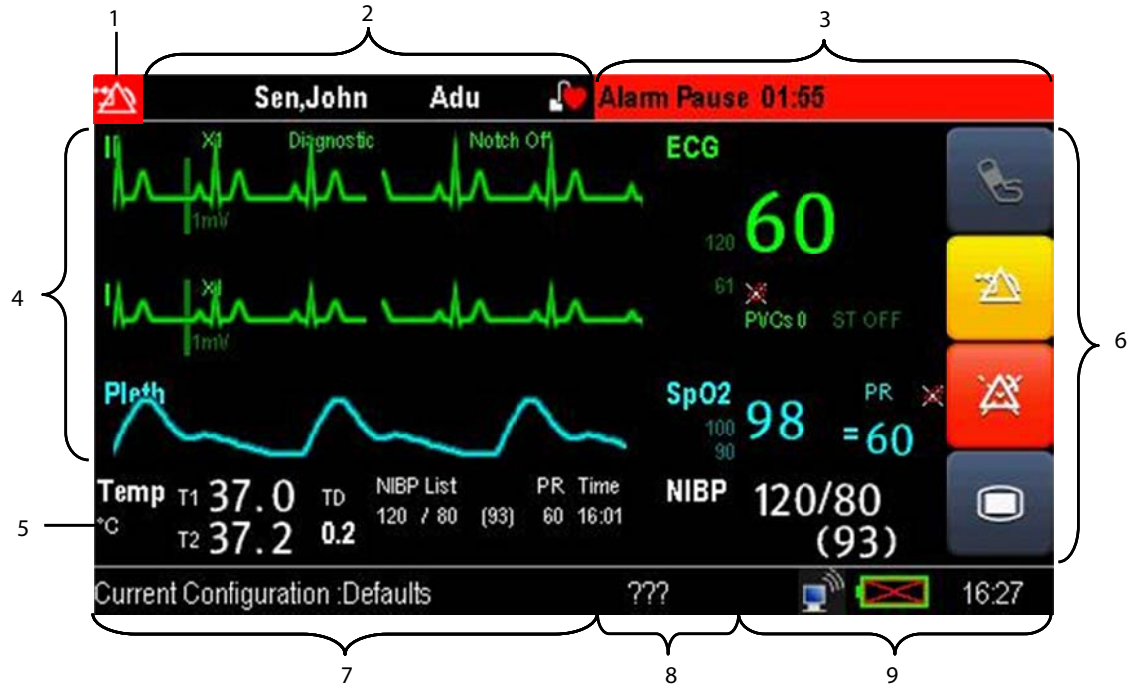
To remove T1 from the T1 docking station:

1. Press and hold the latch at the bottom of T1.
2. Pull the T1 out as indicated.



2.7 Display Screen

This patient monitor adopts a high-resolution TFT LCD to display patient parameters and waveforms. A typical display screen is shown below.



1. Alarm Symbols
2. Patient Information/Technical Alarm Area
   - This area shows the patient information such as department, bed number, room number, patient name, patient category and paced status. indicates that the patient has an implanted pacemaker. If no patient is admitted, selecting this area will enter the [**Patient Setup**] menu. If a patient has been admitted, selecting this area will enter the [**Patient Demographics**] menu.
   - When a technical alarm is presented, patient information will be covered by the technical alarm message. When multiple alarms occur, they will be displayed circularly. Selecting this area will show the Technical Alarms list.
3. Physiological Alarm Area

   This area shows physiological alarm messages. When multiple alarms occur, they will be displayed circularly. Selecting this area will show the Physiological Alarms list.
4. Waveform Area and Parameter Area A

   The left side of this area shows measurement waveforms. The right side of this area shows corresponding measurement parameters. Select this area and the corresponding measurement setup menu will be displayed.
5. Parameter Area B

   For the parameters displayed in this area, corresponding waveforms are not displayed.

6. QuickKeys Area

   This area contains QuickKeys that give you fast access to functions.

    Start or stop NIBP measurements

    Reset the alarm system

    Enter alarm paused status

    Enter the main menu

7. Prompt Message Area

   This area shows the current configuration name and the prompt messages.

8. CMS information area

   If the [**Select CMS**] function is enabled, this area shows the currently selected CMS. If no CMS is selected, this area displays "???". Refer to ***20.4.7.2 Selecting a CMS*** for detail.

9. Status area

   This area shows network status, battery status, and system time.

   -  indicates patient monitor is connected to a wire network successfully.
   -  indicates the patient monitor has failed to connect a wire network.
   -  indicates the wireless function is working.
   -  indicates the wireless function is not working.
   -  indicates a USB drive is inserted.

For details about battery status symbols, refer to ***21 Battery***.

FOR YOUR NOTES

3 Basic Operations

3.1 Installation

⚠ WARNING

- **The equipment shall be installed by personnel authorized by us.**
- **The software copyright of the equipment is solely owned by us. No organization or individual shall resort to juggling, copying, or exchanging it or to any other infringement on it in any form or by any means without due permission.**
- **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 is 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 question, please contact us.**
- **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 manufacturers or else an expert in the field, to ensure the necessary safety of patients and all devices concerned will not be impaired by the proposed combination.**

3.1.1 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.

⚠ WARNING

- **When disposing of the packaging material, be sure to observe the applicable waste control regulations and keep it out of children's reach.**
- **The equipment might be contaminated during storage and transport. Before use, please verify whether the packages are intact, especially the packages of single use accessories. In case of any damage, do not apply it to patients.**

NOTE

- **Save the packing case and packaging material as they can be used if the equipment must be reshipped.**

3.1.2 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.

⚠ WARNING

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

3.2 Getting Started

3.2.1 Turning Power On

Once the patient monitor is installed, you can get ready for monitoring:

1. Before you start to make measurements, check the patient monitor for any mechanic damage and make sure that all external cables, plug-ins and accessories are properly connected.
2. Connect the monitor with the DC adapter or T1 docking station. If you run the patient monitor on battery power, ensure that the battery is sufficiently charged.
3. Press the power on/off switch on the monitor's front.

The monitor performs self test during startup. The system gives a beep, and the alarm lamp simultaneously turns yellow, and then red, and finally off. This indicates that the alarm system functions correctly. The monitor enters the normal monitoring screen after startup.

⚠ WARNING

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

NOTE

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

3.2.2 Starting Monitoring

1. Decide which measurements you want to make.
2. Check that the patient cables and sensors are correctly connected.
3. Check that the patient settings such as [**Patient Cat.**], [**Paced**], etc, are appropriate for your patient.

Refer to the appropriate measurement section for details of how to perform the measurements you require.

3.3 Turning off the Monitor

Before turning off the monitor,

1. Confirm that the patient monitoring is finished.
2. Disconnect patient cables and sensors from the patient.
3. Make sure to save or clear the patient monitoring data as required.

Then press and hold the power on/off switch to turn off the monitor.

⚠ CAUTION

- **Although not recommended, you can press and hold the power on/off switch for ten seconds to forcibly shut down the monitor when it could not be shut down normally or under some special situations. This may cause loss of data of the patient monitor.**

NOTE

- **To completely disconnect the power supply, unplug the power cord.**

3.4 Using the Touchscreen

You can select screen items by touching them directly on the patient monitor's screen.

To avoid misoperation, you can lock the touchscreen. If the touchscreen is locked, a message [**Screen locked. Please move the lock/unlock key to unlock the screen**] is shown. The touchscreen is locked automatically if no operation is detected within 60 seconds.

If the screen is locked, sliding the lock/unlock key to the right can unlock the screen.

3.5 Using the On-screen Keyboard

The onscreen keyboard enables you to enter information.

- Use the ← key to delete the previously entered character.
- Use the  key to toggle between uppercase and lowercase letters.

- Select the ↵ key to confirm what you have entered and close the onscreen keyboard.
- Select the @!# to access the symbol keyboard.
- Select the ⮌ to exit the symbol keyboard.

3.6 Using the External Display

T1 can be connected to an external display through the VGA connector of the T1 docking station. When the external display is connected, you can monitor a patient either through the T1 or through the external display. Sliding the Lock/unlock switch to the right can switch screen display between T1 and the external display.

In the situation that the external display is connected and you switch the display to the T1, if there is no operation on the T1 display within one minute, the display will automatically switch back to the external display.

The external display displays differently with T1, for its screen size is larger. The following screens or functions can only be viewed and operated on the external display:

- Minitrends Screen
- OxyCRG Screen
- View Others Screen
- ECG 7-Lead Half-Screen
- PAWP Screen
- Calculations
- Spider view
- Hemodynamic parameters
- Department change

To connect the external display:

1. Connect one end of the VGA cable to the VGA connector of T1 docking station and the other end to the external display.
2. Connect the external display to the AC mains and turn on the display.
3. Connect T1 to the T1 docking station.

Then you can use the external display to show information from T1. You can adjust the display by pressing the Auto Set key if image offset occurs.
To switch between the T1 and the external display, move the sliding switch on the front panel of T1.

Hot plugging external display may result in abnormity. If a problem occurs:

1. Check that the external display is properly connected to the AC mains and is powered on.
2. Check that the VGA cable is properly connected.
3. Remove T1 from the docking station and reconnect it if the problem persists.

CAUTION

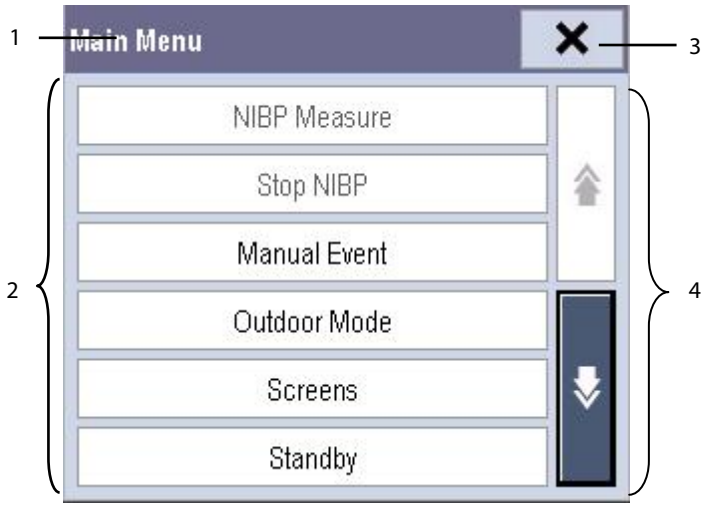
- **Use only display we specify. Using unspecified display may result in unknown problem.**

3.7 Using the Mouse and Keyboard

When connected to the external display, T1 can connect a mouse and a keyboard through the USB connector of the T1 docking station. When a mouse is in use, only the left mouse-button can be used. The right mouse-button is disabled.

3.8 Using the Main Menu

To enter the main menu, select the on-screen QuickKey. Most of monitor operations and settings can be performed through the main menu.



Other menus are similar to the main menu and contain the following parts:

1. Heading: gives a sum-up for the current menu.
2. Main body: displays options, buttons, prompt messages, etc. The menu button with ">>" enlarges a secondary window to reveal more options or information.
3. : select to exit the current menu.
4. and : moves to next page or previous page to reveal more options or information.

3.9 Changing General Settings

3.9.1 Setting up a Monitor

In situations where you install a patient monitor or change the patient monitor's application site, you need to setup the patient monitor as follows:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. In the [**User Maintenance**] menu, select, in turn, [**Monitor Name**], [**Department**] and [**Bed No.**], and then change their settings.

You can set [**Changing Bed No.**] to

- [**Unprotected**]: enables you to change Bed No. in the [**Patient Demographics**] menu.
- [**Protected**]: disables you to change Bed No. in the [**Patient Demographics**] menu.

3.9.2 Changing Language

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. In the [**User Maintenance**] menu, select [**Language**] and then select the desired language.
3. Restart the patient monitor.

The changed language is applied only after the patient monitor is restarted.

3.9.3 Setting the Date and Time

1. Select [**Main Menu**] →[**Maintenance >>**]→[**System Time >>**].
2. Set the date and time.
3. Select [**Date Format**] and toggle between [**yyyy-mm-dd**], [**mm-dd-yyyy**] and [**dd-mm-yyyy**].
4. Select [**Time Format**] and toggle between [**24h**] and [**12h**].

If your patient monitor is connected to a central monitoring system (CMS), the date and time are automatically taken from that CMS. In that case, you cannot change the date and time settings on your patient monitor.

⚠ CAUTION

- **Changing date and time affects the storage of trends and events and may cause data missing.**

3.10 Setting Parameters

3.10.1 Switching the Parameters On/Off

To switch the parameters on or off,

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Others**].
2. Configure the [**Para Switch Authority**] to [**Unprotected**] or [**Protected**].
   - If **[Para Switch Authority**] is configured to [**Unprotected**], select[**Main Menu**]→[**Screen Setup>>**]→[**Screen Layout >>**]→[**Parameters Switch**] to switch the parameters on or off.
   - If [**Para Switch Authority**] is configured to [**Protected**], the parameter switch is password protected. To switch the parameters on or off, select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Others >>**]→[**Parameters Switch Setup >>**].

When a parameter is switched off, its corresponding parameter module stops working, and its parameter value and waveform are not shown on the monitor display.

NOTE

- **ECG is always selected, and you cannot switch it off.**

3.10.2 Accessing the Parameters Menu

Select [**Parameters >>**] from the main menu or select corresponding parameter area or waveform area to access a parameter setup menu.

3.11 Operating Mode

Your monitor has different operating modes. Some are password protected. This section lists the major operating modes.

3.11.1 Monitoring Mode

This is the normal, everyday working mode that you use for monitoring patients. Your monitor automatically enters the monitoring mode after being turned on.

3.11.2 Privacy Mode

Privacy mode is only available when a patient who is admitted at a patient monitor is also monitored by the central station.

To activate the privacy mode, select [**Main Menu**]→[**Screen Setup >>**]→[**Privacy Mode**].

The patient monitor behaves as follows as soon as the privacy mode is activated:

- The screen turns blank and [**Under monitoring. Press any key to exit the privacy mode.**] is displayed.
- Monitoring and data storing continue but patient data is only visible at the central station.
- Alarms can still be triggered. But all audible alarms are suppressed and the alarm light is deactivated at the patient monitor.
- All system sounds are suppressed, including heart beat tone, pulse tone, all prompt tones, etc.

You can press any key to cancel the privacy mode.

The patient monitor exits the privacy mode automatically in one of the following situations:

- The patient monitor disconnects from central station.
- The alarm [**Battery Too Low**] or [**System will shut down soon. Please replace the batteries or use the external power.**] is presented.

The touchscreen is locked automatically in the privacy mode.

⚠ WARNING

- **During privacy mode, all audible alarms are suppressed and the alarm light is deactivated at the patient monitor. Alarms sound only at the central station.**

3.11.3 Night Mode

To avoid disturbing the patient, night mode may be used.

To activate the night mode:

1. Select [**Main Menu**]→[**Screen Setup >>**]→[**Night Mode >>**].
2. In the pop-up menu, set the desired brightness, alarm volume, QRS volume, key volume, NIBP end tone, or whether to stop NIBP measurement or not. When [**Stop NIBP**] is selected, all the NIBP measurements terminate after entering the night mode.
3. Select the [**Enter Night Mode**] button.

To cancel the night mode:

1. Select [**Main Menu**]→[**Screen Setup >>**]→[**Night Mode >>**].
2. Select [**Ok**] in the popup.

⚠ WARNING

- **Before entering night mode, confirm the settings of brightness, alarm volume, QRS volume, and key volume. Pay attention to the potential risk when the setting value is a bit low.**

3.11.4 Outdoor Mode

The outdoor mode is intended for transferring patients outdoors. In this mode, parameter color is white and unchangeable, and the screen brightness is automatically changed to 10.

To activate the outdoor mode, select [**Main Menu**]→[**Outdoor Mode**].
You can also select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password. In the [**Others >>**] menu, set [**Outdoor Mode**] to:

- [**Manual**]: The monitor enters the outdoor mode by manually selecting [**Main Menu**]→[**Outdoor Mode**], or
- [**Auto**]: The monitor enters the outdoor mode automatically if the strength of ambient light is greater than the threshold for more than 5 seconds.

To exit outdoor mode, select [**Main Menu**]→[**Outdoor Mode**]. The monitor automatically exits the outdoor mode when:

- T1 is connected with a host monitor.
- The strength of ambient light is lower than the threshold for more than 5 seconds if [**Outdoor Mode**] is set to [**Auto**].

3.11.5 Configuration Mode

Refer to***6 Managing Configuration*** for the details.

3.11.6 Module Mode

When T1 is connected to a host monitor, it works as the host monitor's parameter module. T1 can be connected to the host monitor either through the module rack of the host monitor or through the T1 docking station.

When T1 is connected to the host monitor through the module rack, operation to T1 is disabled. T1 returns to normal monitoring mode when it is detached from the host monitor. When T1 is connected to the host monitor through the T1 docking station, some functions, including setting alarms, parameters, patient information, and etc, can be achieved by operating either the host monitor or T1. Refer to the host monitor's operating manual for detail.

Insert T1 in module rack of the host monitor

To use T1 with the host monitor, insert T1 to the host monitor's module rack or satellite module rack. Firmly push T1 until you hear that the clip (refer to ***2.2.4 Bottom View***) engages the module rack. To ensure that T1 is properly connected, try to pull T1 outward. T1 properly engages the module rack if you cannot pull T1 out.

CAUTION

- **To prevent T1 from falling off, after inserting T1 into the module rack, always check that T1 properly engages the module rack.**

To remove T1 from the host monitor, lifting the latch (refer to ***2.2.4 Bottom View***) at the bottom of T1 and pull T1 out.

Connect T1 with the host monitor through the docking station

To connect T1 docking station to the host monitor:

1. Connect T1 dock data cable (PN: 009-003591-00 or 009-003592-00) to the external device connector of T1 docking station.
2. Connect T1 dock data cable to the SMR connector of the host monitor.

To disconnect T1 docking station from the host monitor:

1. Disconnect T1 dock data cable from the host monitor.
2. Disconnect T1 dock data cable from T1 docking station.

⚠ WARNING

- **Do not hot plug T1 dock data cable. Hot plug may result in unknown problems.**
- **Make sure that the T1 dock data cable is disconnected from the host monitor when T1 docking station is not in use with the host monitor.**

3.11.7 Demo Mode

In Demo mode, the monitor can demonstrate its major functions when patient or patient simulator is not connected. The Demo mode is password protected.

To enter the Demo mode,

1. Select [**Main Menu**]→[**Maintenance >>**].
2. Select [**Demo >>**]. Enter the required password and then select [**Ok**].

To exit the Demo mode, select [**Main Menu**]→[**Maintenance >>**]→[**Exit Demo**] →[**Ok**].

⚠ WARNING

- **The Demo mode is for demonstration purpose only. To avoid that the simulated data are mistaken for the monitored patient's data, you must not change into Demo mode during monitoring. Otherwise, improper patient monitoring and delayed treatment could result.**

3.11.8 Standby Mode

In standby mode, you can temperately stops patient monitoring without turning off the monitor. To enter the standby mode, select [**Main Menu**]→[**Standby**].

4 User Screens

4.1 Adjusting the Screen Brightness

1. Select the [**Main Menu**]→[**Screen Setup >>**]→[**Brightness**].
2. Select the appropriate setting for the screen brightness.
   - 1 to 10. 10 is the brightest, and 1 is the least bright.
   - Auto: Screen brightness will be adjusted automatically.

If the patient monitor operates on battery power, you can set a less bright screen to prolong the operating time of the battery. When the patient monitor enters standby mode, the screen will change to the least brightness automatically.

4.2 Adjusting Volume

Alarm Volume

1. Select [**Main Menu**]→[**Alarm Setup >>**]→[**Others**].
2. Select [**Alm Volume**] and then select the appropriate volume: X-10, in which X is the minimum volume, depending on the set minimum alarm volume (refer to the ***7.4.2 Setting the Minimum Alarm Volume***), and 10 the maximum volume.
3. Set [**High Alarm Volume**].
4. Set [**Reminder Vol**].

Key Volume

1. Select [**Main Menu**]→[**Screen Setup >>**].
2. Select [**Key Volume**] and then select the appropriate volume. 0 means off, and 10 the maximum volume.

QRS Volume

The QRS tone is derived from either the HR or PR, depending on which is currently selected as the alarm source in [**ECG Setup**] or [**SpO2 Setup**]. When monitoring SpO_2, there is a variable pitch tone which changes as the patient's saturation level changes. The pitch of the tone rises as the saturation level increases and falls as the saturation level decreases. The volume of this tone is user adjustable.

1. Select the ECG parameter window →[**Others >>**], or the SpO_2 parameter window.
2. Select [**QRS Volume**] or [**Beat Vol**] and then select the appropriate volume. 0 means off, and 10 the maximum volume.

4.3 Tailoring Your Screens

You can tailor your patient monitor's screens by setting:

- Waveform sweep mode
- Wave line size
- The color in which each measurement's numerics and waveform are displayed
- The parameter to be monitored.

Changing some settings may be hazardous. Therefore, those setting are password-protected and can be modified by authorized personnel only. Once change is made, those who use the patient monitor should be notified.

4.3.1 Changing the Wave Line Size

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Others >>**].
3. Select [**Wave Line**] and toggle between [**Thick**], [**Mediate**] and [**Thin**].

4.3.2 Changing Measurement Colors

1. Select [**Main Menu**]→[**Screen Setup >>**]→[**Measurement Color Setup >>**].
2. Select the color box next to your desired measurement and then select a color from the popup menu.

4.3.3 Choosing a Screen

By selecting [**Main Menu**]→[**Screens**]→[**Choose Screen**], you can choose eithe r of the following screen:

- Normal Screen
- Big Numerics screen
- ECG 7-Lead Full-Screen if 5-lead or 12-lead ECG is selected
- ECG 12-Lead Full-Screen if 12-lead ECG is selected
- PiCCO Screen if PiCCO module is configured

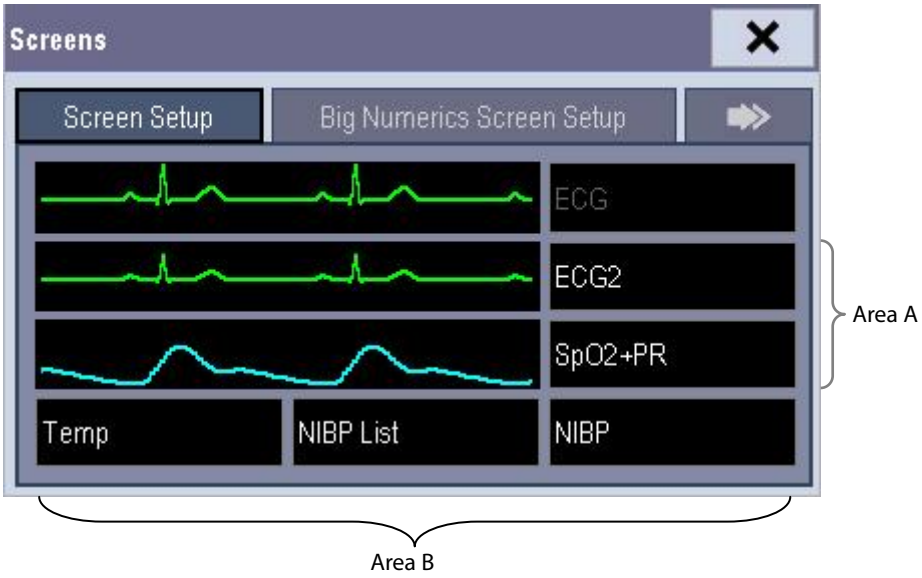
If the external display is connected, you can also choose:

- ECG 7-Lead Half-Screen if 5-lead or 12-lead ECG is selected
- Minitrends Screen
- OxyCRG Screen
- View Others Screen
- PAWP Screen

4.3.4 Changing Screen Layout

Select [**Main Menu**]→[**Screen Setup >>**]→[**Screen Layout >>**] to enter the [**Screens**] menu.

- You can choose the desired screen type in the [**Choose Screen**] window.
- You can select the parameters and waveforms you want to view in the [**Screen Setup**] window. For details, please refer to the section ***Setting the Screen***.
- You can select the parameters you want to view on big numerics screen in the [**Big Numerics Screen Setup**] window.
- You can switch on or off the connected parameter modules in the [**Parameters Switch**] window. If a parameter module is switched off, parameter values and waveforms will not display on the screen.



The ECG parameter and the first ECG waveform always display in the first row. The configurable areas can be classified as Area A and Area B.

- In Area A, you can choose to display the parameters (having waveforms) and their waveforms. Each parameter and the associated waveform are displayed in the same row.
- In Area B, you can choose to display all the parameters except ECG. Associated waveforms will not be displayed.

⚠ WARNING

- **The parameters whose positions are not allocated in the [**Screen Setup**] window will not be displayed. However, the monitor can still give alarms of these parameters.**

4.4 Understanding the Big Numerics Screen

To enter the big numerics screen:

1. Select [**Main Menu**]→[**Screen Setup >>**]→[**Screen Layout >>**].
2. In the [**Choose Screen**] tab, select [**Big Numerics**].

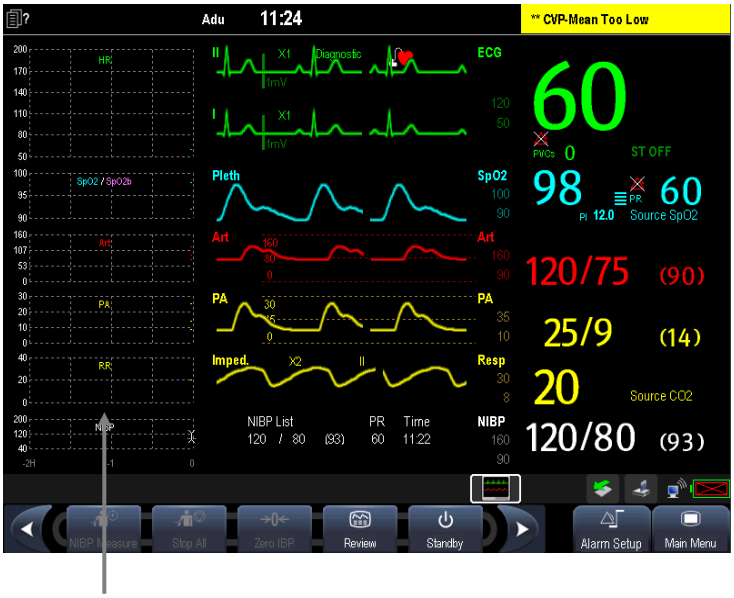
You can select your desired parameters to display in this screen: in the [**Screens**] menu select [**Big Numerics Screen Setup**] and then select the parameters you want. For parameters having a waveform, the waveform will not be displayed.

4.5 Viewing Minitrends (only available for the external display)

4.5.1 Having a Split-Screen View of Minitrends

You can split the normal screen so that one part of the screen, on the left hand side, continuously shows graphic minitrends beside waveforms as shown in the figure below.

To have a split-screen view of minitrends, you can select [**Main Menu**]→[**Screen Setup >>**]→[**Screen Layout >>**]→[**Choose Screen**]→[**Minitrends Screen**]→ ✕.

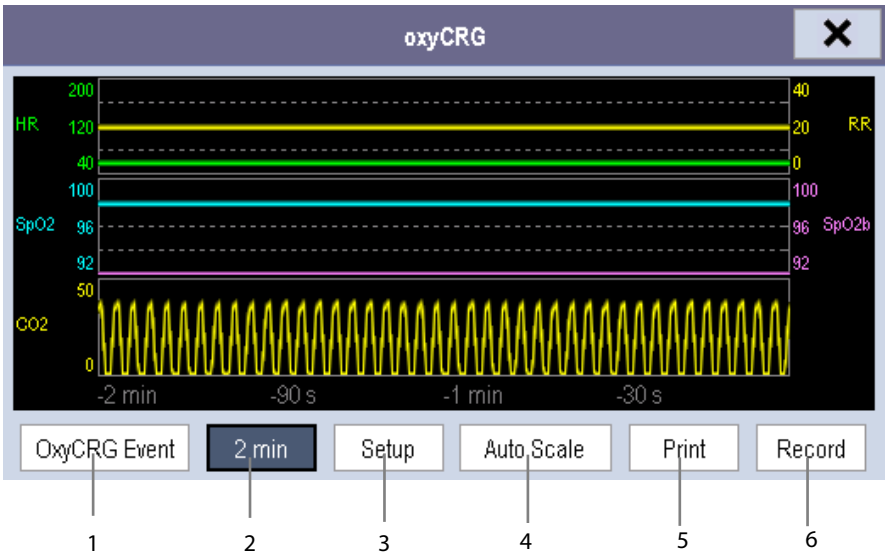


Minitrend View

The split-screen view provides minitrends for multiple parameters. In each field, the label and scale are respectively displayed at the top and left. The time is displayed at the bottom of the minitrends view.

4.6 Viewing OxyCRG (only available for the external display)

To have a split screen view of OxyCRG, you can select [**Main Menu**]→[**Screen Setup >>**]→[**Screen Layout >>**]→[**Choose Screen**]→[**OxyCRG Screen**]→✕.



The split-screen view covers the lower part of the waveform area and shows HR trend, SpO_2 trend, SpO_2b trend, RR trend and a compressed wave (CO_2 wave or Resp wave). At the bottom, there are controls:

1. OxyCRG Event

   You can enter the [**Review**] menu by selecting the [**OxyCRG Event**] button.

2. Trend length list box

   In the trend length list box, you can select [**1 min**], [**2 min**], [**4 min**], or [**8 min**].

3. Setup

   Select [**Setup**] button to enter [**Setup**] menu, in which you can select the parameters for display, the time length to be saved before and after an event, and the scale of the graphic trends and waveform.

4. Auto Scale

   Select [**Auto Scale**] button, and the system automatically adjusts the scaling.

5. Print

   Select [**Print**] to print out the realtime OxyCRG.

6. Record

   Through this button, you can print out the currently displayed OxyCRG trends by the recorder.

4.7 Viewing Other Patients (only available for the external display)

4.7.1 Care Group

You can select other patient monitors (including telemetry) connected to the same LAN into a Care Group. This lets you:

- View information on the monitor screen from another bed in the same Care Group.
- Be notified of physiological and technical alarm conditions at the other beds in the same Care Group.

You can select up to 10 patient monitors in a Care Group. To have a Care Group:

1. Open the [**View Other Patient**] window by selecting [**Main Menu**]→[**Screen Setup >>**]→[**Screen Layout >>**]→[**Choose Screen**]→[**View Others Screen**]→ ✕.
2. Select [**Setup**] in the [**View Other Patient**] window.
3. Select the desired patient monitors from the [**Connected Monitor List**], and then select the ✕ button. The selected patient monitors constitute a Care Group.

This monitor can transmit alarms to multiple monitors when this monitor is in their Care Groups. However, only four monitors can view simultaneously the waveforms and measurements of this monitor in those monitors' [**View Other Patient**] window. If you want to view the waveforms and measurements of this monitor in the fifth monitor, you need to close the [**View Other Patient**] window in any of the four monitors which are viewing the waveforms and measurements right now.

NOTE

- **Monitors of software version prior to 05.25.00 can not view monitors with [Address Type] configured to [DHCP] and with software version 05.25.00 or later.**

4.7.2 Viewing the Care Group Overview Bar

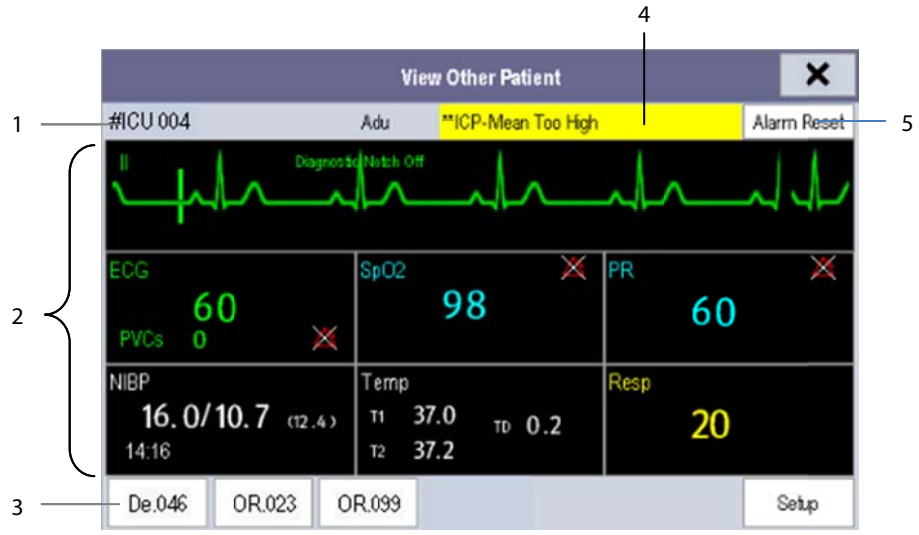
The Care Group overview bar locates at the bottom of the [**View Other Patient**] window. In the overview bar, the department and bed label for any Care Group beds are displayed. For telemetry, # is displayed before the department label. The color in which a Care Group bed appears matches its status:

- Red: indicates the bed is giving high-level physiological alarms or the telemetry is giving alarm, such as nurse call or event.
- Yellow: indicates the bed is giving medium- or low-level physiological alarms, or medium-level technical alarms.
- Blue: indicates the bed is giving low-level technical alarms.
- Grey: indicates the bed fails to be networked or stays in the standby mode.

You can view a Care Group bed's alarms by selecting it from the care group, and as well you can select the [**View This Patient**] button to view this bed in the [**View Other Patient**] window. For more details about Care Group alarms, refer to the ***7Alarms***.

4.7.3 Understanding the View Other Patient Window

When you first open the [**View Other Patient**] window, the patient monitor automatically selects a monitor from the network to display in the [**View Other Patient**] window.



The [**View Other Patient**] window covers the lower part of the waveform area and consists of:

1. Information Area: shows the patient information (including department, bed number, patient name, etc.), and network status symbol.
2. View Area: shows physiological waveforms and parameters. You can switch a waveform area to a parameter area by selecting your desired waveform area and then selecting [**Switch to Parameter Area**], or switch a parameter area to a waveform area by selecting your desired parameter area and then selecting [**Switch to Waveform Area**].
3. Care Group Overview Bar.
4. Message Area: shows physiological, technical and prompt messages from the currently viewed patient monitor. It also shows the alarm given by the telemetry such as nurse call or event. By selecting this area, you can enter the [**Alarm Information List**] to view all physiological, technical and prompt messages coming from the currently viewed patient.
5. [**Alarm Reset**] button

   When [**Reset Other Bed's Alarms**] is set to [**On**] in [**Maintenance>>**]→[**User Maintenance>>**]→[**Alarm Setup>>**], the [**Alarm Reset**] button appears on the [**View Other Patient**] window. You can reset the alarm system for the selected monitor by pressing the button. Refer to ***section 7.11.3 Resetting Care Group Alarms*** for details.

   When [**Reset Other Bed's Alarms**] is set to [**Off**], there is no button appearing on the [**View Other Patient**] window.

Additionally, you can change a waveform or parameter for viewing

- To change a waveform for viewing, select the waveform segment where you want a new waveform to appear and then select the waveform you want from the popup menu.
- To change a parameter for viewing, select the parameter window where you want a new parameter to appear and then select the parameter you want from the popup menu.

WARNING

- **The data presented in the [View Other Patient] window have delay. Do not rely on this window for realtime data.**

FOR YOUR NOTES

5 Managing Patients

5.1 Admitting a Patient

The patient monitor displays physiological data and stores them in the trends as soon as a patient is connected. This allows you to monitor a patient that is not admitted yet. However, it is recommended that you fully admit a patient so that you can clearly identify your patient on reports and network devices.

To admit a patient:

1. Select [**Main Menu**]→[**Patient Setup >>**].
2. Select [**Admit Patient**].

   If a patient has been admitted, a message [**Are you sure to discharge the current patient and admit a new patient?**] pops up. Then select [**Ok**] to clear any previous patient data. If you do not erase data from the previous patient, the new patient's data will be saved into the data of the previous patient. The monitor makes no distinction between the old and the new patient data.

   If no patient is admitted, you can choose either:

   - [**Yes**] to apply the data saved in the patient monitor to the new patient, or
   - [**No**] to clear the data saved in the patient monitor.
3. In the [**Patient Demographics**] menu, enter the demographic details, of which:
   - [**Patient Cat.**] determines the way your patient monitor processes and calculates some measurements, and what safety and alarm limits are applied for your patient.
   - [**Paced**] determines whether to show pace pulse marks on the ECG waveform. When the [**Paced**] is set to [**No**], pace pulse marks are not shown in the ECG waveform.
4. Select [**Ok**].

⚠WARNING

- **[Patient Cat.] and [Paced] will always contain a value, regardless of whether the patient is fully admitted or not. If you do not specify settings for these fields, the patient monitor uses the default settings from the current configuration, which might not be correct for your patient.**
- **For paced patients, you must set [Paced] to [Yes]. If it is incorrectly set to [No], the patient 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].**

5.2 Quick Admitting a Patient

Use [**Quick Admit**] only if you do not have the time or information to fully admit a patient. Complete the rest of the patient demographic details later.

1. Select [**Main Menu**]→[**Patient Setup >>**].
2. Select [**Quick Admit**]. If a patient has been admitted at present, select [**OK**] to discharge the current patient. If .no patient is admitted, you can choose either:
   - [**Yes**] to apply the data in your patient monitor to the new patient, or
   - [**No**] to clear any previous patient data.
3. Enter the patient category and paced status for the new patient, and then select [**Ok**].

5.3 Setting the Monitor Location

To set the monitor location, follow this procedure:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Input the following location of the monitor:
   - [**Facility**]: your facility name.
   - [**Department**]: your department name.
   - [**Room No.**]: room number.
   - [**Bed No.**]: bed number.

5.4 Querying and Obtaining Patient Information

The monitor can obtain patient information from HIS through eGateway. To query or obtain patient information from HIS,

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Network Setup >>**]→[**Gateway Comm Setup >>**], and set [**IP Address**] and [**Port**]. Set [**ADT Query**] to [**On**].
2. Click patient information area to enter the [**Patient Demographics**] menu.
3. Select [**Obtain Patient Info. >>**] to enter the [**Obtain Patient Information**] menu.
4. Input query condition and then select [**Query**]. The monitor will display the obtained patient information.
5. Select a patient and then click [**Import**]. Then the monitor will update the information of corresponding patient.
6. Select ✕ to exit the [**Obtain Patient Information**] menu.

NOTE

- **The option [Obtain Patient Information] is available in the [Patient Setup] menu only when [ADT Query] is set to [On].**
- **When obtaining patient information from HIS, the monitor only update patient inforamtion. The patient's monitoring data is not changed and the patient is not discharged.**

5.5 Querying from Local Facility

You can query the patient information from either the local facility or all networked facilities. To set where to query, follow this procedure:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Network Setup >>**]→[**Gateway Comm Setup >>**].
2. Set [**Query From Local Facility**].
   - ◆ Select [**Yes**] to query only from local facility.
   - ◆ Select [**No**] to query from all networked facilities.

5.6 Associating Patient Information

After associating patient information with HIS, the monitor will automatically update patient information if corresponding information in HIS has been changed. The monitor can associate patient's MRN, visit number, first name, last name, date of birth, and gender with HIS.

NOTE

- **A keyword takes effect only when being defined in eGateway. Refer to *eGateway Integration Manager Installation Guide* for details.**
- **The monitor displays corresponding patient information only when all the keywords have been inputted.**

5.7 Editing Patient Information

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

1. Select [**Main Menu**]→[**Patient Setup >>**].
2. Select [**Patient Demographics**] and then make the required changes.
3. Select [**Ok**].

You can also input the patient's visit number in the [**Patient Demographics**] menu, but the [**Visit Number**] option needs to be enabled.

To display the [**Visit Number**] option in the [**Patient Demographics**] menu:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Set [**Visit Number**] to [**On >>**].

5.8 Discharging a Patient

To discharge a patient:

1. Select [**Main Menu**]→[**Patient Setup >>**].
2. Select [**Discharge Patient**]. In the popup menu, you can either:
   - ◆ Directly select [**Ok**] to discharge the current patient, or
   - ◆ Select [**Standby**] then [**Ok**]. The patient monitor enters the standby mode after discharging the current patient, or
   - ◆ Select [**Cancel**] to exit without discharging the patient.

NOTE

- **Discharging a patient clears all history data in the monitor.**

5.9 Transferring a Patient

You can transfer patient data between monitors without re-entering the patient demographic information. Transferring of patient data enables you to understand the patient's history condition. The patient data that can be transferred includes: patient demographics, trend data, alarm events and parameters alarm limits.

You can use a USB Drive to transfer data between two patient monitors. You can also connect T1 with the host monitor to implement patient transfer.

⚠WARNING

- **Do not discharge a patient before the patient is successfully transferred.**
- **After a patient is successfully transferred, check if the patient settings (especially patient category, paced status and alarm limits settings, etc) on the monitor are appropriate for this patient.**

NOTE

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

5.9.1 Transferring Patient Data via a USB Drive

Select [**Others >>**] from [**User Maintenance**] menu. In the popup menu, set [**Data Transfer Method**] to [**USB Drive**]. You can also set [**Transferred Data Length**]. The default is [**4 h**].

5.9.1.1 Transferring Data from the Monitor to a USB Drive

1. Connect the T1 to the T1 docking station.
2. Connect a USB Drive to the T1 docking station's USB connector.
3. Select [**Main Menu**] →[**Patient Setup >>**].
4. Select [**Transfer to Storage Medium**]. In the popup menu, select [**Ok**].
5. Wait until the following message appears: [**Transfer to storage medium successful. Please remove the USB drive.**].
6. Remove the USB drive from the T1 docking station.

5.9.1.2 Transferring Data from a USB Drive to the Monitor

1. Connect a USB Drive to the T1 docking station's USB connector.
2. In the popup menu, you can:
   - Select [**Transfer**] to transfer the patient data to the monitor, or
   - Select [**Cancel Transfer**] to cancel the operation of transferring patient data.
   - Select [**Unload USB Drive**] to not transfer the patient data and to unload the USB drive.
3. After you select [**Transfer**], in the popup menu you can further select the patient data contents that need to be transferred. [**Patient Demographics**] must be selected. After [**Ok**] is selected, the monitor compares the patient information stored in both the storage medium and monitor and deals with the patient data based on the following.
   - Different Patients: The monitor erases all the current patient data, transfers the patient data from the storage medium, and loads the configuration according to the patient category.
   - Same Patient: In the popup dialog box, you can:
     - Select [**Yes**] to merge the patient data in the monitor and storage medium.
     - Select [**No**] to erase all the current patient data in the monitor and to transfer the patient data from the storage medium.
4. Wait until the following message appears: [**Transfer from storage medium successful.**].

⚠WARNING

- **The USB drive you use may have write-protect function. In this case, please make sure the USB drive for data transfer is in read/write mode.**
- **Do not remove the storage medium during data transfer process. Otherwise, data files may be damaged.**
- **Check that the USB drive is removed before disconnecting T1 from the T1 docking station.**

5.9.2 Transferring Patient via T1

T1 can be used with a host monitor or the docking station to implement patient transfer. For patient transfer via the host monitor, refer to the host monitor's operating manual for detail.

NOTE

- **Only host monitors with a system software version 05.00.00 or greater support patient transfer via T1.**

In the situation that T1 is in use with the docking station for patient transfer, you need to configure the docking station on T1. To configure the docking station, select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→[**Others >>**]→[**Dock Setup >>**].

NOTE

- **The function of dock setup is active only when T1 is inserted into the docking station.**

Setting Woke Mode

Work Mode defines the source of department, bed number, and central station IP settings when T1 is connected with the docking station.

- In Dock mode, T1 uses the settings of T1 when T1 is connected, and the settings remain the unchanged when T1 is removed from the docking station.
- In host mode, T1 uses the settings of the docking station when T1 is connected, and the settings remains unchanged when T1 is removed from the docking station.

Setting Network Type

Network Type specifies the source of T1's network configuration when T1 is connected with the docking station.

- If [**Use Current T1 Net Setting**] is selected, T1's network setting is the current T1's network setting when T1 is connected, and the settings does not change when T1 is removed from the docking station.
- If [**Use Current Dock Net Setting**] is selected, T1's network setting is the current network setting of the docking station, and the setting restore to the previous T1's settings when T1 is removed from the docking station.

Setting Central Station IP

Central Station IP defines the IP address of the central station to which T1 is connected. T1 can only be connected to the specified central station.

The current central station IP is shown in the prompt message area. You can select this area to pop up the [**Central Station IP**] menu.

NOTE

- **For central station with system software system software 06.08.00 or greater, as long as a patient is admitted, T1 can be automatically connected to the specified central station.**

5.10 Connecting to a Central Monitoring System

If your patient monitor is connected to a central monitoring system (CMS):

- All patient information, measurement data and settings on the patient monitor can be transferred to the CMS.
- All patient information, measurement data and settings can be displayed simultaneously on the patient monitor and CMS. For some functions such as editing patient information, admitting a patient, discharging a patient, starting/stopping NIBP measurements, etc., bi-directional control can be achieved between your patient monitor and the CMS.

NOTE

- **Only Mindray CMS with a system software version 06.03.00 or greater supports T1.**

For details, refer to the CMS's instructions for use.

FOR YOUR NOTES

6 Managing Configuration

6.1 Introduction

When performing continuous monitoring on a patient, the clinical professional often needs to adjust the monitor's settings according to the patient's condition. The collection of all these settings is called a configuration. Allowing you to configure the monitor more efficiently, the monitor offers different sets of configuration to suit different patient categories and departments. You can change some settings from a certain set of configuration and then save the changed configuration as a user configuration.

The default configurations provided for your monitor are department-oriented. You can choose either from:

- General
- OR
- ICU
- NICU
- CCU

Each department has three different sets of configurations tailored for adult, pediatric and neonatal patients.

⚠WARNING

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

The system configuration items can be classified as:

- Parameter configuration items

  These items relates to parameters, e.g., waveform gain, alarm switch, alarm limits.

- Conventional configuration items

  These items define how the monitor works, e.g., screen layout, record, print and alarm settings.

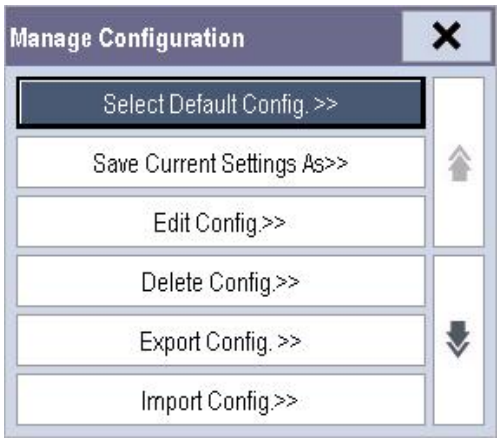
- User maintenance items

  These items relates to user maintenance settings, e.g., unit setup, time format and data format.

For the important configuration items and their default values and user maintenance items, see ***C Default Configurations***.

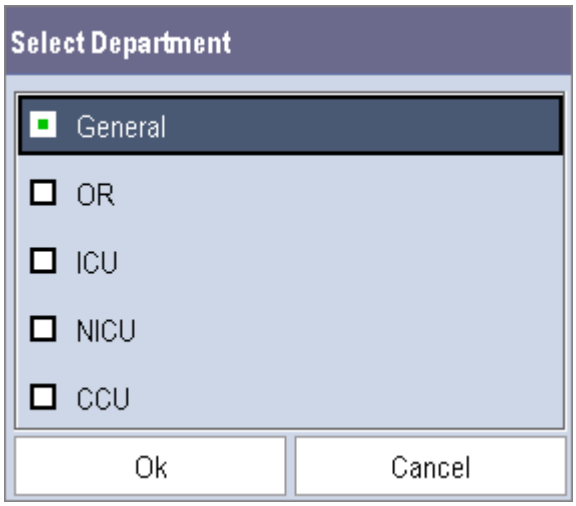
6.2 Entering the Manage Configuration Menu

To access configuration management, select [**Main Menu**]→[**Maintenance >>**]→[**Manage Configuration >>**]. Enter the required password and then select [**Ok**].



6.3 Changing Department

If the current department configuration is not the one you want to view, you can select [**Change Department >>**] in the [**Manage Configuration**] menu and then choose the one you want for viewing as shown below.



NOTE

- **Changing the department will delete all current user configurations. Please act with caution.**

6.4 Setting Default Configuration

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

- The patient monitor restarts after quitting over 120 seconds.
- A patient is admitted.
- A patient is discharged.
- Patient data is cleared.
- Patient category is changed.

To set default configuration:

1. Select [**Select Default Config. >>**] in the [**Manage Configuration**] menu.
2. In the [**Select Default Config.**] menu, select [**Load the Latest Config.**] or [**Load Specified Config.**].

When you select [**Load Specified Config.**], the configuration (adult, pediatric or neonate) to be restored is subject to the patient category. This configuration can be either factory configuration or saved user configuration. Take adult as an example, select [**Default Adu Config.**] and toggle between [**Defaults**] or user configuration(s).

NOTE

- **When the patient monitor starts, it shows what configuration is restored at the prompt information area for about 10 seconds.**

6.5 Saving Current Settings

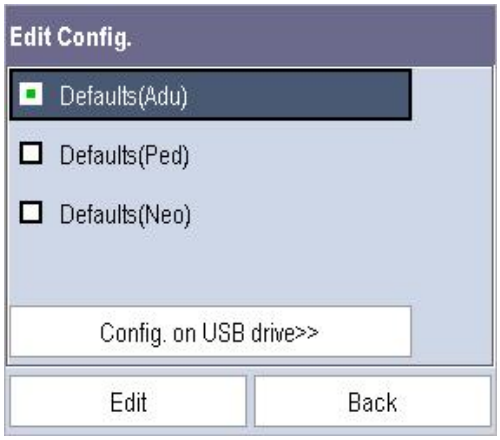
Current settings can be saved as user configuration. Up to 3 user configurations can be saved.

To save current settings:

1. Select [**Save Current Settings As >>**] in the [**Manage Configuration**] menu.
2. In the popup dialog box, enter the configuration name and then select [**Ok**].

6.6 Editing Configuration

1. Select [**Edit Config. >>**] in the [**Manage Configuration**] menu. The popup menu shows the existing configurations on the monitor. Selecting [**Config. on USB drive >>**] will show the existing configurations on the USB drive.



2. Select the desired configuration and then select the [**Edit**] button.

3. Select [**Alarm Setup >>**], [**Screen Setup >>**] or [**Parameter >>**] to enter the corresponding menu in which settings can be changed. The changed items of alarm setup will be marked in red.
4. You can select [**Save**] or [**Save as**] to save the changed configuration. Select [**Save**] to overwrite the original configuration. Select [**Save as**] to save the changed configuration in another name.

6.7 Deleting a Configuration

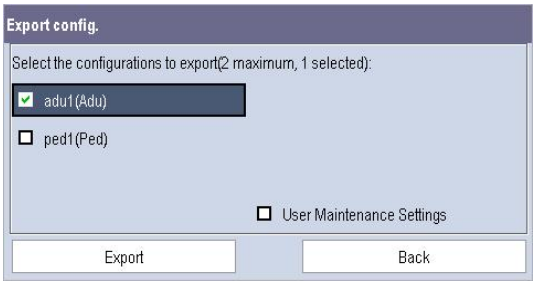
1. Select [**Delete Config. >>**] in the [**Manage Configuration**] menu. The popup menu shows the existing user configurations on the monitor. Selecting [**Config. on USB drive >>**] will show the existing user configurations on the USB drive.
2. Select the user configurations you want to delete and then select [**Delete**].
3. Select [**Yes**] in the popup.

6.8 Transferring a Configuration

When installing several monitors with identical user configuration it is not necessary to set each unit separately. An USB drive may be used to transfer the configuration from monitor to monitor.

To export the current monitor's configuration:

1. Connect a USB Drive to the T1 dock station's USB connector.
2. Select [**Export Config. >>**] in the [**Manage Configuration**] menu.
3. In the [**Export Config.**] menu, select the configurations and [**User Maintenance Settings**] to export. Then select the [**Export**] button.



To import the configuration on the USB drive to the monitor:

1. Connect the USB Drive to theT1 docking station's USB connector.
2. Select [**Import Config. >>**] in the [**Manage Configuration**] menu.
3. In the [**Import Config.**] menu, select the configurations and [**User Maintenance Settings**] to import. Then select the [**Import**] button. A status message will report completion of the transfer.

6.9 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 so as to ensure that all the settings are appropriate for your patient.

To load a configuration,

1. Select [**Load Configuration >>**] from the main menu. The popup menu shows the existing configurations on the monitor. Selecting [**Config. on USB drive >>**] will show the existing configurations on the USB drive.
2. Select a desired configuration.
3. Select [**Load**] to load this configuration.

6.10 Restoring the Latest Configuration Automatically

During operation, you may make changes to some settings. However, these changes may not be saved as user configuration. To prevent the changes from losing in case of a sudden power failure, the patient monitor stores the configuration in real time. The saved configuration is the latest configuration.

The monitor restore the latest configuration if restarts within 60 seconds after the power failure. And it will restore the default configuration rather than the latest configuration if restarts 120 seconds later after the power failure. The monitor may load either the latest configuration or the default configuration if restarts from 60-120 seconds after the power failure.

6.11 Modifying Password

To modify the password for accessing the [**Manage Configuration**] menu,

1. Select [**Modify Password >>**] in the [**Manage Configuration**] menu.
2. Input a new password in the popup menu.
3. Select [**Ok**].

7 Alarms

Alarms, triggered by a vital sign that appears abnormal or by technical problems of the patient monitor, are indicated to the user by visual and audible alarm indications.

⚠WARNING

- **A potential hazard can exist if different alarm presets are used for the same or similar equipment in any single area, e.g. an intensive care unit or cardiac operating room.**
- **If your patient monitor is connected to the central monitoring system (CMS) or other monitors, alarms can be displayed and controlled remotely. Remote suspension, inhibition, or reset of monitor alarms via the CMS or other monitors may cause a potential hazard. For details, refer to the operator's manual of the CMS and the other monitors.**

7.1 Alarm Categories

By nature, the patient monitor's alarms can be classified into two categories: physiological alarms and technical alarms.

- Physiological alarms

  Physiological alarms, also called patient status alarms, are triggered by a monitored parameter value that violates set alarm limits or an abnormal patient condition. Physiological alarm messages are displayed in the physiological alarm area.

- Technical alarms

  Technical alarms, also called system status alarms, are triggered by a device malfunction or a patient data distortion due to improper operation or mechanical problems. Technical alarm messages are displayed in the technical alarm area.

  Apart from the physiological and technical alarm messages, the patient monitor shows some messages telling the system status or patient status. Messages of this kind are included into the prompt message category and usually displayed in the prompt information area. Some prompt messages that indicate the arrhythmia events are displayed in the physiological alarm area. For some measurements, their related prompt messages are displayed in their respective parameter windows.

7.2 Alarm Levels

By severity, the patient monitor's alarms can be classified into three categories: high level, medium level and low level..

	Physiological alarms	Technical alarms
High level	Indicate that your patient is in a life threatening situation, such as Asystole, Vfib/Vtac and so forth, and an emergency treatment is demanded.	Indicate a severe device malfunction or an improper operation, which could make it possible that the monitor cannot detect critical patient status and thus threaten the patient's life.
Medium level	Indicate that your patient's vital signs appear abnormal and an immediate treatment is required.	Indicate a device malfunction or an improper operation, which may not threaten the patient's life but may compromise the monitoring of vital physiological parameters.
Low level	Indicate that you patient's vital signs appear abnormal and an immediate treatment may be required.	Indicate a device malfunction or an improper operation, which may compromise a certain monitoring function but will not threaten the patient's life.

7.3 Alarm Indicators

When an alarm occurs, the patient monitor will indicate it to the user through visual or audible alarm indications.

- Alarm lamp
- Audible alarm tones
- Alarm message
- Flashing numeric

7.3.1 Alarm Lamp

If a technical alarm or physiological alarm occurs, the alarm lamp will flash. The color and flashing frequency match the alarm level as follows:

- High level alarms: the lamp quickly flashes red.
- Medium level alarms: the lamp slowly flashes yellow.
- Low level alarms the lamp lights yellow without flashing.

7.3.2 Audible Alarm Tones

The alarm tone is distinct from heart beat tone, keystroke tone and pulse tone in frequency. This monitor has three choices of alarm tones and patterns: ISO, Mode 1 and Mode 2. For each pattern, the alarm tones identify the alarm levels as follows:

- ISO pattern:
  - High level alarms: triple+double+triple+double beep.
  - Medium level alarms: triple beep.
  - Low level alarms: single beep.
- Mode 1:
  - High level alarms: high-pitched single beep.
  - Medium level alarms: double beep.
  - Low level alarms: low-pitched single beep.
- Mode 2:
  - High level alarms: high-pitched triple beep.
  - Medium level alarms: double beep.
  - Low level alarms: low-pitched single beep.

NOTE

- **When multiple alarms of different levels occur simultaneously, the patient monitor will select the alarm of the highest level to light the alarm lamp and give alarm sounds accordingly, while all the alarm messages are displayed circularly on the screen.**

7.3.3 Alarm Message

When an alarm occurs, an alarm message will appear in the technical or physiological alarm area. The alarm message has different background color which matches the alarm level.

- High level alarms red
- Medium level alarms yellow
- Low level alarms yellow

For physiological alarms, the asterisk symbols (*) before the alarm message match the alarm level as follows:

- High level alarms ***
- Medium level alarms **
- Low level alarms *

You can view the alarm messages by selecting the physiological or technical alarm area.

NOTE

- **Some physiological alarms, such as asystole, are exclusive. They have identical alarm tones and alarm lights with normal high level physiological alarms, but their alarm messages are displayed exclusively. That is to say, when an exclusive physiological alarm and a normal high level physiological alarm are triggered simultaneously, only alarm message of the exclusive physiological alarm is displayed.**

7.3.4 Flashing Numeric

If an alarm triggered by an alarm limit violation occurs, the numeric of the measurement in alarm will flash every second, and the corresponding alarm limit will also flash at the same frequency indicating the high or low alarm limit is violated.

7.3.5 Alarm Status Symbols

Apart from the aforementioned alarm indicators, the patient monitor still uses the following symbols telling the alarm status:

-  indicates alarms are paused.
-  indicates alarms are reset.
-  indicates the alarm sound is turned off.
-  indicates individual measurement alarms are turned off or the system is in alarm off status.

7.4 Alarm Tone Configuration

7.4.1 Changing the Alarm Volume

1. Select [**Main Menu**]→[**Alarm Setup >>**]→[**Others**].
2. Select the appropriate volume from [**Alm Volume**]: X to 10, in which X is the minimum volume, depending on the set minimum alarm volume, and 10 the maximum volume.
3. Select [**High Alarm Volume**] to set the volume of the high priority alarm as [**Alm Volume+0**], [**Alm Volume+1**] or [**Alm Volume+2**].
4. Select [**Reminder Vol**] to set the volume of the reminder tone as [**High**], [**Med**] or [**Low**].

When alarm volume is set to 0, the alarm sound is turned off and a  symbol appears on the screen.

7.4.2 Setting the Minimum Alarm Volume

1. Select [**Main Menu**] →[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Alarm Setup >>**] to enter the [**Alarm Setup**] menu.
3. Select [**Minimum Alarm Volume**] and toggle between 0 and 10.

The minimum alarm volume refers to the minimum value you can set for the alarm volume, which is not affected by user or factory default configurations. The setting of minimum alarm volume remains unchanged when the patient monitor shuts down and restarts.

7.4.3 Changing the Alarm Tone Pattern

To change the alarm tone pattern:

1. Select [**Main Menu**] →[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Alarm Setup >>**] to enter the [**Alarm Setup**] menu.
3. Select [**Alarm Sound**] and toggle between [**ISO**], [**Mode 1**]and [**Mode 2**].

User or factory default configurations exert no impact on the setup of alarm tone pattern. The alarm tone pattern remains unchanged after the monitor restarts.

7.4.4 Setting the Interval between Alarm Sounds

If you choose the ISO pattern, you can change the interval between alarm tones. To change the interval between alarm tones:

1. Select [**Main Menu**] →[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Alarm Setup >>**] to enter the [**Alarm Setup**] menu.
3. Select [**High Alarm Interval (s)**], [**Med Alarm Interval (s)**] and [**Low Alarm Interval (s)**] in turn and then select the appropriate settings.

You cannot change the interval between alarm tones if you choose mode 1 or 2 as your desired alarm tone pattern. For these two patterns, the interval between alarm tones identifies the alarm levels as follows:

- Mode 1:
  - Interval between high level alarm tones: continuously.
  - Interval between medium level alarm tones: 5 s.
  - Interval between low level alarm tones: 20 s.
- Mode 2:
  - Interval between high level alarm tones: 1 s.
  - Interval between medium level alarm tones: 5 s.
  - Interval between low level alarm tones: 20 s.

⚠ WARNING

- **When the alarm sound is switched off, the patient monitor will give no audible alarm tones even if a new alarm occurs. Therefore the user should be very careful about whether to switch off the alarm sound or not.**
- **Do not rely exclusively on the audible alarm system for patient monitoring. Adjustment of alarm volume to a low level may result in a hazard to the patient. Always keep the patient under close surveillance.**

7.4.5 Setting the Reminder Tones

When the alarm volume is set to zero, or the alarm is reset or switched off, the patient monitor issues a periodical reminder tone.

1. Select [**Main Menu**] →[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Alarm Setup >>**] to enter the [**Alarm Setup**] menu.
3. Set the [**Reminder Tones**] to [**On**], [**Off**] or [**Re-alarm**]. When [**Re-alarm**] is selected, the acknowledged physiological alarms and technical alarms marked with " √ " will be re-generated after the [**Reminder Interval**] if the alarm condition persists.

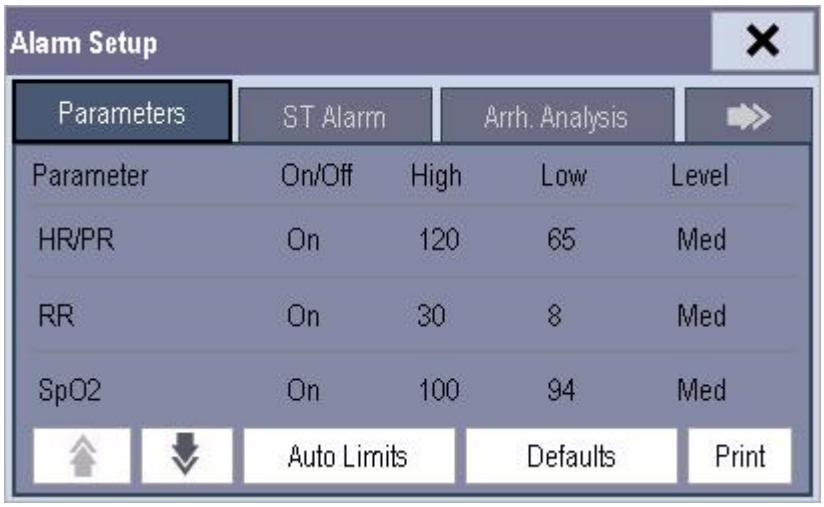
To set the interval between reminder tones, select [**Reminder Interval**] and toggle between [**1min**], [**2min**] and [**3min**].

In addition, you can set the volume of alarm reminder tones. To set the volume of alarm reminder tones, select [**Main Menu**]→[**Alarm Setup >>**]→[**Others**]. Then, select [**Reminder Vol**] and toggle between [**High**], [**Medium**] and [**Low**].

7.5 Understanding the Alarm Setup Menu

Select [**Main Menu**]→[**Alarm Setup >>**] to enter the [**Alarm Setup**], where you can:

- Set alarm properties for all parameters.
- Change ST alarm settings.
- Change arrhythmia alarm settings.
- Set the threshold for some arrhythmia alarms.
- Change other settings.



Please refer to the ***8 Monitoring ECG*** for how to change ST alarm settings, how to change arrhythmia alarm settings and how to set the threshold for some arrhythmia alarms.

7.5.1 Setting Alarm Properties for All Parameters

In the main menu, select [**Alarm Setup >>**]→[**Parameters**]. You can review and set alarm limits, alarm switches, and alarm level for all parameters.

⚠WARNING

- **Make sure that the alarm limits settings are appropriate for your patient before monitoring.**
- **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.**
- **Setting alarm limits to extreme values may cause the alarm system to become ineffective. For example, High oxygen levels may predispose a premature infant to retrolental fibroplasia. If this is a consideration do NOT set the high alarm limit to 100%, which is equivalent to switching the alarm off.**

7.5.2 Adjusting Alarm Limits Automatically

The monitor can automatically adjust alarm limits according to the measured vital signs, using the auto limits function. 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. Then, in the main menu, select [**Alarm Setup >>**]→[**Parameters**]→[**Auto Limits**] →[**Ok**]. The monitor will create new alarm limits based on the measured values.

Before applying these automatically created alarm limits, confirm if they are appropriate for your patient in the mass alarm setup 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 the auto limits based on the following rules.

Module	Parameter	Low alarm limit		High alarm limit		Auto alarm limits range
		Adult/ pediatric	Neonate	Adult/ pediatric	Neonate	
ECG	HR/PR	HR × 0.8 or 40bpm (whichever is greater)	(HR – 30) or 90bpm (whichever is greater)	HR × 1.25 or 240bpm (whichever is smalle)	(HR + 40) or 200bpm (whichever is smaller)	Adult/pediatric: 35 to 240 Neonate: 55 to 225
Resp	RR	RR × 0.5 or 6 rpm (whichever is greater)	(RR – 10) or 30 rpm (whichever is greater)	RR × 1.5 or 30 rpm (whichever is smaller)	(RR + 25) or 85 rpm (whichever is smaller)	Adult/pediatric: 6 to 55 Neonate: 10 to 90
SpO_2	SpO_2	Same as the default alarm limit	Same as the default alarm limit	Same as the default alarm limit	Same as the default alarm limit	Same as the measurement range

Module	Parameter	Low alarm limit		High alarm limit		Auto alarm limits range
		Adult/ pediatric	Neonate	Adult/ pediatric	Neonate	
NIBP	NIBP-S	(SYS × 0.68 + 10) mmHg	(SYS – 15) or 45mmHg (whichever is greater)	(SYS × 0.86 + 38) mmHg	(SYS + 15) or 105mmHg (whichever is smaller)	Adult: 45 to 270 Pediatric: 45 to 185 Neonate: 40 to 115
	NIBP-D	(Dia × 0.68 + 6) mmHg	(Dia – 15) or 20mmHg (whichever is greater)	(Dia × 0.86 + 32) mmHg	(Dia + 15) or 80mmHg (whichever is smaller)	Adult: 25 to 210 Pediatric: 25 to 150 Neonate: 20 to 90
	NIBP-M	(Mean × 0.68 + 8) mmHg	(Mean – 15) or 35mmHg (whichever is greater)	(Mean × 0.86 + 35) mmHg	(Mean + 15 or 95)mmHg (whichever is smaller)	Adult: 30 to 230 Pediatric: 30 to 165 Neonate: 25 to 105
Temp	T1	(T1 – 0.5)℃	(T1 – 0.5) ℃	(T1 + 0.5)℃	(T1 + 0.5)℃	1 to 49 ℃
	T2	(T2 – 0.5)℃	(T2 – 0.5) ℃	(T2 + 0.5)℃	(T2 + 0.5)℃	1 to 49 ℃
	TD	Same as the default alarm limit	Same as the default alarm limit	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	(SYS × 0.68＋ 10) mmHg	(SYS – 15) or 45mmHg (whichever is greater)	(SYS × 0.86＋ 38) mmHg	(SYS + 15) or 105mmHg (whichever is smaller)	Adult: 45 to 270 Pediatric: 45 to 185 Neonate: 35 to 115
	IBP-D	(Dia × 0.68＋ 6)mmHg	(Dia – 15) or 20mmHg (whichever is greater)	(Dia × 0.86＋ 32)mmHg	(Diav15) or 80mmHg (whichever is smaller)	Adult: 25 to 225 Pediatric: 25 to 150 Neonate: 20 to 90
	IBP-M	(Mean × 0.68 + 8)mmHg	(Mean – 15) or 35mmHg (whichever is greater)	(Mean × 0.86 + 35)mmHg	(Mean + 15) or 95mmHg (whichever is smaller)	Adult: 30 to 245 Pediatric: 30 to 180 Neonate: 25 to 105
IBP: PA	IBP-S	SYS × 0.75	SYS × 0.75	SYS × 1.25	SYS × 1.25	3 to 120mmHg
	IBP-D	Dia × 0.75	Dia × 0.75	Dia × 1.25	Dia × 1.25	
	IBP-M	Mean × 0.75	Mean × 0.75	Mean × 1.25	Mean × 1.25	
IBP	CPP	CPP × 0.68 + 8mmHg	(CPP – 15) or 35mmHg (whichever is greater)	CPP × 0.86＋ 35mmHg	(CPP＋15) or 95mmHg (whichever is smaller)	Adult: 20 to 235 mmHg Pediatric: 25 to 175 mmHg Neonate: 25 to 100 mmHg

Module	Parameter	Low alarm limit		High alarm limit		Auto alarm limits range
		Adult/ pediatric	Neonate	Adult/ pediatric	Neonate	
IBP: CVP/ ICP/ LAP/ RAP/ UVP/ P1-P4 (Venous pressure)	IBP-M	Mean × 0.75	Mean × 0.75	Mean × 1.25	Mean × 1.25	3 to 40mmHg
CO_2	$EtCO_2$	0 to 32mmHg: remains the same	0 to 32mmHg: remains the same	0 to 32mmHg: remains the same	0 to 32mmHg: remains the same	Same as the measurement range
		32 to 35mmHg: 29mmHg	32 to 35mmHg: 29mmHg	32 to 35mmHg: 41mmHg	32 to 35mmHg: 41mmHg	
		35 to 45mmHg: ($etCO_2$-6) mmHg	35 to 45mmHg: ($etCO_2$-6) mmHg	35 to 45mmHg: ($etCO_2$+6) mmHg	35 to 45mmHg: ($etCO_2$+6) mmHg	
		45 to 48mmHg:39 mmHg	45 to 48mmHg:39 mmHg	45 to 48mmHg:51 mmHg	45 to 48mmHg:51 mmHg	
		>48mmHg: remains the same	>48mmHg: remains the same	>48mmHg: remains the same	>48mmHg: remains the same	
	$FiCO_2$	N/A	N/A	Same as the default alarm limit	Same as the default alarm limit	Same as the measurement range
	awRR	awRR × 0.5 or 6 rpm (whichever is greater)	(awRR – 10) or 30 rpm (whichever is greater)	awRR × 1.5 or 30 rpm (whichever is smaller)	(awRR+25) or 85 rpm (whichever is smaller)	Adult/pediatric: 6 to 55 Neonate: 10 to 90

7.5.3 Setting Alarm Delay Time

You can set the alarm delay time for over-limit alarms of continuously measured parameters. If the alarm-triggered condition disappears within the delay time, the patient monitor will not give the alarm.

To set the alarm delay time,

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]. Enter the required password and then select [**Ok**].
2. Select [**Alarm Setup >>**]→[**Alarm Delay**].

Alarm delay is not applied to the following physiological alarms:

- Apnea
- ST alarms
- Arrhythmia alarms
- ECG weak signal
- Resp artifact
- No pulse
- HR over alarm limits
- Measurements of noncontinuous parameters over alarm limits

You can set [**Apnea Delay**] and [**ST Alarm Delay**] separately.

7.5.4 Setting SpO_2 Technical Alarm Delay

You can set the [**Tech. Alarm Delay**] in the [**Others**] tab of the [**Alarm Setup**] menu. The options are [**Off**], [**5s**], [**10s**] and [**15s**]. The delay is effective to the following technical alarms: SpO_2 Sensor Off, SpO_2 Too Much Light, SpO_2 Low Signal and SpO_2 Interference.

7.5.5 Setting Recording Length

You can change the length of the recorded waveforms. In the [**Others**] window of the [**Alarm Setup**] menu, select [**Recording Length**] and toggle between [**8 s**], [**16 s**] and [**32 s**]:

- [**8 s**]: 4 seconds respectively before and after the alarm or manual event trigger moment.
- [**16 s**]: 8 seconds respectively before and after the alarm or manual event trigger moment.
- [**32 s**]: 16 seconds respectively before and after the alarm or manual event trigger moment.

7.5.6 Entering CPB Mode

When performing Cardiopulmonary bypass (CPB), you can set the patient monitor to enter CPB mode in order to reduce unnecessary alarms. The CPB mode is activated only if you select [**OR**]. To select [**OR**],

1. Select [**Main Menu**]→[**Maintenance >>**]→[**Manage Configuration >>**]. Enter the required password and then select [**OK**].
2. Select [**Change Department >>**]→[**OR**].

In the CPB mode, all the physiological alarms, technical alarms and prompt messages are switched off. In CPB mode, [**CPB Mode**] is displayed in the physiological alarm area with red background color.

To enter CPB mode, select the [**CPB Mode**] Quickkey or select [**Enter CPB Mode**] in the [**Others**] window of the [**Alarm Setup**] menu. Then select [**Ok**] in the popup dialog box.

7.5.7 Intubation Mode

When performing intubation during general anesthesia, you can set the patient monitor to enter intubation mode in order to reduce unnecessary alarms. Intubation mode is available for Resp and CO2parameters. In the setup menu of these parameters, you can choose [**Intubation Mode**] button to disable respective physiological alarms.

The default intubation time is 2 minutes. You can also change the time by following this procedure:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Alarm Setup >>**], and set the [**Intubation Mode Period**] to [**1 min**], [**2 min**], [**3 min**], or [**5 min**].

NOTE

- **The intubation mode is subject to the host monitor when T1 connects to the host monitor. The intubation mode of the host monitor is not changed and T1 exits the intubation mode when the host monitor is in the intubation mode but T1 disconnected from the host monitor.**

7.6 Pausing Alarms

You can temporarily disable alarm indicators by pressing the on-screen Alarm Pause QuickKey  When alarms are paused:

- For physiological alarms, no alarm indication is shown. New physiological alarm will not be presented.
- The remaining alarm pause time is displayed in the physiological alarm area.
- For technical alarms, alarm sounds are paused, but alarm lamps and alarm messages remain presented.
- The  alarms pause symbol is displayed in the alarm symbol area. If a new technical alarm is triggered in the alarm paused period, the alarm message will be displayed.

When the alarm pause time expires, the alarm paused status is automatically deactivated. You can also cancel the alarm paused status by pressing the  QuickKey.

The alarm pause time can be set to [**1 min**], [**2 min**], [**3 min**], [**5 min**], [**10 min**], [**15 min**] or [**Permanent**]. The default alarm pause time is 2 minutes.

1. Select [**Main Menu**] →[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Alarm Setup >>**]→[**Alarm Pause Time]** and then select the appropriate setting from the popup list.

You can also temporarily prolong the alarm pause time after the monitor enters the alarm paused status:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Alarm Setup >>**].
2. In the [**Alarm Setup**] menu, set the [**Max. Alarm Pause 15min**] to [**Enable**].
3. In the physiological alarm area, select a proper time in the [**Alarm Pause Time**] menu.

NOTE

- **[Max. Alarm Pause 15min] is configured to [Disable] by default. In this case, you cannot prolong the pause time.**
- **The prolonged pause time is only effective to the current paused alarms.**

7.7 Swiching Off All Alarms

If [**Alarm Pause Time**] is set to [**Permanent**]: the patient monitor will enter into the alarm off status after the QuickKey is pressed. During the alarm off status,

- As for physiological alarms: no alarm lamps flash and no alarms are sounded.
- As for physiological alarms: no numeric and alarm limit flash.
- No physiological alarm messages are shown.
- [**Alarm Off**] is displayed in the physiological alarm area with red background.
- As for technical alarms: no alarms are sounded.
- The alarm off symbol is displayed in the alarm symbol area.

You can cancel the alarm off status by pressing the QuickKey.

WARNING

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

7.8 Resetting Alarms

By selecting the QuickKey, you can reset the alarm system to acknowledging the on-going alarms and enable the alarm system to respond to a subsequent alarm condition.

For physiological alarms, except the NIBP-related alarms, when the alarm system is reset:

- The alarm sound is silenced.
- A √ appears before the alarm message, indicating that the alarm is acknowledged.
- The icon appears in the alarm symbol area.
- The parameter numeric and alarm limits still flash.

The indication of alarm lamp for the physiological alarm depends on the alarm light setting.

- When [**Alarm Light on Alarm Reset**] is set to [**On**], the alarm lamp remains flashing.
- When [**Alarm Light on Alarm Reset**] is set to [**Off**], the alarm lamp stops flashing.

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

- For some technical alarms, including the NIBP-related alarms, a √ appears before the alarm message and  appears in the alarm symbol area, indicating that the alarm is acknowledged. The indication of the alarm lamp depends on the alarm light setting.
- Some technical alarms are changed to the prompt messages.
- Some technical alarms are cleared. The monitor gives no alarm indications.

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

To set [**Alarm Light on Alarm Reset**]:

1. Select [**Main Menu**] →[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Alarm Setup >>**] to enter the [**Alarm Setup**] menu.
3. Select [**Alarm Light on Alarm Reset**], and toggle between [**On**] and [**Off**].

The default setting for [**Alarm Light on Alarm Reset**] is [**On**].

7.9 Latching Alarms

The latching setting for physiological alarms defines how alarm indicators behave when you do not acknowledge them.

- If you do not "latch" the physiological alarms, their alarm indications disappear when the alarm condition ends.
- If you "latch" the physiological alarms, all visual and audible alarm indications last until you acknowledge the alarms, except that:
  - The parameter reading and violated alarm limit stop flashing.
  - The time when the alarm is last triggered is displayed behind the alarm message.

You can separately latch the visual indications or simultaneously latch the visual and the audible indication.

- When the visual indications are latched, the visual indications, including alarm lamp, alarm message and its background remains when the alarm condition ends.
- When the audible indications are latched, the monitor issues alarm sounds when the alarm condition ends.

To latch a physiological alarm:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Alarm Setup** >>]→[**Latching Alarms>>**].
3. In the [**Latching Alarms**] menu, select how you want to latch the alarms.

The rules for latching the alarms are:

- You can separately select [**Latching Visual Signal**].
- Selecting [**Latching Audible Signal**] simultaneously latches the visual signal.
- Selecting alarms of lower priority simultaneously latches the alarms of higher priority.

NOTE

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

7.10 Using Care Group Alarms (Only Available for the External Display)

7.10.1 Care Group Auto Alarms

If any monitor in the Care group not being viewed by your monitor is alarming, a flashing symbol will appear beside the QuickKeys area. The alarm symbol is shown as below.

The background colors of the alarm symbols indicate alarm levels, and are the same as those of the corresponding alarm messages. If multiple alarms are active in the Care Group, the background color is the same as that of the highest level alarm message. For more information about the alarm message and background color, see***7.3.3Alarm Message***.

When a patient monitor in the Care Group is disconnected, the flashing symbol is shown as below.

The department and bed label of the alarming monitor appear on the symbols. You can enter the view other patient window by pressing the symbol.

7.10.2 Resetting the Care Group Alarms

You can reset the alarms presented on the viewed bed by pressing the [**Alarm Reset**] from the current monitor's [**View Other Patient**] window. To enable this function:

1. Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Alarm Setup>>**]→[**Other Bed Alarm Setup>>**].
2. Set [**Reset Other Bed's Alarms**] to [**On**].

The alarms presented on the current monitor can also be reset from another monitor viewing this monitor. To do so, proceed as follows:

1. In the current monitor, select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Alarm Setup>>**]→[**Other Bed Alarm Setup>>**].
2. Set [**Alarm Reset By Other Bed**] to [**On**].
3. In the other monitor, select the [**Alarm Reset**] button from the [**View Other Patient**] window.

⚠WARNING

- **Resetting care group alarms may cause a potential hazard. Please act with caution.**

7.10.3 Switching Off the Remote Device Disconnection Alarm

The monitor can provide an alarm if a viewed bed device is disconnected. By default, the function is enabled. To disable the alarm, follow this procedure:

1. In the current monitor, select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Alarm Setup>>**]→[**Other Bed Alarm Setup>>**].
2. Set [**Other Bed Disconnection Alm**] to [**Off**].

7.10.4 Setting Care Group Alert Tone

7.10.4.1 Setting the Alarm Reminder

When a monitor in the Care Group issues an alarm, your patient monitor prompts you by giving alert tone. To set the alert tone, follow this procedure:

1. In the current monitor, select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Alarm Setup>>**]→[**Other Bed Alarm Setup>>**].
2. Set the [**Alarm Reminder**].
   - [**Repeat**]: The monitor gives continuous alert tone when the alarm occurs at the viewed bed is the same level as the setup level in the monitor. To set which alarm level applies to continuous alert tone, see section ***7.10.4.2Setting the Alarm Level***.
   - [**Once**]: The monitor gives a single alert tone when an alarm occurs at the viewed bed.
   - [**Off**]: The monitor do not give any alert tone when an alarm occurs at the viewed bed.

7.10.4.2 Setting the Alarm Level

When [**Alarm Reminder**] is set to [**Repeat**], you can set which alarm level of the viewed bed alarm applies to the continuous alert tone. To set the alarm level of the viewed bed alarm, follow this procedure:

1. In the current monitor, select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Alarm Setup>>**]→[**Other Bed Alarm Setup>>**].
2. Set the [**Alarm Lev**].
   - [**All**]: This monitor gives continous alert tone to all the alarms of the viewed bed when [**Alarm Reminder**] is set to [**Repeat**].
   - [**High Only**]: This monitor gives continous alert tone only to high level alarms of the viewed bed when [**Alarm Reminder**] is set to [**Repeat**].
   - [**High&Med**]: This monitor gives continous alert tone to high level and mediate level alarms of the viewed bed when [**Alarm Reminder**] is set to [**Repeat**].

NOTE

- **The setting of the [Alarm Lev] is valid only when [Alarm Reminder] is set to [Repeat].**

7.11 Testing Alarms

The monitor performs self test during startup. The system gives a beep, and the alarm lamp simultaneously turns yellow, and then red, and finally off. This indicates that the alarm system functions correctly.

For further testing of individual measurement alarms: perform the measurement on yourself (for example SpO_2 or CO_2) or use a simulator. Adjust alarm limits and check that appropriate alarm behaviour is observed.

7.12 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 troubleshooting specific alarms: see ***D Alarm Messages***.

8 Monitoring ECG

8.1 Introduction

The electrocardiogram (ECG) measures the electrical activity of the heart and displays it on the patient monitor as a waveform and a numeric. ECG monitoring provides the following algorithms:

- Mindray algorithm: provides 3-, 5-, and 12-lead ECG monitoring, ST-segment analysis, arrhythmia analysis.
- Mortara algorithm: provides 3-, 5-, and 12-lead ECG monitoring, ST-segment analysis, arrhythmia analysis.
- Glasgow algorithm: provides resting 12-lead ECG analysis.

You can select algorithms as required. The patient monitor incorporating Mortara algorithm is labelled with the logo of Mortara. The patient monitor incorporating Glasgow algorithm is labelled with the logo of Glasgow.

8.2 Safety

⚠ WARNING

- **This equipment is not suitable for direct cardiac application.**
- **Use only ECG electrodes and cables specified by the manufacturer.**
- **Make sure the conductive parts of electrodes and associated connectors for applied parts, including the neutral electrode, should not contact any other conductive parts including earth.**
- **Periodically inspect the electrode application site to ensure skin quality. If the skin quality changes, replace the electrodes or change the application site.**
- **Use defibrillation-proof ECG cables during defibrillation.**
- **Do not touch the patient, or table, or instruments during defibrillation.**
- **ECG cables may be damaged when connected to a patient during defibrillation. Check cables for functionality before using them again.**
- **Keep distance with 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 electro-surgery unit (ESU).**
- **The neutral electrode of the electro-surgery unit (ESU) shall properly contact the patient. Otherwise, burns may result.**

⚠ CAUTION

- **Interference from a non-grounded instrument near the patient and electrosurgery interference can cause problems with the waveform.**

NOTE

- **After defibrillation, the screen display recovers within 10 seconds if the correct electrodes are used and applied in accordance with the manufacturer's instructions for use.**

8.3 Preparing to Monitor ECG

8.3.1 Preparing the Patient and Placing the Electrodes

1. Prepare the patient's skin. Proper skin preparation is necessary for good signal quality at the electrode, as the skin is a poor conductor of electricity. To properly prepare the skin, choose flat areas and then follow this procedure:
   - ◆ Shave hair from skin at chosen sites.
   - ◆ Gently rub skin surface at sites to remove dead skin cells.
   - ◆ Thoroughly cleanse the site with a mild soap and water solution. We do not recommend using ether or pure alcohol, because this dries the skin and increases the resistance.
   - ◆ Dry the skin completely before applying the electrodes.
2. Attach the clips or snaps to the electrodes before placing them.
3. Place the electrodes on the patient.
4. Attach the electrode cable to the patient cable and then plug the patient cable into the ECG connector.

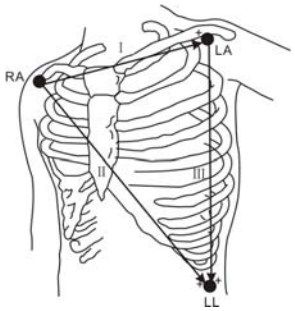
8.3.2 Choosing AHA or IEC Lead Placement

1. Select the ECG parameter window or waveform area to enter the [**ECG Setup**] menu.
2. Select [**Others**]→[**Lead Set**] and then select [**3-lead**], [**5-lead**], [**12-lead**] or [**Auto**] according to the applied electrodes.
3. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password
4. Select [**Others >>**]→[**ECG Standard**] and then select [**AHA**] or [**IEC**] according to the standard that is applied for your hospital.

8.3.3 ECG Lead Placements

The electrode placement illustrations in this chapter adopt the AHA standard.

3-Leadwire Electrode Placement

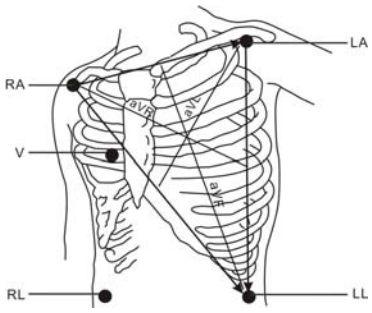


Following is an electrode configuration when using 3 leadwires:

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

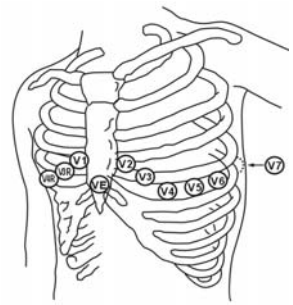
5-Leadwire Electrode Placement

Following is an electrode configuration when using 5 leadwires:



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

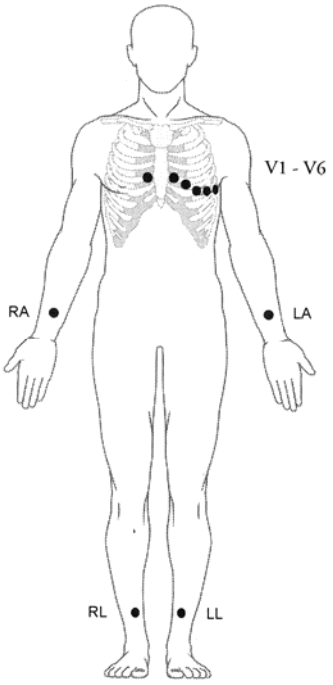
The chest (V) electrode can be placed on one of the following positions:



- V1 placement: on the fourth intercostal space at the right sternal border.
- V2 placement: on the fourth intercostal space at the left sternal border.
- V3 placement: midway between the V2 and V4 electrode positions.
- V4 placement: on the fifth intercostal space at the left midclavicular line.
- V5 placement: on the left anterior axillary line, horizontal with the V4 electrode position.
- V6 placement: on the left midaxillary line, horizontal with the V4 electrode position.
- V3R-V6R placement: on the right side of the chest in positions corresponding to those on the left.
- VE placement: over the xiphoid process.
- V7 placement: on posterior chest at the left posterior axillary line in the fifth intercostal space.
- V7R placement: on posterior chest at the right posterior axillary line in the fifth intercostal space.

12-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 the physician's preference.



Lead Placement for Surgical Patients

The surgical site should be taken into consideration when placing electrodes on a surgical patient. e.g. 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

- **When using an electrosurgery unit (ESU), ensure proper contact of the ESU's return electrode to the patient to avoid burns at the monitor measurement site. Never entangle the ESU cable and the ECG cable together.**
- **The neutral electrode of the electrosurgical unit shall properly contact the patient. Otherwise, burns may result.**
- **When using electrosurgical units (ESU), never place ECG electrodes near to the return electrode of the ESU, as this can cause a lot of interference on the ECG signal.**

8.3.4 Checking Paced Status

It is important to set the paced status correctly when you start monitoring ECG. The paced symbol  is displayed in the ECG waveform area when [**Paced**] is set to [**Yes**]. The pace pulse markers "|" are shown on the ECG wave when the patient has a paced signal. If [**Paced**] is set to [**No**] or the patient's paced status is not selected, the symbol  will be shown in the ECG waveform area.

To change the paced status, you can select either:

- the patient information area, or
- [**Main Menu**]→[**Patient Setup**]→[**Patient Demographics**], or,
- the ECG parameter window or waveform area→[**Others >>**],

and then, select [Paced] from the popup menu and toggle between [**Yes**] and [**No**].

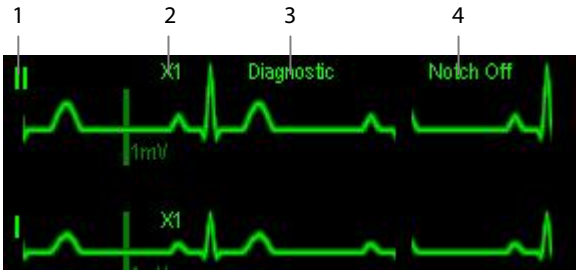
If you do not set the paced status, the patient monitor issues a prompt tone when pace pulse is detected. At the same time, the paced symbol flashes and the message [**Please confirm the pace of patient**] appears in the ECG waveform area. Then, please check and set the paced status of the patient.

Warning

- **For paced patients, you must set [Paced] to [Yes]. If it is incorrectly set to [No], the patient monitor could mistake a pace pulse for a QRS and fail to alarm when the ECG signal is too weak. 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].**
- **False low heart rate indicators or false Asystole calls may result with certain pacemakers because of pacemaker artifact such as electrical overshoot of the pacemaker overlapping the true QRS complexes.**
- **The auto pacer recognition function is not applicable to pediatric and neonatal patients.**

8.4 Understanding the ECG Display

Your display may be configured to look slightly different.



1. Lead label of the displayed wave
2. ECG gain
3. ECG filter label
4. Notch filter status

Besides, when a paced signal has been detected, the pace pulse marks "|" are shown on the ECG wave if the [**Paced**] has been set to [**Yes**].

1. Current heart rate alarm limits
2. Heart beat symbol
3. Current heart rate

NOTE

- **When an electro-surgery unit is in use, a question mark (?) may display on the right of the HR value. This indicates there is high frequency interference**

For 12-lead ECG display screen, refer to the section ***8.10 12-Lead ECG Monitoring***.

8.5 Changing ECG Settings

8.5.1 Accessing ECG Menus

By selecting the ECG parameter window or waveform area, you can access the [**ECG Setup**] menu.

8.5.2 Choosing the Alarm Source

In most cases the HR and PR numerics are identical. In order to avoid simultaneous alarms on HR and PR, the monitor uses either HR or PR as its active alarm source. To change the alarm source, select [**Alm Source**] in the [**ECG Setup**] menu and then select either:

- [**HR**]: if you want the HR to be the alarm source for HR/PR.
- [**PR**]: if you want the PR to be the alarm source for HR/PR.
- [**Auto**]: If the [**Alm Source**] is set to [**Auto**], the patient monitor will use the heart rate from the ECG measurements as the alarm source whenever a valid heart rate is available. If the heart rate becomes unavailable, for example the ECG module is turned off or becomes disconnected, the patient monitor will automatically switch to PR as the alarm source.

8.5.3 Changing ECG Wave Settings

In the [**ECG Setup**] menu:

- You can select [**ECG**], [**ECG1**], or [**ECG2**] to select a lead to view. The waveform of selected lead should have the following characteristics:
  - The QRS should be either completely above or below the baseline and it should not be biphasic.
  - The QRS should be tall and narrow.
  - The P-waves and T-waves should be less than 0.2mV.
- If the wave is too small or clipped, you can change its size by selecting an appropriate [**Gain**] setting. If you select [**Auto**] from [**Gain**], the patient monitor will automatically adjust the size of the ECG waves. In normal screen, only the selected ECG wave's size is adjusted. In other screens, all ECG waves' size is adjusted simultaneously.
- You can change the wave sweep speed by selecting [**Sweep**] and then selecting the appropriate setting.

8.5.4 Changing the ECG Filter Settings

The ECG filter setting defines how ECG waves are smoothed. To change the filter setting, select [**Filter**] from [**ECG Setup**] and then select the appropriate setting.

- [**Monitor**]: Use under normal measurement conditions.
- [**Diagnostic**]: Use when diagnostic quality is required. The unfiltered ECG wave is displayed so that changes such as R-wave notching or discrete elevation or depression of the ST segment are visible.
- [**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. In the operating room, the surgery filter reduces artifacts and interference from electrosurgical units. Under normal measurement conditions, selecting [**Surgery**] may suppress the QRS complexes too much and then interfere with ECG analysis.
- [**ST**]: Use when ST monitoring is applied.

⚠WARNING

- **The [**Diagnostic**] filter is recommended when monitoring a patient in an environment with slight interference only.**

8.5.5 Setting Pacemaker Rate (For Mortara only)

Some pacemaker pulses can be difficult to reject. When this happens, the pulses are counted as a QRS complex and could result in an incorrect HR and failure to detect some arrhythmias. You can set [**Pacemaker Rate**] to the pacemaker's rate in the [**ECG Setup**] menu. In this way, the patient monitor can calculate HR and detect arrhythmias more accurately. When [**Paced**] is set to [**No**], the pacemaker rate cannot be set.

8.5.6 Choosing an ECG Display Screen

When monitoring with a 5-lead or 12-lead set, you can select [**Others>>**]→[**ECG Display**]in the [**ECG Setup**] menu to choose the screen type as:

- [**Normal Screen**]: The ECG waveform area shows 2 ECG waveforms.
- [**Full-Screen**]: The whole waveform area shows 7 ECG waveforms only.

When monitoring with a 12-lead set, you can also choose the screen type as [**12-Lead**].

When the screen type is set to [**Normal Screen**], cascaded ECG waveforms can be displayed. To cascade ECG waveforms:

1. Select the [**Main Menu**]→[**Screens**]→[**Screen Setup**].
2. Select [**ECG1 Casc.**] in the second row. A cascaded waveform is displayed in two waveform positions.

8.5.7 Setting the Notch Filter

The notch filter removes the line frequency interference. Only when [**Filter**] is set to [**Diagnostic**], the [**Notch Filter**] is adjustable.

1. Select the ECG parameter window or waveform area to enter its setup menu. Then select [**Others >>**].
2. Set [**Notch Filter**] to
   - [**Strong**] when there is strong interference (such as spikes) with the waveform.
   - [**Weak**] when there is weak interference with the waveform.
   - [**Off**] to turn the notch filter off.

Set notch frequency according to the electric power frequency of your country. Follow this procedure:

1. When [**Notch Filter**] is set on, select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Others >>**]→[**Notch Freq.**] and then select [**50Hz**] or [**60Hz**] according to the power line frequency.

8.5.8 Changing the Pacer Reject Settings

Select [**ECG Setup**]→[**Others>>**]→[**Pacer Reject**], and toggle between [**On**] and [**Off**].

- When [**Pacer Reject**] is switched on, pace pulses are not displayed..
- When [**Pacer Reject**] is switched off, pace pulses are displayed.

NOTE

- **When pace pulses are detected, pace pulse marks "|" are shown on the ECG waveforms. Pacer Rejection setting has no impact on the display of pace pulse marks "|"**

NOTE

- **When [Paced] is set to [No], the pace markers are not shown on the ECG wave, and the options of [Pacer Reject] are inactivated.**

8.5.9 Adjusting the Minimum QRS Detection Threshold (For Mindray ECG Algorithm)

To avoid false asystole alarms when the R wave amplitude is low and missed asystole alarms during ventricular standstill (tall P waves, but no QRS), a means to manually adjust the minimum QRS detection threshold is provided.

To adjust the QRS detection threshold,

1. In the [**ECG Setup**] menu, set [**Filter**] to [**Monitor**].
2. Select [**Others >>**]→[**Minimum QRS Threshold >>**] to enter the [**Minimum QRS Threshold**] menu.
3. Select the up or down arrow to adjust the QRS threshold. Selecting [**Defaults**] resets the QRS threshold to the default value (0.16 mV).
4. Select [**Confirm**] to make the changes effective.

CAUTION

- **The setting of QRS threshold can affect the sensitivity of 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 may occur.**

NOTE

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

8.5.10 Enabling Smart Lead Off

To switch on/off the smart lead off function, select [**Others >>**] from the [**ECG Setup**] menu; select [**Smart Lead Off**] and toggle between [**On**] and [**Off**] from the popup menu.

When the smart lead off function is set on and there is a "lead off" in the lead of the first ECG wave, if another lead is available, this available lead automatically becomes that lead. The system will re-calculate HR and analyze and detect arrhythmia. When the "lead off" condition is corrected, the leads are automatically switched back.

8.5.11 Setting the Alarm Level for ECG Lead Off Alarms

Select [**Alarm Setup >>**] from the [**User Maintenance**] menu. You can set [**ECGLeadOff Lev.**] from the popup menu.

8.5.12 Adjusting QRS Volume

QRS sounds are produced based on the alarm source. To adjust the QRS volume, select [**Others >>**] from the [**ECG Setup**] menu; select [**QRS Volume**] from the popup menu and select the appropriate setting. When valid SpO_2 measured value is available, the system adjusts the pitch tone of QRS sound based on the SpO_2 value.

8.5.13 About the Defibrillator Synchronization

If a defibrillator is connected, a defibrillator synchronization pulse (100 ms, +5V) is outputted through the multifunctional Connector every time when the patient monitor detects an R-wave.

⚠WARNING

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

8.6 About ST Monitoring

- Mortara ST segment analysis is not intended for neonatal patients.
- ST segment analysis calculates ST segment elevations and depressions for individual leads and then displays them as numerics in the ST1 and ST2 areas.
- A positive value indicates ST segment elevation; a negative value indicates ST segment depression.
- Measurement unit of the ST segment: mV or mm. You can set the unit in the [**Unit Setup**] menu from the [**User Maintenance**] menu.
- Measurement range of the ST segment: -2.0 mV to +2.0 mV.

⚠ WARNING

- **The ST algorithm has been tested for accuracy of the ST segment data. The significance of the ST segment changes need to be determined by a clinician.**

8.6.1 Switching ST On and Off

To switch ST monitoring on or off:

1. In the [**ECG Setup**] menu, select [**ST Analysis >>**].
2. Select [**ST Analysis**] to toggle between [**On**] and [**Off**].

Reliable ST monitoring can hardly be ensured if:

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

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

8.6.2 Changing ST Filter Settings

ST-segment analysis can be carried out only when the filter mode is set to [**Diagnostic**] or [**ST**]. When ST-segment analysis is switched on, [**Filter**] will automatically switch to [**ST**] if it is not [**Diagnostic**] or [**ST**]. When ST-segment analysis is switched off, the filter mode automatically switches to previous manual setting.

However, if you switch [**Filter**] to [**Monitor**] or [**Surgery**], ST-segment analysis will turn off automatically. In case that you change [**Monitor**] or [**Surgery**] to [**Diagnostic**] or [**ST**], ST-segment analysis keeps off, you can turn it on manually.

8.6.3 Understanding the ST Display

8.6.3.1 ST Numerics

This example shows ST numerics with 5-lead ECG. Your monitor screen may look slightly different from the illustration.

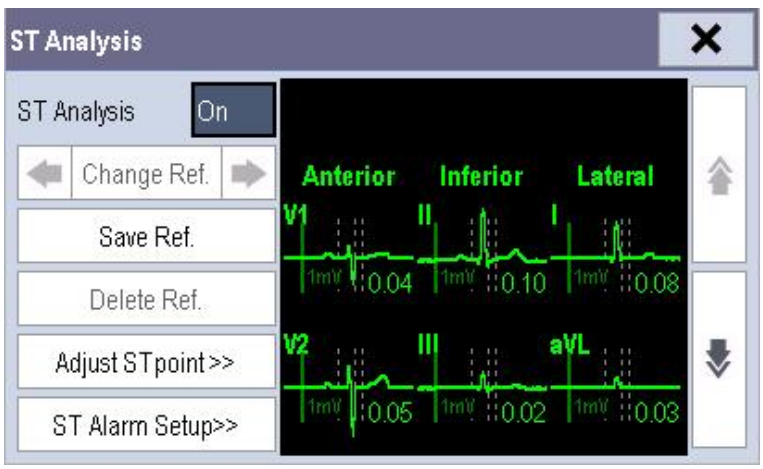
8.6.3.2 ST Segment

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

To display the ST segment on normal screen:

1. Enter the [**ST Analysis**] menu. Set [**ST Analysis**] to [**On**].
2. Enter the [**Screen Setup**] window of [**Screens**] menu. Set [**ST Segment**] to be displayed.

Select the ST parameter window or ST segment area and you can enter the [**ST Analysis**] menu.



8.6.4 Saving the Current ST Segment as Reference

Select [**Save Ref.**] in the [**ST Analysis**] menu to save the current segment as reference. Up to 20 reference segment groups can be saved.

NOTE

- **If the memory is full and you do not delete a group before saving a new one, the oldest saved group is deleted automatically.**

8.6.5 Changing the Reference Segment

Select the ⬅ and ➡ arrow keys beside the [**Change Ref.**] to switch between different reference segment groups.

8.6.6 Deleting a Reference Segment

To delete the current ST reference segment, select [**Delete Ref.**] in the [**ST Analysis**] menu and then select [**Ok**] in the popup.

8.6.7 Changing the ST Alarm Limits

High and low ST alarm limits can be set individually for each ECG lead. Alarm limits can also be set separately for single-lead and multi-lead ST monitoring. You can select [**ST Alarm Setup >>**] from [**ST Analysis**] menu and then change ST alarm settings for each lead.

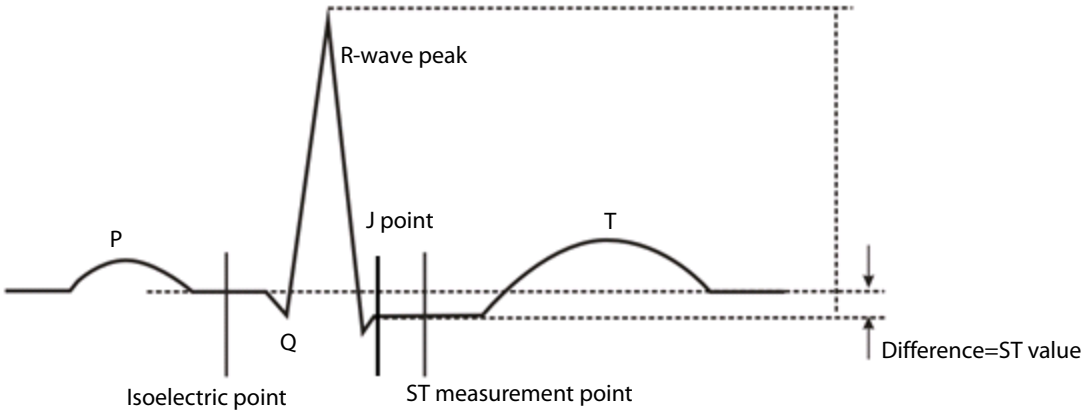
8.6.8 Setting the ST Alarm Delay Time

To set the ST alarm delay time,

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]. Enter the required password and then select [**OK**].
2. Select [**Alarm Setup >>**]→[**ST Alarm Delay**].

8.6.9 Adjusting ST Measurement Points

As shown in the figure below, the ST measured for each beat complex is the vertical difference between two measurement points with the R-wave peak as the baseline for the measurement.



The ISO and ST points need to be adjusted when you start monitoring and if the patient's heart rate or ECG morphology changes significantly. Exceptional QRS complexes are not considered for ST-segment analysis.

WARNING

- **Always make sure that the positions of ST measurement points are appropriate for your patient.**

To adjust the ST measurement points:

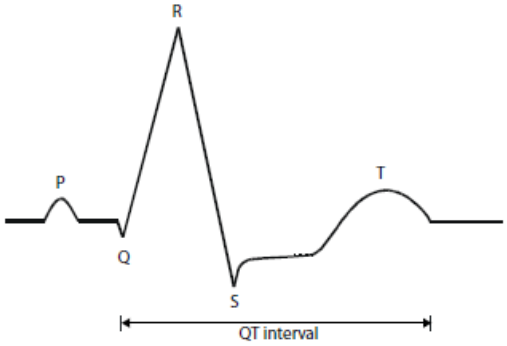
1. In the [**ST Analysis**] menu, select [**Adjust ST Point >>**]. In the [**Adjust ST Point**] window, three vertical lines represent the ISO, J and ST point positions respectively.
2. Use the arrows ⬅ and ➡ besides the [**View Leads**] button to select an ECG lead with obvious J point and R wave.
3. Adjust the position of [**ISO**], [**J**] or [**ST Point**].
   - 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 either [**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.

8.7 QT/QTc Interval Monitoring (For Mindray ECG Algorithm)

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 the depolarization (QRS duration) and repolarization (ST-T) phases of the the ventricles. QT interval monitoring can assist in the detection of long QT syndrome.

The QT interval has an inverse relationship to heart rate. As heart rate increases, the QT interval shortens, while at lower heart rates QT interval gets longer. Several formulas are available to correct QT interval for heart rate. The heart rate corrected QT interval is abbreviated as QTc.

QT/QTc Interval Monitoring is intended for adult, pediatric, and neonate patients.



8.7.1 QT/QTc Monitoring Limitations

Some conditions may make it difficult to achieve reliable QT 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
- T-waves are very flat or 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 150bpm for adults and over 180bpm for pediatrics and neonates), QT will not be measured. When the heart rate changes, it can take several minutes for the QT interval to stabilize. For reliable QTc calculation it is important to avoid the region where the heart rate is changing.

8.7.2 Enabling QT/QTc Monitoring

The QT monitoring function is disabled by default. Before you start QT monitoring, enable the QT function. To enable QT/QTc monitoring:

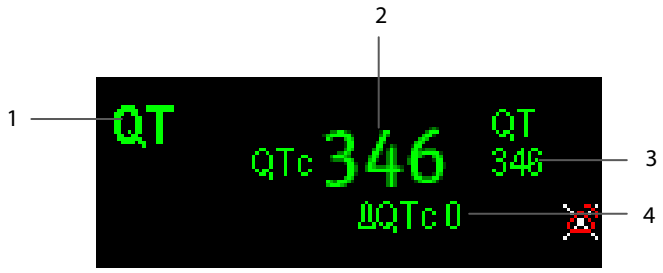
1. In the [**ECG Setup**] menu, select [**QT Analysis>>**] to enter the [**QT Analysis**] menu.
2. Set [**QT Analysis**] to [**On**].

8.7.3 Displaying QT/QTc Parameters and Waveform

To display QT/QTc parameters and waveform:

1. Select [**Main Menu**] →[**Screen Setup>>**]→[**Screen Layout>>**], and then select [**Screen Setup**] to enter the [**Screen Setup**] window.
2 Select the parameter area where you want to display the QT parameters, and then select [**QT**].

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



1. Parameter label 2. QTc value 3. QT value
4. ΔQTc value (the difference between the current and reference QTc values. If ΔQTc alarm is off, the alarm off symbol is displayed on the right.)

NOTE

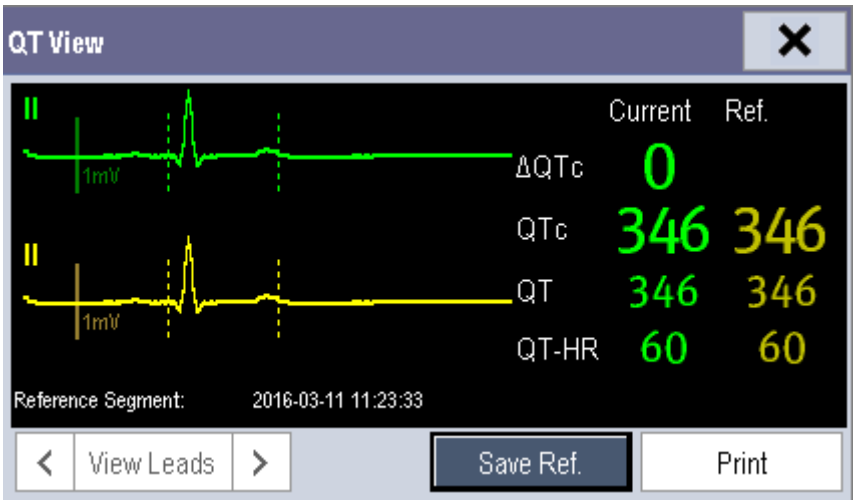
- **QTc values are calculated based on the QT-HR, not the ECG HR. To view the QT-HR, open the QT View window. For more information. see *8.7.4Entering the QT View*.**

8.7.4 Entering the QT View

QT View shows the current and reference QT parameter values and waveforms. To enter the QT View:

1. Select the QT parameter area or waveform area to enter the [**QT Analysis**] menu.
2. Select [**QT View>>**].

The following picture shows the QT view.



- The current waveform is shown in the upper half in green.
- The reference waveform is shown below in yellow.
- The start of QRS complex and the end of the T wave are marked with vertical lines.
- 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. Additionally the message "Cannot Analyze QT" is shown in the technical alarm area.

Select the arrows beside [**View Leads**] to switch leads. Corresponding waveform will be highlighted.

8.7.5 Saving the Current QTc as Reference

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

To set QT reference, select [**Save Ref.**] at the bottom of the QT View.

If you set a new reference, the previous reference is discarded.

CAUTION

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

8.7.6 Changing QT Settings

8.7.6.1 Setting QT Alarm Properties

To set QT alarm properties,

1. Select [**Alarm Setup>>**] from the [**QT Analysis]** menu.
2. Set QTc and ΔQTc alarm properties.

8.7.6.2 Selecting Leads for QT Calculation

You can select one lead or all leads for QT calculation. To do so, select [**Analysis Lead**] from the [**QT Analysis**] menu. [**All**] is selected by default. This means all leads are used for QT calculation.

8.7.6.3 Changing the QTc Formula

The monitor uses as a default the Hodges correction formula to correct the QT interval for heart rate. To change the QTc formula, select [**QTc Formula**] from the [**QT Analysis**] menu.

- Hodges: $QTc = QT + 1.75 \times (HeartRate - 60)$
- Bazett: $QTc = QT \times \left(\frac{HeartRate}{60} \right)^{\frac{1}{2}}$
- Fridericia: $QTc = QT \times \left(\frac{HeartRate}{60} \right)^{\frac{1}{3}}$
- Framingham: $QTc = QT + 154 \times \left(1 - \frac{60}{HeartRate} \right)$

8.8 About Arrhythmia Monitoring

Arrhythmia analysis provides information about your patient's condition, including heart rate, PVC rate, rhythm and ectopics.

⚠ WARNING

- **Arrhythmia analysis program is intended to detect ventricular arrhymias and atrial fibrillation. It is not designed to detect all the atrial or supraventricular arrhythmias. It may incorrectly identify the presence or absence of an arrhythmia. Therefore, a physician must analyze the arrhythmia information with other clinical findings.**
- **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.**
- **Atrial fibrillation (Afib) detection function is not intended for pediatric and neonatal patients.**
- **Mortara arrhythmia algorithm is not intended for neonatal patients.**

8.8.1 Understanding the Arrhythmia Events

Mindray algorithm

Arrhythmia message	Description	Category
Asystole	No QRS detected within the set time threshold in absence of ventricular fibrillation or chaotic signal.	Lethal arrhythmia
Vfib/Vtac	A fibrillatory wave for 6 consecutive seconds. A dominant rhythm of adjacent Vs and a HR > the V-Tac HR limit.	
Vtac	The consecutive PVCs ≥ Vtac PVCs limit, and the HR ≥ the Vtac rate limit.	
Vent. Brady	The consecutive PVCs ≥ the Vbrd threshold and the ventricular HR < the Vbrd Rate threshold.	
Extreme Tachy	The heart rate is equal to or greater than the extreme tachycardia limit.	
Extreme Brady	The heart rate is equal to or less than the extreme bradycardia limit.	
PVCs	PVCs/min exceeds high limit	Nonlethal arrhythmia
Pacer not paced	No pace pulse detected for 1.75 x average R-to-R intervals following a QRS complex (for paced patients only).	
Pacer not capture	No QRS complex detected for 300 milliseconds following a pace pulse (for paced patients only).	
PVC	One PVC detected in normal heartbeats.	
Couplet	Paired PVCs detected in normal heartbeats.	
Run PVCs	More than 2 consecutive PVCs.	
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.	
R on T	R on T detected in normal heartbeats.	
Missed Beats	No beat detected for 1.75 x average R-R interval for HR <120, or No beat for 1 second with HR > 120 (for non-paced patients only), or No beat detected for more than the set pause threshold.	
Brady	The average heart rate is equal to or less than the bradycardia limit.	

Arrhythmia message	Description	Category
Tachy	The average heart rate is equal to or greater than the tachycardia limit.	
Vent. Rhythm	The consecutive PVCs ≥ the Vbrd PVCs limit, and the HR ≥ Vbrd Rate limit but < the Vtac Rate limit.	
Multif. PVC	Multiform PVCs detected in Multif. PVC's Window (which is adjustable).	
Nonsus. Vtac	The consecutive PVCs < the Vtac PVCs limit but > 2, and HR ≥ the Vtac Rate limit.	
Pause	No QRS detected within the set time threshold of pause.	
Irr. Rhythm	Consistently irregular rhythm.	
Afib	P wave is absent and normal beat RR intervals are irregular.	

Mortara algorithm

Arrhythmia Message	Description	Category
Asystole	No QRS complex detected within the set time threshold (in absence of ventricular fibrillation or chaotic signals).	Lethal arrhythmia
Vfib	Ventricular fibrillation occurs and persists for 6 seconds.	
Vtac	Ventricular HR is greater or equal to the preset threshold and the number of consecutive PVCs is greater than the preset threshold.	
PVCs	PVCs/min exceeds high limit	Nonlethal arrhythmia
Pacer not paced	No pace pulse detected for (60*1000/pace rate +90) milliseconds following a QRS complex or a pacer pulse (for paced patients only).	
Pacer not capture	No QRS complex detected for 300 milliseconds following a pace pulse (for paced patients only).	
Multif. PVC	More than 2 PVCs of different forms occur in the predefined search window (3-31).	
Couplet	Paired PVCs are detected.	
Run PVCs	Ventricular HR is greater than or equal to the preset threshold and the number of PVCs is greater than or equal to 3 but less than the preset threshold.	
Vent. Rhythm	Ventricular HR is less than the preset threshold and the number of PVCs is greater than or equal to 3.	
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.	
R on T	R on T is detected.	
Irr. Rhythm	Consistently irregular rhythm	
Missed Beats	No beat detected for 1.75x average R-R interval for HR <120, or No beat for 1 second with HR >120 (for non-paced patients only), or No beat detected for more than the set pause threshold.	
Brady	The HR is less than the set bradycardia low limit.	
Tachy	The HR is greater than the set tachycardia high limit.	

8.8.2 Changing Arrhythmia Alarm Settings

To change arrhythmia alarm settings, select the ECG parameter area or waveform area →[**ECG Setup**]→ [**Arrh. Analysis >>**]. In the pop-up menu, you can set the [**Alm Lev**] to [**High**], [**Med**], [**Low**] or [**Message**], or switch on lethal arrhythmia analysis alarms only or switch on/off all arrhythmia analysis alarms. In the [**Alarm Setup**] menu from the [**User Maintenance**] menu, you can enable/disable turning off lethal arrhythmia analysis alarms.

⚠ WARNING

- **If you switch off all arrhythmia analysis alarms, the monitor cannot give any arrhythmia analysis alarm. Always keep the patient under close surveillance.**

NOTE

- **The priority of lethal arrhythmia alarms is always high. It is unchangeable.**

8.8.3 Changing Arrhythmia Threshold Settings

Select the ECG parameter window or waveform area→[**Arrh. Analysis >>**]→[**Arrh. Threshold**], and you can then change threshold settings for some arrhythmia alarms. In case an arrhythmia violates its threshold, an alarm will be triggered. The asystole delay time relates to ECG relearning. When HR is less than 30 bpm, it is recommended to set the asystole delay time to 10 seconds.

Mindray algorithm

Arrh. event	Range	Default	Step	Unit
PVCs High	1 to 100	10	1	/min
Asys. Delay	3 to 10	5	1	s
Tachy High	60 to 300	Adult: 120 Pediatric: 160 Neonate: 180	5	bpm
Brady Low	15 to 120	Adult: 50 Pediatric: 75 Neonate: 90	5	bpm
Extreme Tachy	120 to 300	Adult: 160 Pediatric: 180 Neonate: 200	5	bpm
Extreme Brady	15 to 60	Adult: 35 Pediatric: 50 Neonate: 60	5	bpm
Multif. PVC's Window	3 to 31	15	1	/min
Vtac Rate	100 to 200	Adult, pediatric: 130 Neonate: 160	5	bpm
Vtac PVCs	3 to 99	6	1	/min
Pause Time	1.5, 2.0,2.5	2	/	s
Vbrd PVCs	3 to 99	5	1	/min
Vbrd Rate	15 to 60	40	5	bpm

Mortara algorithm

Arrh. event	Range	Default	Step	Unit
PVCs High	1 to 100	10	1	/min
Asys. Delay	2 to 10	5	1	s
Vtac Rate	100 to 200	130	5	bpm
Vtac PVC	3 to 12	6	1	beats
Multif. PVC	3 to 31	15	1	beats
Tachy High	Adult: 100 to 300 Pediatric: 160 to 300	Adult: 100 Pediatric: 160	5	bpm
Brady Low	Adult: 15 to 60 Pediatric: 15 to 80	Adult: 60 Pediatric: 80	5	bpm

8.8.4 Setting the Extended Arrh. (For Mindray Algorithm Only)

The following arrhythmia events are defined as extended arrhythmia:

- Extreme Tachy
- Extreme Brady
- Vent. Brady
- Nonsus. Vtac
- Multif. PVC
- Irr. Rhythm
- Pause
- Afib

You can select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→select [**Alarm Setup >>**], and set [**Extended Arrh.**] to [**Enable**] or [**Disable**]. When [**Extended Arrh.**] is set to [**Disable**], the patient monitor does not analysis the extended arrhythmia events and corresponding alarms are not given.

8.8.5 Reviewing Arrhythmia Events

Please refer to the ***Review*** chapter.

8.9 ECG Relearning

8.9.1 Initiating an ECG Relearning Manually

During ECG monitoring, you may need to initiate an ECG relearning when the patient's ECG template changes dramatically. A change in the ECG template could result in:

- incorrect arrhythmia alarms
- loss of ST measurement, and/or
- inaccurate heart rate

ECG relearning allows the monitor to learn the new ECG template so as to correct arrhythmia alarms and HR value, and restore ST measurements. To initiate relearning manually, select the ECG parameter window or waveform area→ [**Relearn**]. When the patient monitor is learning, the message [**ECG Learning**] is displayed in the technical alarm area.

⚠CAUTION

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

8.9.2 Automatic ECG Relearning

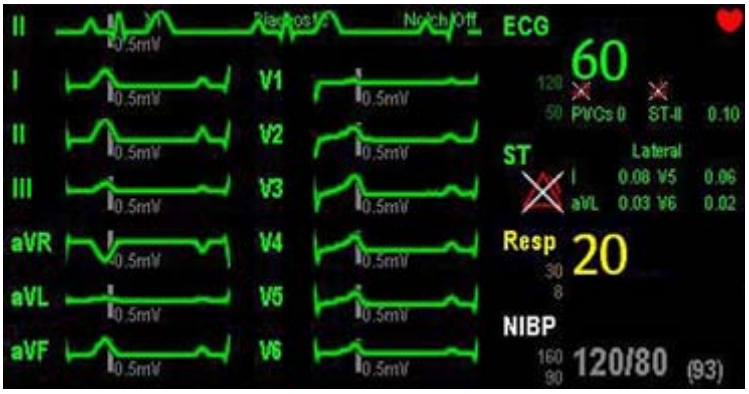
ECG relearning is initiated automatically whenever:

- The ECG lead or lead label is changed
- The ECG lead is re-connected
- A new patient is admitted
- After the calibration is completed, select [**Stop Calibrating ECG**]
- Switch between normal screen and 12-lead full screen for 12-lead ECG monitoring.
- The paced status of the patient is changed.

8.10 12-Lead ECG Monitoring

8.10.1 Entering the 12-lead ECG Monitoring Screen

1. Refer to the section ***8.3.3 ECG Lead Placements*** to place the electrodes.
2. In the [**ECG Setup**] menu, select [**Others>>**] to enter the [**Others Setup Menu**].
3. Set [**Lead Set**] to [**12-Lead**], set [**ECG Display**] to [**12-Lead**].



There are totally 12 ECG waves and 1 rhythm wave displayed on the screen. The rhythm lead is ECG Ⅰ before entering the 12-lead ECG screen.

The [**Filter**] mode is automatically switched to [**Diagnostic**] when the patient monitor accesses the 12-lead full-screen; the [**Filter**] mode resumes to the configuration before accessing the 12-lead full screen when the patient monitor exit the 12-lead full screen.

8.10.2 Setting ECG Waveform Sequence

You can select the sequence of ECG waveforms on the 12-lead ECG screen and 12-lead ECG report.

To select the sequence of the ECG waveforms,

1. In the [**ECG Setup**] menu, select [**Others>>**] to enter the [**Others Setup Menu**].
2. Set [**Waveform Layout**] to [**Standard**] or [**Cabrera**].
   - [**Standard**]: the sequence is I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6.
   - [**Cabrera**]: the sequence is aVL, I, -aVR, II, aVF, III, V1, V2, V3, V4, V5, V6.

8.10.3 Extending the rhythm lead waveform area

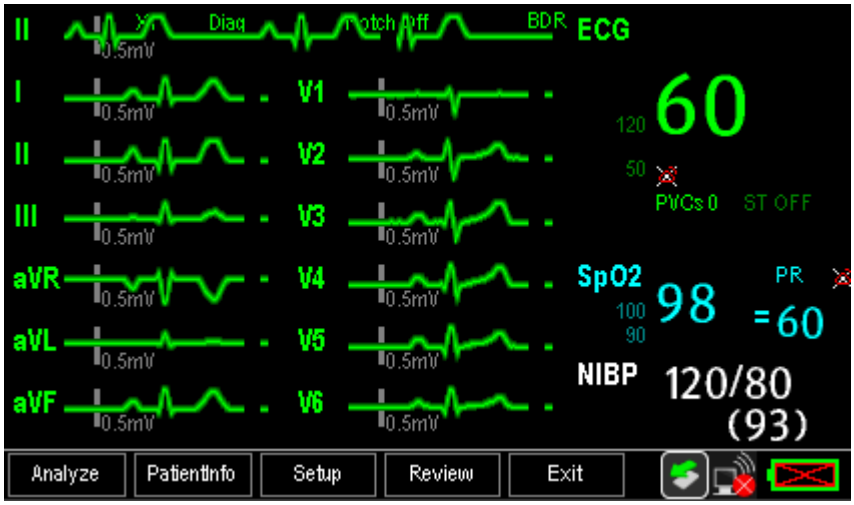
You can extend the height of rhythm lead waveform area. To do so,

1. In the [**ECG Setup**] menu, select [**Others>>**] to enter the [**Others Setup Menu**].
2. Set **[ECG Display Area**] to [**Extended**].

8.11 Resting 12-lead ECG Analysis

8.11.1 Entering the 12-lead Screen

1. In the [**ECG Setup**] menu, select [**Others>>**] to enter the [**Other Setup Menu**].
2. Set [**Lead Set**] to [**12-Lead**].
3. Set [**ECG Display**] to [**12-Lead**].



The functions of the keys at the bottom of the 12-lead screen are as follows:

- [**Analyze**]: starts resting 12-lead analysis.
- [**Patient Info**]: enters the patient information.
- [**Setup**]: enters the 12-lead setup menu.
- [**Review**]: enters the [**Review**] window.
- [**Exit**]: exits the 12-lead screen.

8.11.2 Entering Patient Information

Some patient information may directly affect ECG analysis. Complete and correct patient information is helpful for accurate diagnosis and treatment of the patient. Enter patient information before taking an ECG measurement.

To enter the patient information, select [**Patient Info**] from the 12-lead screen.

NOTE

- **Check that patient information is correct before resting 12-lead analysis.**
- **We recommend using pediatric lead placement V4R, V1, V2, V4 - V6 if the patient is under 16 years of age. Please record V4R using the V3 electrode. Also set [V3 Electrode Placement] to [V4R]. This is a normal practice for a patient of this age.**

8.11.3 12-Lead Setup

In the 12-lead screen, select [**Setup**] to enter the [**12-Lead Setup**] menu to change the settings related to 12-lead ECG analysis. In the [**12-Lead Setup**] menu, you can also select [**Report Setup>>**] to set the format and contents of the ECG reports.

12-lead Setup			
Menu item	**Option**	**Default**	**Description**
Filter	Diagnostic, ST	Diagnostic	Set filter mode. **Note:** The filter mode automatically switches to [**Diagnostic**] when the patient monitor accesses the 12-lead -screen and resumes to the original setting when the patient monitor exits the 12-lead screen.
Baseline Drift Removal	On, Off	On	Select whether the baseline drift removal (BDR) process or 0.05-Hz filter is used. [**On**]: BDR is enabled. This process suppresses most baseline drift interference and also is able to preserve the fidelity of the ST-segment level. [**Off**]: BDR is disabled and the 0.05-Hz filter is used. **NOTE:** BDR or 0.05-Hz selection applies to the displayed ECG, printed report, analyzed and stored data. BDR introduces around 1-second delay. We recommend use of BDR except when the delay is unacceptable. Both BDR and 0.05-Hz selections meet requirements of the 1990 American Heart Association Recommendations for Standardization and Specifications in Automated Electrocardiography: Bandwidth and Signal Processing pertaining to lower-frequency response in electrocardiography.
Tachy High	80 - 130	100	Adjusts tachycardia threshold. Heart rates above the setting are labelled Tachycardia. Only applies to patients whose age exceeds 180 days.
Brady Low	40 - 60	50	Adjusts bradycardia threshold. Heart rates below the setting are labelled Bradycardia. Only applies to patients whose age exceeds 2191 days.
QTc Formula	Hodges, Bazett, Fridericia, Framingham	Hodges	Selects QTc formula. Hodges: $QTc = QT + 1.75 \times (HeartRate - 60)$ Bazett: $QTc = QT \times \left(\frac{HeartRate}{60} \right)^{\frac{1}{2}}$

			Fridericia: $QTc = QT \times \left(\frac{HeartRate}{60} \right)^{\frac{1}{3}}$ Framingham: $QTc = QT + 154 \times \left(1 - \frac{60}{HeartRate} \right)$
Waveform Layout	Standard, Cabrera	Standard	Select ECG lead sequence for displaying and printing. [**Standard**]: the sequence is I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6. [**Cabrera**]: the sequence is aVL, I, -aVR, II, aVF, III, V1, V2, V3, V4, V5, V6.
Report setup			
Menu item	**Option**	**Default**	**Description**
Report Format	12×1, 6×2, 3×4+1	3×4+1	Selects the format of the 12-lead ECG report. [**12×1**]: ECG waveforms are displayed in 12 lines. [**6×2**]: ECG waveforms are displayed in 6 lines and 2 columns. [**3×4+1**]: ECG waveforms are displayed in 3 lines and 4 columns followed by the rhythm lead waveform.
Median Complex	On, Off	Off	Selects whether Median Complex is included on the 12-lead ECG report. Median Complex displays a median complex waveform for each lead and a rhythm lead waveform of 10 seconds in 3x4+1 format. For each waveform, short vertical lines are used to mark the start of the P-wave and QRS complex, and the end of the P-wave, QRS complex, and T-wave.
Measurements	On, Off	On	Selects whether the measurement result is included on the 12-lead ECG report. Measurement result includes Vent. Rate, PR Interval, QRS Duration, QT/QTc Interval, and P/QRS/T Axes.
Interpretation	On, Off	On	Selects whether diagnoses are included on the 12-lead ECG report.
Interpretation Summary	On, Off	On	Selects whether interpretation summary is included on the 12-lead ECG report. Note: If the [**Interpretation**] option is not enabled, interpretation summary is not included on the report even if [**Interpretation Summary**] is enabled.

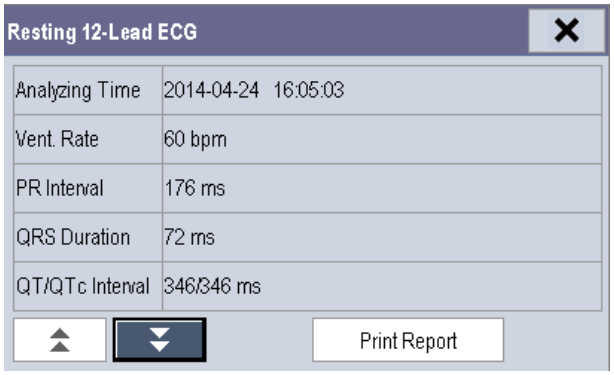
8.11.4 Resting 12-lead ECG Analysis

The Glasgow algorithm provides an interpretation of the resting 12-lead ECG in all situations.

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.

To start analyzing, select the [**Analyze**] key. The resting 12-lead analysis takes about 10 seconds. During this period, keep the patient still.

After analysis finishes, the following dialog-box pops out.



Select [**Print Report**] to pint the resting 12-lead ECG report from the external printer.

You can also print the latest 12-lead ECG report by selecting [**Report**] from the 12-lead screen.

Refer to***12-Lead ECG Interpretive Program Physician's Guide*** (PN: ***046-006360-00***) for details.

⚠CAUTION

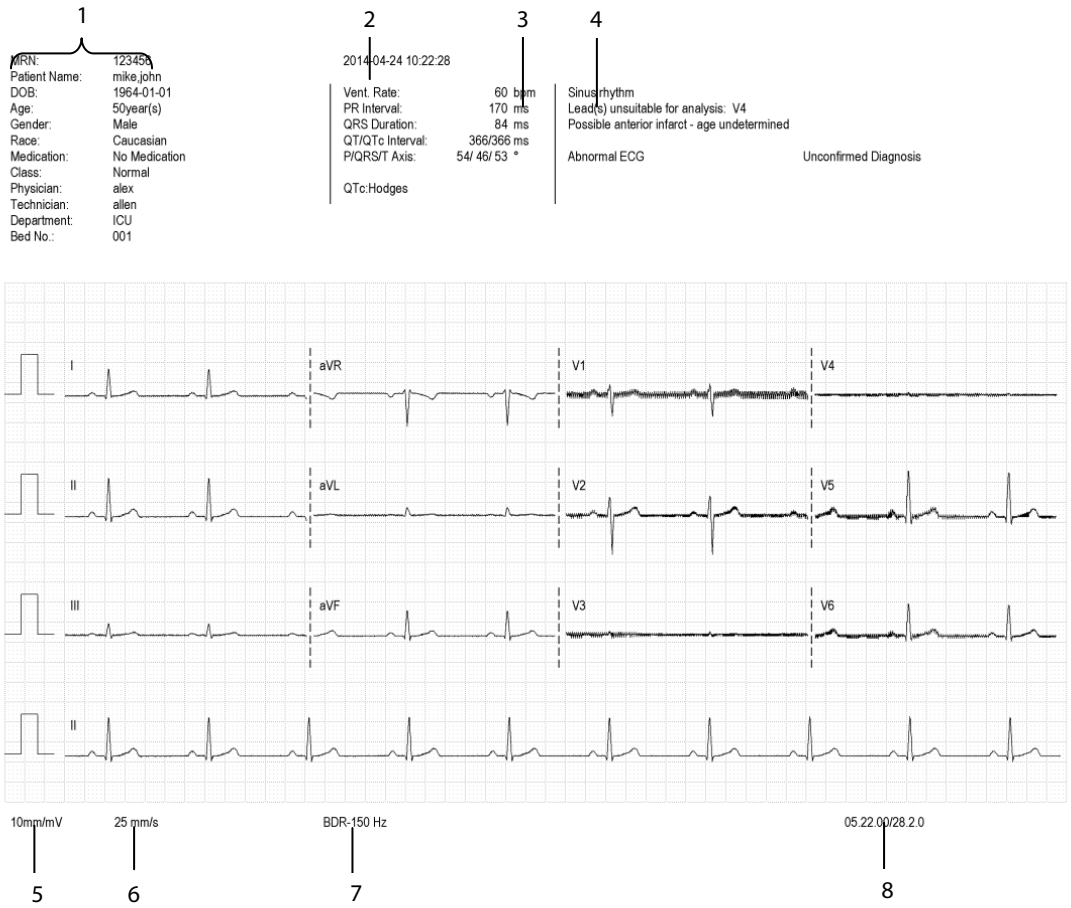
- **During the resting 12-lead ECG analysis, keep the patient still. Patient movement may cause misdiagnosis.**

NOTE

- **Glasgow resting 12-lead ECG intepretation is applied to adult, pediatric and neonate.**
- **During 12-lead ECG analaysis, 12-lead related settings are disabled.**
- **Changing patient information, including the patient's age, date of birth, gender, race, medication, class, or V3 placement setting,may change diagnosis statement. You shall select the [Analyze] key to reanalyze the patient's ECG before you print the latest 12-lead ECG report.**

8.11.5 12-lead ECG Report

The following is a sample of the12-lead ECG report with default configuration.



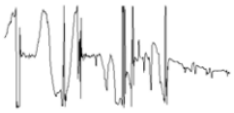
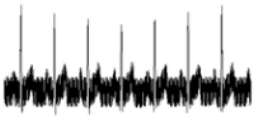
1. Patient information
2. Time of resting 12-lead ECG analysis
3. Measurements
4. Diagnosis statement
5. Waveform amplitude
6. Paper speed
7. Frequency range
8. System software version/algorithm version

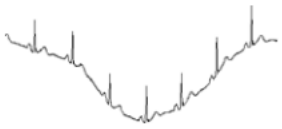
8.12 Troubleshooting

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.

⚠CAUTION

- **Never try to disassemble the equipment or supplied accessories. There are no internal user-serviceable parts.**

Symptoms	Possible Cause	Correction Action
Noisy ECG traces 	Loose or dry electrodes	Apply fresh and moist electrodes.
	Defective electrode wires	Replace wires if necessary.
	Patient cable or leads are routed too close to other electrical devices	Move the patient cable or leads away from the electrical device.
Excessive Electro-surgical Interference	Wrong ECG cable used	Use ESU-proof ECG cables. For details, refer to 2 4.1 ECG Accessories .
Muscle Noise 	Inadequate skin preparation prior to application of electrode, tremors, tense subject, and/or poor electrode placement	Repeat skin preparation as described in ***8.3.1 Preparing the Patient and Placing the Electrodes*** and re-place the electrodes. Apply fresh, moist electrodes. Avoid muscular areas.
Intermittent Signal	Connections not tight and/or properly secured	Check that the cables are properly connected.
	Electrodes dry or loose	Repeat skin preparation as described in ***8.3.1 Preparing the Patient and Placing the Electrodes*** and apply fresh and moist electrodes.
	Cable or lead wires damaged	Change cable and lead wires.
Excessive alarms: heart rate, lead fault	Electrodes dry	Repeat skin preparation as described in ***8.3.1 Preparing the Patient and Placing the Electrodes*** and apply fresh, moist electrodes.
	Excessive patient movement or muscle tremor	Reposition the electrodes. Replace fresh and moist electrodes if necessary.
Low Amplitude ECG Signal	Gain set too low	Set the gain as required. For details, refer to ***8.5.3 Changing ECG Wave Settings***.
	Electrodes dry / old	Apply fresh and moist electrodes.
	Skin improperly prepared	Repeat skin preparation as described in ***8.3.1 Preparing the Patient and Placing the Electrodes***.
	This could be the patient's normal QRS complex	Verify with another well-functioning monitor.
	Electrode could be positioned over a bone or muscle mass	Move ECG patches away from the bone or muscle mass.
No ECG Waveform	Gain set too low	Set the gain as required. For details, refer to ***8.5.3***

Symptoms	Possible Cause	Correction Action
		Changing ECG Wave Settings.
	Lead wires and patient cable not fully or properly inserted	Check that the leadwires and patient cables are properly connected.
	Cable or lead wires damaged	Change cable and lead wires.
Base Line Wander 	Patient moving excessively	Secure leadwires and cable to patient.
	Electrodes dry or loose	Repeat skin preparation as described in ***8.3.1 Preparing the Patient and Placing the Electrodes*** and apply fresh and moist electrodes.
	ECG Filter set to ST or Diagnostic mode	Set ECG Filter to "Monitor" mode.

FOR YOUR NOTES

9 Monitoring Respiration (Resp)

9.1 Introduction

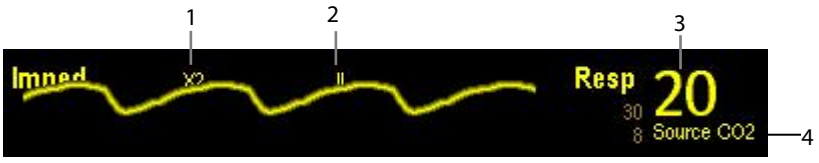
Impedance respiration is measured across the thorax. When the patient is breathing or ventilated, the volume of air changes in the lungs, resulting in impedance changes between the electrodes. Respiration rate (RR) is calculated from these impedance changes, and a respiration waveform appears on the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

9.2 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 1V/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.**

9.3 Understanding the Resp Display



1. Gain
2. Resp lead label
3. Respiration rate
4. RR source

By selecting the waveform area or parameter area, you can enter the [**Resp Setup**] menu.

NOTE

- **Respiration monitoring is not for use on the patients who are very active, as this will cause false alarms.**

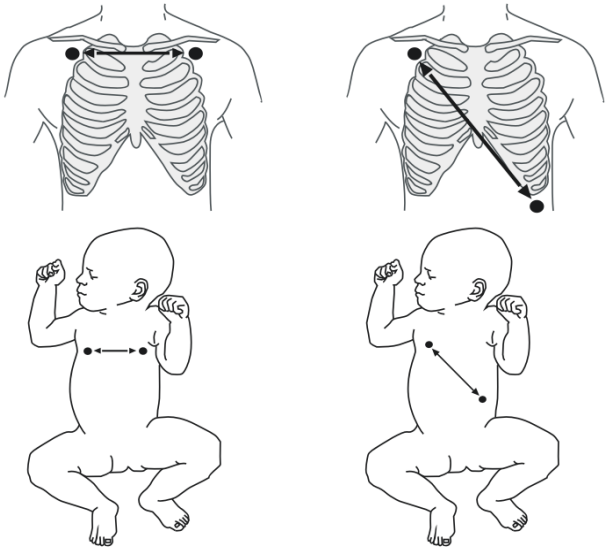
9.4 Placing Resp Electrodes

As the skin is a poor conductor of electricity, preparing the skin is necessary for a good Respiration signal. You can refer to the ECG section for how to prepare the skin.

As the Respiration measurement adopts the standard ECG electrode placement, you can use different ECG cables (3-lead, 5-lead or 12-lead). 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.

NOTE

- **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.**



Lead I Lead II

9.4.1 Optimizing Lead Placement for Resp

If you want to measure Resp and you are already measuring ECG, you may need to optimize the placement of the two electrodes between which Resp will be measured. Repositioning ECG electrodes from standard positions results in changes in the ECG waveform and may influence ST and arrhythmia interpretation.

9.4.2 Cardiac Overlay

Cardiac activity that affects the Resp waveform is called cardiac overlay. It happens when the Resp electrodes pick up impedance changes caused by the rhythmic blood flow. 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. This is particularly important for neonates.

9.4.3 Abdominal Breathing

Some patients with restricted movement breathe mainly abdominally. In these cases, you may need to place the left leg electrode on the left abdomen at the point of maximum abdominal expansion to optimise the respiratory wave.

9.4.4 Lateral Chest Expansion

In clinical applications, some patients (especially neonates) expand their chests laterally, causing a negative intrathoracic pressure. In these cases, it is better to place the two respiration electrodes in the right midaxillary and the left lateral chest areas at the patient's maximum point of the breathing movement to optimise the respiratory waveform.

9.5 Choosing the Respiration Lead

In the [**Resp Setup**] menu, set [**Resp Lead**] to [**I**], [**II**] or [**Auto**].

9.6 Changing the Apnea Alarm Delay

The apnea alarm is a high-level alarm used to detect apneas. You can set the apnea alarm delay time after which the patient monitor alarms if the patient stops breathing. In the [**Resp Setup**] menu, select [**Apnea Delay**] and then select the appropriate setting. The [**Apnea Delay**] of Resp and CO_2, module keeps consistent with each other.

9.7 Changing Resp Detection Mode

In the [**Resp Setup**] menu, select [**Detection Mode**] and toggle between [**Auto**] and [**Manual**].

- In auto detection mode, the patient monitor adjusts the detection level automatically, depending on the wave height and the presence of cardiac artifact. Note that in auto detection mode, the detection level (a dotted line) is not displayed on the waveform.

  Use auto detection mode for situations where:

  - The respiration rate is not close to the heart rate.
  - Breathing is spontaneous, with or without continuous positive airway pressure (CPAP).
  - Patients are ventilated, except patients with intermittent mandatory ventilation (IMV).

- In manual detection mode, you adjust the dotted detection level line to the desired level by selecting [**Upper Line**] or [**Lower Line**]. 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.

  Use manual detection mode for situations where:

  - 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.

In 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 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 as described in the section "Lateral Chest Expansion".

9.8 Changing Resp Wave Settings

⚠WARNING

- **When monitoring in manual detection mode, make sure to check the respiration detection level after you have increased or decreased the size of the respiration wave.**

In the [**Resp Setup**] menu, you can:

- Select [**Gain**] and then select an appropriate setting. The bigger the gain is, the larger the wave amplitude is.
- Select [**Sweep**] and then select an appropriate setting. The faster the wave sweeps, the wider the wave is.

9.9 Setting RR Source

To set RR source:

1. Enter the [**Resp Setup**] menu.
2. Select [**RR Source**] and then select a source or [**Auto**] from the dropdown list.

The dropdown list displays the currently available RR source. When you select [**Auto**], the system will automatically select the RR source according to the priority. When the current RR source does not have valid measurement, the system will automatically switch the [**RR Source**] to [**Auto**]. RR source switches back to impedance respiration if you press the  silence QuickKey during an apnea alarm.

The RR source options and description are shown in the table below.

Option	Description
Auto	RR source is automatically selected according to the priority.
CO_2	RR source is from CO_2 measurement.
ECG	RR source is from impedance respiration measurement.

9.10 Setting alarm properties

Select [**Alarm Setup >>**] from the [**Resp Setup**] menu. In the popup menu, you can set alarm properties for this parameter.

10 Monitoring PR

10.1 Introduction

The pulse numeric counts the arterial pulsations that result from the mechanical activity of the heart. You can display a pulse from any measured SpO_2 or any arterial pressure (see ***14 Monitoring IBP***). The displayed pulse numeric is color-coded to match its source.

NOTE

- **A functional tester or SpO2 simulator can be used to determine the pulse rate accuracy.**

10.2 Setting the PR Source

The current pulse source is displayed in the PR parameter area. The pulse rate chosen as pulse source:

- is monitored as system pulse and generates alarms when you select PR as the active alarm source;
- 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 the PR source , it is unlikely to distinguish the PR source ;
- is sent via the network to the central monitoring system, if available.

To set which pulse rate as PR source:

1. Enter the [**SpO2 Setup**] menu.
2. Select [**PR Source**] and then select a label or [**Auto**] from the popup menu.

The popup 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 from the popup menu. When 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 from the popup menu.

10.3 Selecting the Active Alarm Source

In most cases the HR and pulse numerics are identical. In order to avoid simultaneous alarms on HR and Pulse, the monitor uses either HR or Pulse as its active alarm source. To change the alarm source, select [**Alm Source**] in the [**ECG Setup**] or [**SpO2 Setup**] menu and then select either:

- [**HR**]: The monitor will use the HR as the alarm source for HR/pulse.
- [**PR**]: The monitor will use the PR as the alarm source for HR/pulse.
- [**Auto**]: If the [**Alm Source**] is set to [**Auto**], the monitor will use the heart rate from the ECG measurement as the alarm source whenever the ECG measurement is switched on and a valid heart rate is available. If the heart rate becomes unavailable, for example if leads becomes disconnected, and a pulse source is switch on and available, the monitor will automatically switch to Pulse as the alarm source. When the Leads Off condition is corrected, the monitor will automatically switch back to the heart rate as the alarm source.

10.4 QRS Tone

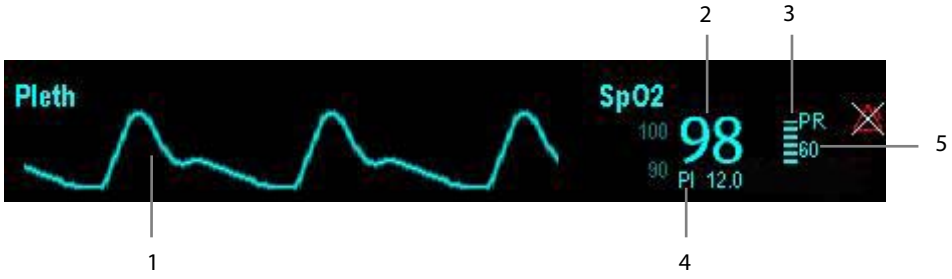
When PR is used as the alarm source, the PR source will be used as a source for the QRS tone. You can change the QRS volume by adjusting [**Beat Vol**] in the [**SpO2 Setup**] menu. When a valid SpO_2 value exists, the system will adjust the pitch tone of QRS volume according to the SpO_2 value.

11 Monitoring SpO_2

11.1 Introduction

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 probe passes through the tissue and is converted into electrical signals by the photodetector in the probe. The SpO_2 module processes the electrical signal and displays a waveform and digital values for SpO_2 and pulse rate. SpO_2 measurement can be used for adults, pediatrics and neonates.

This device is calibrated to display functional oxygen saturation.



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. 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 quality of SpO2 measurement. Above 1 is optimal, between 0.3 and 1 is acceptable. Below 0.3 indicates low perfusion; reposition the SpO2 sensor or find a better site. If low perfusion persists, choose another method to measure oxygen saturation if possible.

   PI is available for Mindray SpO_2 module and Masimo SpO_2 module. When PI is below 03, a question mark (?) is displayed to the right of the SpO_2 value, indicating that the patient is in low perfusion and SpO_2 value may be inaccurate.
5. Pulse rate (derived from pleth wave): detected pulsations per minute.

NOTE

- **A functional tester or SpO2 simulator cannot be used to assess the accuracy of a SpO2 module or a SpO2 sensor.**
- **A functional tester or SpO_2 simulator can be used to determine the pulse rate accuracy.**

11.2 Safety

WARNING

- **Use only SpO2 sensors specified in this manual. Follow the SpO2 sensor's instructions for use and adhere to all warnings and cautions.**
- **When a trend toward patient deoxygenation is indicated, blood samples should be analyzed by a laboratory co-oximeter to completely understand the patient's condition.**
- **Do not use SpO2 sensors during magnetic resonance imaging (MRI). Induced current could potentially cause burns. The sensor may affect the MRI image, and the MRI unit may affect the accuracy of the oximetry measurements.**
- **Prolonged continuous monitoring may increase the risk of undesirable changes in skin characteristics, such as irritation, reddening, blistering or burns. Inspect the sensor site every two hours and move the sensor if the skin quality changes. Change the application site every four hours. For neonates, or patients with poor peripheral blood circulation or sensitive skin, inspect the sensor site more frequently.**
- **If the sensor is too tight because the application site is too large or becomes too large due to edema, excessive pressure for prolonged periods may result in venous congestion distal from the application site, leading to interstitial edema and tissue ischemia.**

11.3 Identifying SpO_2 Modules

The monitor can be configured with Mindray SpO_2 module, Masimo SpO_2 module, or Nellcor SpO_2 module. To identify which SpO_2 module is incorporated into your monitor, see the company logo located at the right upper corner. The color of the cable connector matches the company as shown below:

- Mindray SpO_2 module: a blue connector without logo.
- Masimo SpO_2 module: a white connector with a logo of Masimo SET.
- Nellcor SpO_2 module: a grey connector with a logo of Nellcor.

The two SpO_2 modules are mutually exclusive.

11.4 Applying the Sensor

1. Select an appropriate sensor according to the module type, patient category and weight.
2. Remove colored nail polish from the application site.
3. Apply the sensor to the patient.
4. Select an appropriate adapter cable according to the connector type and plug this cable into the monitor.
5. Connect the sensor cable to the adapter cable.

WARNING

- **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.**

11.5 Changing SpO_2 Settings

11.5.1 Accessing SpO_2 Menus

By selecting the SpO_2 parameter window or waveform area, you can access the [**SpO2 Setup**] menu.

11.5.2 Setting SpO_2 Sensitivity

For Masimo SpO_2 module, you can set [**Sensitivity**] to [**Normal**] or [**Maximum**] in the [**SpO2 Setup**] menu. When the [**Sensitivity**] is set to [**Maximum**], the patient monitor is more sensitive to minor signals. When monitoring critically ill patients whose pulsations are very weak, it is strongly recommended that the sensitivity is set to [**Maximum**]. When monitoring neonatal or non-critically ill patients who tend to move a lot, noise or invalid signals may be caused. In this case, it is recommended that the sensitivity is set to [**Normal**] so that the interference caused by motion can be filtered and therefore the measurement stability can be ensured.

11.5.3 Changing Averaging Time

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 patient monitor responds to changes in the patient's oxygen saturation level. Contrarily, the longer the averaging time is, the slower the patient monitor responds to changes in the patient's oxygen saturation level, but the measurement accuracy will be improved. For critically ill patients, selecting shorter averaging time will help understanding the patient's state.

To set the averaging time:

- For Mindray SpO_2 module, select [**Sensitivity**] in the [**SpO2 Setup**] menu and then toggle between [**High**], [**Med**] and [**Low**], which respectively correspond to 7 s, 9 s and 11 s.
- For Masimo SpO_2 module, select [**Averaging**] in the [**SpO2 Setup**] menu and then toggle between [**2-4 s**], [**4-6 s**], [**8 s**], [**10 s**], [**12 s**], [**14 s**] and [**16 s**].

11.5.4 Monitoring SpO_2 and NIBP Simultaneously

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

11.5.5 Sat-Seconds Alarm Management

With traditional alarm management, high and low alarm limits are set for monitoring oxygen saturation. During monitoring, as soon as 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 alarm 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 module to decrease the likelihood of false alarms caused by motion artifacts. To set the Sat-Seconds limit, select [**Sat-Seconds**] in the [**SpO2 Setup**] menu and then select the appropriate setting.

With Sat-Seconds alarm management, high and low alarm limits are set in the same way as traditional alarm

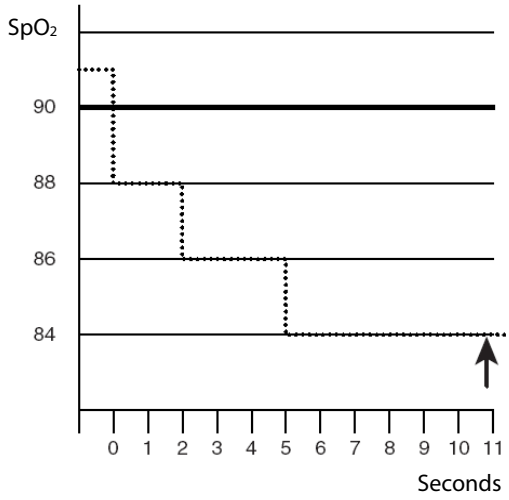
management. A Sat-Seconds limit is also set. The Sat-Seconds limit controls the amount of time that SpO_2 saturation may be outside the set limits before an alarm sounds. The method of calculation is as follows: the number of percentage points that the SpO_2 saturation falls outside the alarm limit is multiplied by the number of seconds that it remains 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.**

11.5.6 Changing the Speed of the Pleth Wave

In the [**SpO2 Setup**] menu, select [**Sweep**] and then select the appropriate setting. The faster the waveform sweeps, the wider the waveform is.

11.5.7 Setting the Alarm Level for SpO_2 Sensor Off Alarm

Select [**Alarm Setup >>**] from the [**User Maintenance**] menu. You can set the [**SpO2SensorOff Lev.**] in the popup menu.

11.5.8 Setting the SpO_2 Tone Mode

Select [**Others >>**] from the [**User Maintenance**] menu. In the popup menu, you can set [**SpO2 Tone**] as [**Mode 1**] or [**Mode 2**].

⚠WARNING

- **The same SpO_2 tone mode shall be used for the same patient monitors in a single area.**

11.5.9 Adjusting the Desat Alarm

The desat alarm is a high level alarm notifying you of potentially life threatening drops in oxygen saturation. Select [**Alarm Setup >>**] from the [**SpO2 Setup**] menu. From the popup menu, you can set low alarm limit, alarm switch, and alarm recording for [**Desat**]. When the SpO_2 value is below the desat alarm limit and desat alarm switch is set on, the message [**SpO2 Desat**] is displayed.

11.6 Measurement Limitations

If you doubt the measured SpO_2, check patient vital signs first. Then check the patient monitor and SpO_2 sensor. The following factors may influence the accuracy of measurement:

- Ambient light
- Physical movement (patient and imposed motion)
- Diagnostic testing
- Low perfusion
- Electromagnetic interference, such as MRI environment
- Electrosurgical units
- Dysfunctional haemoglobin, such as carboxyhemoglobin (COHb)and methemoglobin (MetHb)
- Presence of certain dyes, such as methylene and indigo carmine
- Inappropriate positioning of the SpO2 sensor, or use of incorrect SpO2 sensor
- Drop of arterial blood flow to immeaurable level caused by shock, anemia, low temperature or vasoconstrictor.

11.7 Masimo Information

- Masimo Patents

This device is covered under one or more the following U.S.A. patents: 5,758,644, 6,011,986, 6,699,194, 7,215,986, 7,254,433, 7,530,955and other applicable patents listed at: www.masimo.com/patents.htm.

- No Implied License

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

11.8 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.

- No Implied License

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

11.9 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.

CAUTION

- **Never try to disassemble the equipment or supplied accessories. There are no internal user-serviceable parts.**

Symptoms	Possible Cause	Correction Action
Dashes "- -" display in place of numerics.	Measurement is invalid.	Check that the sensor is properly applied. Change the application site if necessary.
Do not see SpO2 parameter tiles in display.	Parameter not configured to display.	Switch the SpO2 monitoring function on as described in ***3.10.1 Switching the Parameters On/Off***.
Unable to obtain SpO2 reading	Patient has poor perfusion	Change the application site or notify the physician
	Sensor not on patient	Check if the "SPO2 Sensor Off" alarm is reported. If so, reapply the sensor. If not, contact the service personnel.
	Cables loose/not connected	Check the cable connections. Switch the cable if necessary.
	Ambient light	Check if the "SpO2 Too Much Light" alarm is reported. If so, move the sensor to a place with lower level of ambient light or cover the sensor to minimize the ambient light.
No SpO2 waveform	Waveform not selected to display	Switch the SpO2 monitoring function on as described in ***3.10.1 Switching the Parameters On/Off***.
	Cable or sensor not plugged in	Check that the cable is properly connected and sensor securely applied.
Low amplitude SpO2 signal	SpO2 sensor on same limb as cuff	Check that the sensor is properly applied. Change the application site if necessary.
	Patient has poor perfusion	Change the application site.

FOR YOUR NOTES

12 Monitoring NIBP

12.1 Introduction

The patient monitor uses the oscillometric method for measuring the non-invasive blood pressure (NIBP). This measurement can be used for adults, pediatrics and neonates.

Automatic non-invasive blood pressure monitoring uses the oscillometric method of measurement. To understand how this method works, we'll compare it to the auscultative method. With auscultation, the clinician listens to the blood pressure and determines the systolic and diastolic pressures. The mean pressure can then be calculated with reference to these pressures as long as the arterial pressure curve is normal.

Since the monitor cannot hear the blood pressure, it measures cuff pressure oscillation amplitudes. Oscillations are caused by blood pressure pulses against the cuff. The oscillation with the greatest amplitude is the mean pressure. This is the most accurate parameter measured by the oscillometric method. Once the mean pressure is determined, the systolic and diastolic pressures are calculated with reference to the mean.

Simply stated, auscultation measures systolic and diastolic pressures and the mean pressure is calculated. The oscillometric method measures the mean pressure and determines the systolic and diastolic pressures.

As specified by IEC 80601-2-30, NIBP measurement can be performed during electro-surgery and discharge of defibrillator.

NIBP diagnostic significance must be decided by the doctor who performs the measurement.

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.**

12.2 Safety

⚠ WARNING

- **Be sure to select the correct patient category setting for your patient before measurement. Do not apply the higher adult settings for pediatric or neonatal patients. Otherwise it may present a safety hazard.**
- **Do not measure NIBP on the limb where skin damage has occurred or is expected.**
- **Use clinical judgement 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 use the NIBP cuff on the arm on the side of a mastectomy.**
- **Continuous CUFF pressure due to connection tubing kinking may cause blood flow interference and resulting 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 readings, determines the patient's vital signs by alternative means and then verify that the monitor is working correctly.**

12.3 Measurement Limitations

Measurements are impossible with heart rate extremes of less than 40bpm or greater than 240bpm, or if the patient is on a heart-lung machine.

The measurement may be inaccurate or impossible:

- If a regular arterial pressure pulse is hard to detect
- With excessive and continuous patient movement such as shivering or convulsions
- With cardiac arrhythmias
- Rapid blood pressure changes
- Severe shock or hypothermia that reduces blood flow to the peripheries
- Obesity, where a thick layer of fat surrounding a limb dampens the oscillations coming from the artery

12.4 Measurement Methods

There are four methods of measuring NIBP:

- Manual: measurement on demand.
- Auto: continually repeated measurements at set intervals.
- STAT: continually rapid series of measurements over a five minute period, then return to the previous mode.
- Sequence: continually automatic measurement at set durations and intervals.

12.5 Setting Up the NIBP Measurement

12.5.1 Preparing the Patient

In normal use, perform NIBP measurement on a patient who is in the following position:

- Comfortably seated
- Legs uncrossed
- Feet flat on the floor
- Back and arm supported
- Middle of the cuff at the level of the right atrium of the heart

NOTE

- **It is recommended that the patient relaxes as much as possible before performing measurement and that the patient does not talk during NIBP measurement.**
- **It is recommended that 5 min should elapse before the first reading is taken.**
- **The operator should not touch the cuff or tubing during NIBP measurement.**

12.5.2 Preparing to Measure NIBP

1. Power on the monitor.
2. Verify that the patient category is correct. Change it if necessary. If not, select [**Main Menu**]→ [**Patient Setup>>**] → [**Patient Demographics**] → [**Patient Cat.**], and set the patient category to [**Adu**], [**Ped**] or [**Neo**].
3. Plug the air tubing into the NIBP connector on the monitor.
4. Select a correct sized cuff by referring to the limb circumference marked on the cuff. The width of the cuff should be 40% (50% for neonates) of the limb circumference, or 2/3 of the upper arm's length. The inflatable part of the cuff should be long enough to encircle at least 50% to 80% of the limb.
5. Apply the cuff to an upper arm or thigh of the patient and make sure the Φ marking on the cuff matches the artery location. Do not wrap the cuff too tightly around the limb. It may cause discoloration, and ischemia of the extremities. Make sure that the cuff edge falls within the marked range. If it does not, use a cuff that fits better.
6. Connect the cuff to the air tubing and make sure that the air tubing is not compressed or twisted. Air must pass unrestricted through the tubing.

NOTE

- **The use of the equipment is restricted to one patient at a time.**
- **For known hypertensive patients, you need to set initial cuff pressure to a higher value to reduce the measurement time.**

12.5.3 Starting and Stopping Measurements

Select the on-screen QuickKey  or [**Main Menu**]→[**NIBP Measure**] to start an NIBP measurement. You can select [**Stop NIBP**] in the main menu to stop NIBP measurements.

12.5.4 Correcting the Measurement if Limb is not at Heart Level

The cuff should be applied to a limb at the same level as the patient's heart. If the limb is not at the heart level, to the displayed value:

- Add 0.75 mmHg (0.10 kPa) for each centimetre higher, or
- Deduct 0.75 mmHg (0.10 kPa) for each centimeter lower.

12.5.5 Enabling NIBP Auto Cycling and Setting the Interval

1. Select the NIBP parameter window to enter the [**NIBP Setup**] menu.
2. Select [**Interval**] and then select a desired time interval. Selecting [**Manual**] switches to manual mode.
3. Start a measurement manually. The monitor will then automatically repeat NIBP measurements at the set time interval.

Or

1. Select [**NIBP Measure**] QuickKey  .
2. Select a proper interval.
3. Start a measurement manually. The monitor will then automatically repeat NIBP measurements at the set time interval.

In auto mode, you can enable the clock function to synchronize the NIBP automatic measurements with the real time clock.

For example, when the clock is enabled, if Interval is [**20min**], and then you start NIBP auto measurement at 14: 03, the next measurement will be taken at 14: 20, and the following measurement time will be 14:40, 15:00, and so on.

To enable the clock, in the [**NIBP Setup**] menu, set [**Clock**] to [**On**].

NOTE

- **The clock function is available only when the auto measurement internal is 5 minutes or more.**

12.5.6 Starting a STAT Measurement

1. Select the NIBP parameter window to enter the [**NIBP Setup**] menu.
2. Select [**NIBP STAT**].

Or

1. Select [**NIBP Measure**] QuickKey  .
2. Select [**STAT**].

The STAT mode initiates 5 minutes of continuous, sequential, automatic NIBP measurements.

⚠WARNING

- **Continuous non-invasive blood pressure measurements may cause purpura, ischemia and neuropathy in the limb with the cuff. Inspect the application site regularly to ensure skin quality and inspect the extremity of the cuffed limb for normal color, warmth and sensitivity. If any abnormity occurs, move the cuff to another site or stop the blood pressure measurements immediately.**

12.5.7 Sequence Measurement

NIBP sequence measurement can include up to five cycles: A, B, C, D and E. You can individually set the duration and interval for each cycle.

To set the sequence measurement, follow this procedure:

1. Select the NIBP parameter window to enter the [**NIBP Setup**] menu.
2. Select [**Sequence Setup>>**]
3. Set up [**Duration**] and [**Interval**] for each cycle.

To start the sequence measurement, follow this procedure:

1. Select the NIBP parameter window to enter the [**NIBP Setup**] menu.
2. Set [**Interval**] to [**Sequence**]
3. Select [**Start NIBP**], or select [**NIBP Measure**] Quickkey in the main screen.

12.6 Understanding the NIBP Numerics

The NIBP display shows numerics only as below. Your display may be configured to look slightly different.

1. Systolic pressure
2. Diastolic pressure
3. Mean pressure obtained after the measurement and cuff pressure obtained during the measurement

If the NIBP measurement exceeds the measurement range, "---" will be displayed.

12.7 Changing NIBP Settings

By selecting the NIBP parameter window, you can enter the [**NIBP Setup**] menu.

12.7.1 Setting the Initial Cuff Inflation Pressure

You can set the initial cuff inflation pressure manually. In the [**NIBP Setup**] menu, select [**Initial Pressure**] and then select the appropriate setting.

NOTE

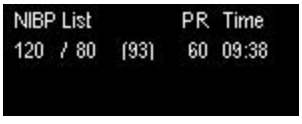
- **For known hypertensive patients, you need to set initial cuff pressure to a higher value to reduce the measurement time.**

12.7.2 Setting NIBP Alarm Properties

Select [**Alarm Setup >>**] from the [**NIBP Setup**] menu. You can set the alarm properties for this parameter in the popup menu.

12.7.3 Displaying NIBP List

Select [**Main Menu**]→[**Screens**]→[**Screen Setup**]. You can set [**NIBP List**] to be displayed at the bottom area of the screen. Then, multiple sets of most recent NIBP measurements will be displayed. And PR displayed is derived from NIBP.



You can display NIBP list only in normal screen.

12.7.4 Setting the Pressure Unit

Select [**Unit Setup >>**] from the [**User Maintenance**] menu. In the popup menu, select [**Press. Unit**] and toggle between [**mmHg**] and [**kPa**].

12.7.5 Switching On NIBP End Tone

The monitor can issue a reminder tone at the completion of NIBP measurement. The NIBP End Tone is off by default. You can switch it on by accessing the [**NIBP Setup**] menu.

12.8 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.

1. Select [**VeniPuncture >>**] from the [**NIBP Setup**] menu. In the popup menu, verify that the [**Cuff Press.**] value is appropriate. Change it if necessary.
2. Select [**VeniPuncture**].
3. Puncture vein and draw blood sample.
4. Select the on-screen QuickKey  to deflate the cuff. The cuff deflates automatically after a set time if you do not deflate it.

During measurement, the NIBP display shows the inflation pressure of the cuff and the remaining time in venous puncture mode.

FOR YOUR NOTES

13 Monitoring Temp

13.1 Making a Temp Measurement

This monitor can simultaneously monitor two temperature sites.

Verify that the probe detection program works correctly before monitoring. Plug out the temperature probe cable from the T1 or T2 connector, and the monitor can display the message [**T1 Sensor Off**] or [**T2 Sensor Off**] and give alarm tones correctly.

1. Select an appropriate probe for your patient according to patient type and measuring site.
2. If you are using a disposable probe, connect the probe to the temperature cable.
3 Plug the probe or temperature cable to the temperature connector.
4. Attach the probe to the patient correctly.
5. Check that the alarm settings are appropriate for this patient.

13.2 Understanding the Temp Display

The temperature monitoring is displayed on the monitor as three numerics: T1, T2 and TD. By selecting this area, you can enter the [**Alarm Setup**] menu.

13.3 Changing Temperature Settings

13.3.1 Setting the Temperature Unit

Select [**Unit Setup >>**] from the [**User Maintenance**] menu. In the popup menu, select [**Temp Unit**] and toggle between [**ºC**] and [**ºF**].

13.3.2 Setting the Temperature Label

The default temperature label is T1 and T2. To change the Temp label, follow this procedure:

1. Select the Temp parameter area to enter [**Temp Setup**] menu.
2. Select [**Temp-1 Label**] or [**Temp-2 Label**], and in the drop-down list, select a proper label.

FOR YOUR NOTES

14 Monitoring IBP

14.1 Introduction

The monitor can monitor two invasive blood pressures and displays the systolic, diastolic and mean pressures and a waveform for each pressure.

14.2 Safety

⚠ 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.**
- **The neutral electrode of the high-frequency surgical unit shall properly contact the patient. Otherwise, burns may result.**
- **When using accessories, their operating temperature should be taken into consideration. For details, refer to instructions for use of accessories.**
- **The neutral electrode of the electro-surgery unit (ESU) shall properly contact the patient. Otherwise, burns may result.**

14.3 Measuring an Invasive Blood Pressure

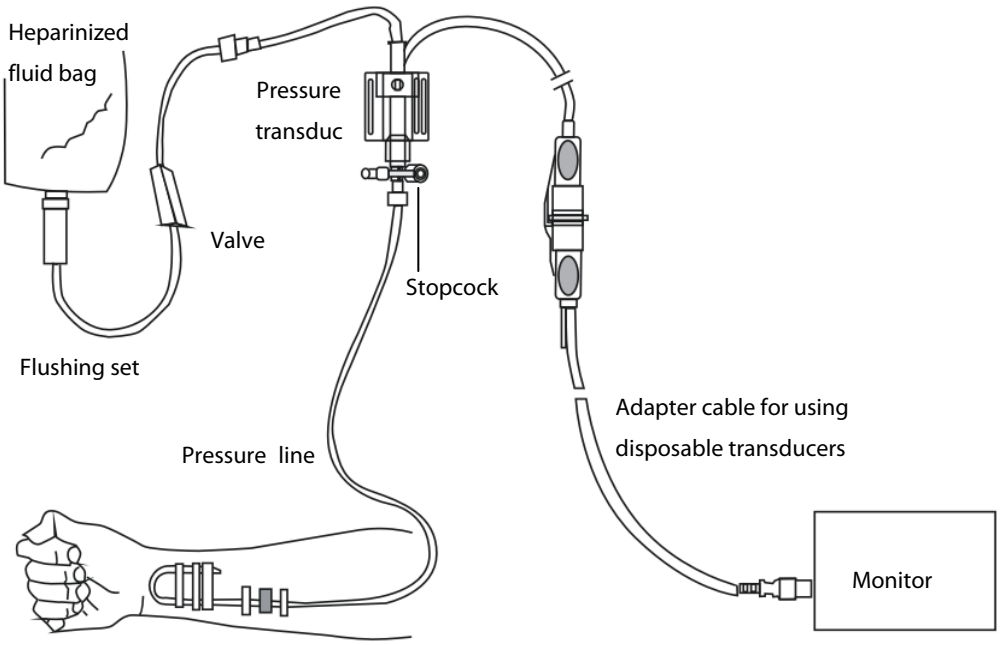
14.3.1 Setting Up the Pressure Measurement

1. Plug the pressure cable into the IBP connector.
2. Prepare the flush solution.
3. Flush the system to exhaust all air from the tubing. Ensure that the transducer and stopcocks are free of air bubbles.

⚠ WARNING

- **If air bubbles appear in the tubing system, flush the system with the infusion solution again. Air bubble may lead to wrong pressure reading.**

4. Connect the pressure line to the patient catheter.
5. Position the transducer so that it is level with the heart, approximately at the level of the midaxillary line.
6. Select the appropriate label.
7. Zero the transducer. After a successful zeroing, turn off the stopcock to the atmosphere and turn on the stopcock to the patient.



⚠ WARNING

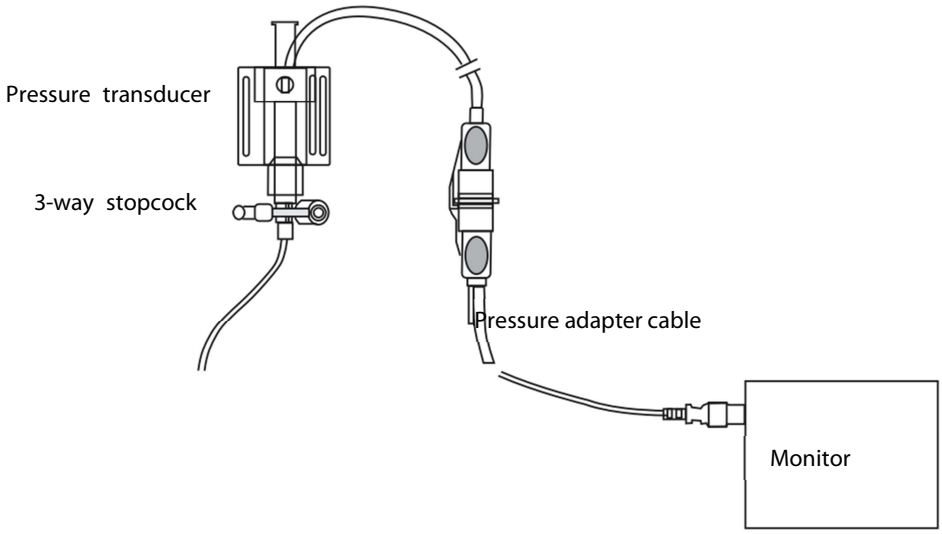
- **If measuring intracranial pressure (ICP) with a sitting patient, level the transducer with the top of the patient's ear. Incorrect leveling may give incorrect values (not applicable if measursing ICP with the Codman ICP transducer).**

14.3.2 Zeroing the Transducer

To avoid inaccurate pressure readings, the monitor requires a valid zero. Zero the transducer in accordance with your hospital policy (at least once per day). Zero whenever:

- A new transducer or adapter cable is used.
- You reconnect the transducer cable to the monitor.
- The monitor restarts.
- You doubt the readings.

1. Turn off the stopcock to the patient.



2. Vent the transducer to the atmospheric pressure by turning on the stopcock to the air.
3. In the setup menu for the pressure (e.g. Art), select [**Art Zero >>**]→[**Zero**]. During zero calibration, the [**Zero**] button appears dimmed. It recovers after the zero calibration is completed.
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.

NOTE

- **Your hospital policy may recommend that the ICP transducer is zeroed less frequently than other transducers.**

14.4 Measuring ICP Using the Codman ICP Transducer

14.4.1 Zeroing the Codman ICP transducer

You shall zero the Codman ICP transducer (PN: 040-002336-00) before use. To zero the ICP transducer, follow this procedure:

1. Before unpacking the ICP transducer, check that the monitor supports the Codman ICP transducer.

   a. Select [**Main Menu**]→[**Parameters>>**]→[**ICP Setup>>**] (if you cannot find [**ICP Setup>>**] button, you can select any IBP setup button to enter its corresponding setup menu, and then select [**Label**] and change current label to [**ICP**]) → select the [**Zero Ref. >>**] button.

   b. Check that the following icon is displayed in the [**ICP Zero**] menu. The monitor supports the Codman ICP transducer if the following icon is displayed in the [**ICP Zero**] menu.

2. Connect the ICP transducer, the ICP adapter cable and the module.
3. Follow the manufacturer's instructions to prepare the ICP transducer.
4. Zero the ICP transducer: when you see the message [**Zero Ref.?**] in the ICP numeric area, select the ICP waveform area or numeric area to enter the [**ICP Setup**] menu → select the [**Zero Ref. >>**] button → select the [**Zero**] button.
5. 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.

14.4.2 Measuring ICP

To monitor ICP, follow this procedure:

1. Zero the Codman ICP transducer. For more information, see section ***14.4.1 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**].
   - Incosistent: 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 ***14.4.1 Zeroing the Codman ICP transducer***. If the target monitor does not support the Codman ICP transducer, do not use it for ICP monitoring.

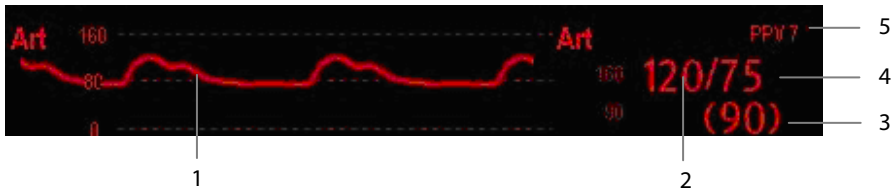
If the target monitor supports the Codman ICP transducer, follow this procedure to transfer the patient:

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**].

14.5 Understanding the IBP Display

The IBP measurement is displayed on the monitor as a waveform and numeric pressures. The figure below shows the waveform and numerics for the Art pressure. For different pressures, this display may be slightly different.



1. Waveform
2. Systolic pressure
3. Mean pressure
4. Diastolic pressure
5. PPV measurement

For some pressures, the parameter window may show the mean pressure only. For different pressures, their defaults unit may be different. If the Art and ICP pressures are measured simultaneously, the ICP parameter area will display numeric CPP, which is obtained by subtracting ICP from the Art mean.

14.6 Changing IBP Settings

14.6.1 Changing a Pressure for Monitoring

1. Select the pressure you want to change to enter its setup menu.
2. Select [**Label**] and then select your desired label from the list. The already displayed labels cannot be selected.

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

- **When two pressures are deteted having the same label, the patient monitor changes one pressure label to a currently unused one.**

14.6.2 Setting the Pressure Label Order

Select [**IBP Label Order Setup >>**] from the parameter setup menu to set the display order of the pressure labels. The default display order is: Art, pArt, CVP, pCVP, ICP, PA, Ao, UAP, FAP, BAP, LV, LAP, RAP, UVP, P1, P2, P3, P4. To restore the default setting, you can select [**Defaults**] from the [**IBP Label Order Setup**] window

14.6.3 Setting Alarm Properties

Select [**Alarm Setup >>**] from the parameter setup menu. You can set alarm properties for this parameter in the popup menu.

14.6.4 Setting the IBP Wave

In the setup menu for the pressure, you can:

- Select [**Sweep**] and then select the appropriate setting. The faster the wave sweeps, the wider the wave is.
- Select [**Scale**] and then select the appropriate setting. If [**Auto**] is selected, the size of the pressure's waveform will be adjusted automatically.
- Select [**Filter**] and then select the desired option.

14.6.5 Changing Averaging Time

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 patient monitor responds to changes in the patient's blood pressure. Contrarily, the longer the averaging time is, the slower the patient monitor responds to changes in the patient's blood pressure, but the measurement accuracy will be improved. For critically ill patients, selecting shorter averaging time will help understanding the patient's state.

To set the averaging time, in the parameter setup menu, select [**Sensitivity**] and toggle between [**High**], [**Med**] and [**Low**], the corresponding averaging time is about 1 s, 8 s and 12 s respectively.

14.6.6 Enabling PPV Measurement and Setting PPV Source

PPV indicates pulse pressure variation. To enable PPV measurement, set [**PPV Measurement**] to [**On**]

You can select PPV source when PPV measurement is enabled.

WARNING

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

NOTE

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

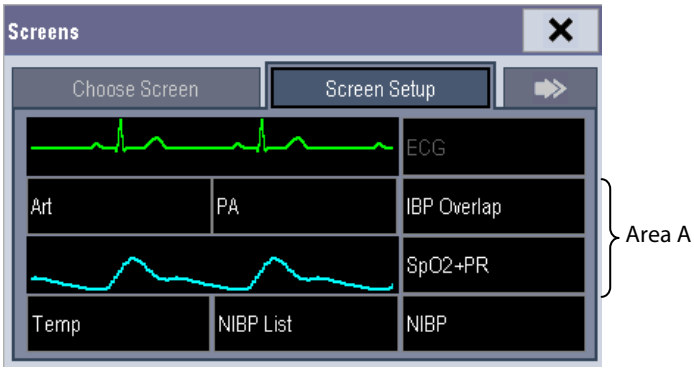
14.6.7 Setting the Pressure Unit

Select [**Unit Setup >>**] from the [**User Maintenance**] menu. In the popup menu, select [**Press. Unit**] and toggle between [**mmHg**] and [**kPa**]. Select [**CVP Unit**] and toggle between [**mmHg**], [**cmH2O**] and [**kPa**].

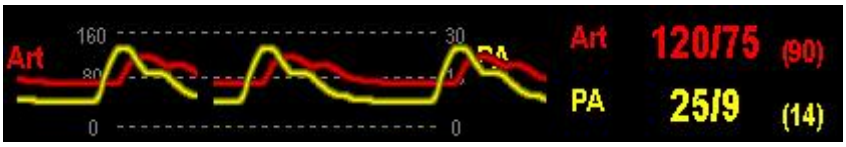
14.7 Overlapping IBP Waveforms

The IBP waveforms can be displayed together. To combine IBP waveforms,

1. Select [**Main Menu**]→[**Screen Setup>>**]→[**Screen Layout>>**] to access the [**screens**] window.
2. Select the [**Screen Setup**] tab.
3. In Area A, select [**IBP Overlap**] from the drop-down list, and then select the IBP waves to be overlapped on the left side of the same line.



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 pops up the [**Overlapping Waveform Setup**] menu, where you can:

- Set [**Left Scale**] and **[Right Scale**] and then set the scales for the overlapped waveforms. The left scale is for Art, LV, Ao, FAP, BAP, UAP, and the arterial waveforms of P1~P4; the right scale is for CVP, ICP, LAP, RAP, UVP, and the venous waveforms of P1~P4.
- Set [**CVP Scale**] individually If CVP waveform is combined and CVP unit is different from IBP unit.
- Set [**PA Scale**] individually if PA waveform is combined.
- Set [**Gridlines**] to [**On**] or [**Off**] to show gridlines or not in the overlapped waveform area.
- Select [**Sweep**] and then set the sweep speed for the overlapped waveforms.
- Select [**Filter**] and then set the filter for the overlapped waveforms.

Note

- **CVP scale is changed together with right scale. The unit of CVP scale is consistent with CVP parameter unit.**

14.8 Measuring PAWP (only available for the external display)

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

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

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

⚠WARNING

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

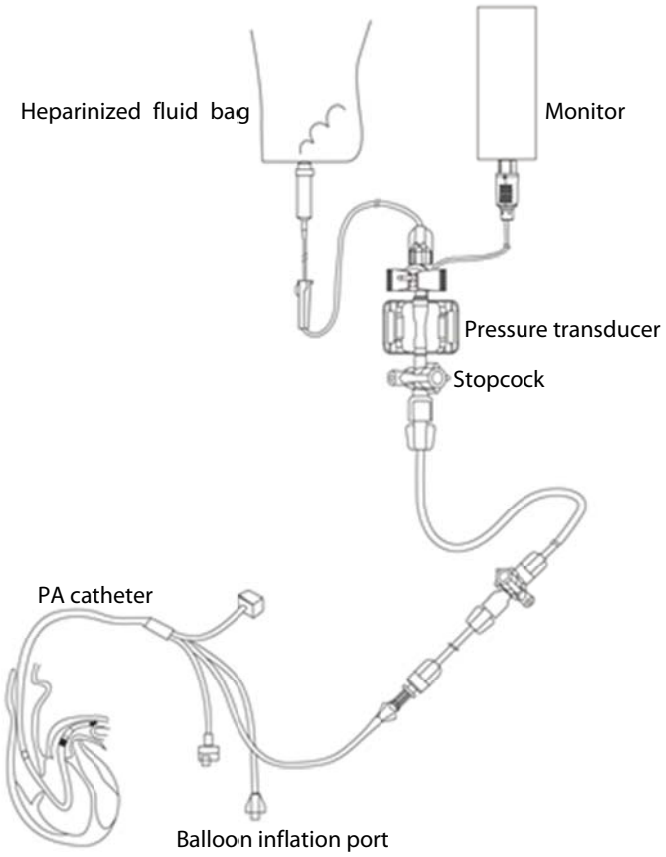
NOTE

- **After entering the PAWP measurement window, the monitor will turn off the PA alarm automatically.**

14.8.1 Preparing to Measure PAWP

1. Connect the catheter and transducer as shown below. Make sure that:

   - The PA catheter is in place in the patient.
   - The IBP transducer is properly connected to the IBP connector on the monitor.

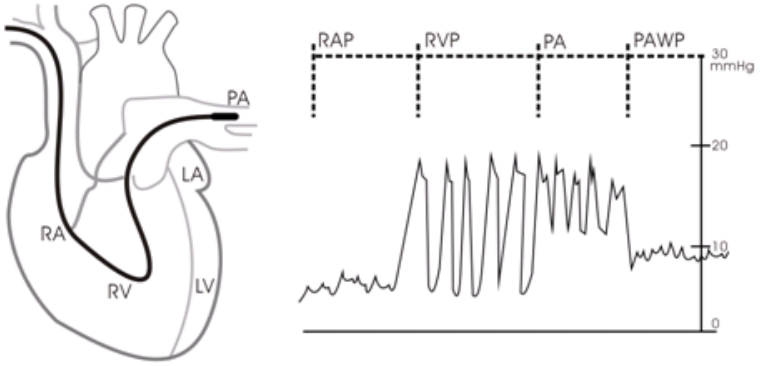


   Since PAWP is measured on PA, selecting [**PA**] as the IBP label is recommended.

2. Select the PA parameter window or waveform area to enter its setup menu. Then, select [**PAWP**] to enter the PAWP measurement window. You can also enter the PAWP measurement window from the P1-P4 parameter window.

14.8.2 Setting Up the PAWP Measurement

1. Select [**Start**] in the PAWP measurement window.
2. Wedge the flotation catheter into the pulmonary artery. When the prompt message [**Ready for balloon inflation**] appears, inflate the balloon and pay attention to PA waveform changes on the screen.



3. When the prompt message [**Ready for balloon deflation**] appears, deflate the balloon. After the measurement finishes, the PAWP value displays under the PA waveform.
4. Select [**Edit**] → [**Confirm**] to save the PAWP value.
5. If you need to start a new measurement, select [**Start**] again.

If the measurement fails or you need to adjust the PAWP value, select [**Edit**] to freeze the waveforms and activate the [**Adjust**] button.

- Select the ▲ or ▼ beside the [**Adjust**] button to adjust the PAWP value.
- Select ◄ or ► beside the [**Adjust**] button to view the frozen waveforms of 40 seconds.
- Select [**Confirm**] 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.**

14.8.3 Understanding the PAWP Setup Menu

Select [**Setup**] to enter the [**PAWP Setup**] menu. In this menu, you can:

- Select a ECG lead wave as the first reference wave.
- Select a respiration wave as the second reference wave.
- Select a sweep speed for the displayed waveform.
- Change the size of the PA waveform by adjusting the scale height.

The setting of the [**Sweep**] and [**PA Scale**] is only applied to waveforms on the PAWP screen.

14.8.4 Performing Hemodynamic Calculation

In the PAWP window, select [Calc.>>] to enter the hemodynamic calculation menu. Refer to ***18.5 Hemodynamic Calculations*** for details.

14.9 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.

CAUTION

- **Never try to disassemble the equipment or supplied accessories. There are no internal user-serviceable parts.**

Symptoms	Possible Cause	Correction Action
Damped invasive waveform	Air bubbles in tubing	Eliminate air from tubing as described in ***14.4 Setting Up the Pressure Measurement.***
	Kinked catheter	Change the position of catheter.
	Blood in tubing	Pressurize the solution bag to 300 mmHg. For details, refer to the instructions for use of the solution bag.
IBP not displayed or no IBP waveform	Improper setup	Check display setup in monitor setup.
	Cable not plugged in	Check that the cables are properly connected.
	Transducer not connected.	Check that the transducer is properly connected.
	Stopcock turned improperly.	Check that the stopcock is turned to the correct position.
	Transducer not zeroed	Check and zero the transducer as described in ***14.3 Zeroing the Transducer***.
Dashes "- -" display in place of numerics.	The measured result is invalid or out of range. IBP might be set to non-pulsatile labels like CVP, LA, RA, and ICP.	Change to a pulsatile label.
Abnormally high or low readings	Transducer too High or too Low.	Adjust the position of the transducer and make sure that it is level with the heart, approximately at the level of the midaxillary line. Zero the transducer as described in ***14.3 Zeroing the Transducer***
Unable to Zero	Stopcock not open to atmosphere.	Check the transducer and make sure the stopcock is turned to the air.
PAWP button disabled	One IBP channel must be labeled PA	Label an IBP channel as PA. (Also Label an IBP channel as P1/P2/P3/P4, it will automatically change to PA)

15 Monitoring Carbon Dioxide

15.1 Introduction

CO_2 monitoring is a continuous, non-invasive technique for determining the concentration of CO_2 in the patient' airway by measuring the absorption of infrared (IR) light of specific wavelengths. The 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 is passed 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.

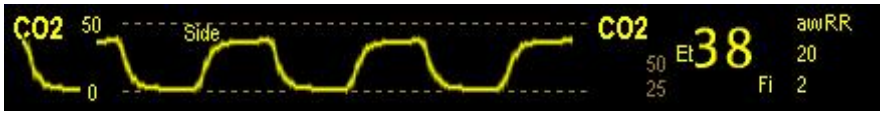
There are two methods for measuring CO_2 in the patient's airway:

- Mainstream measurement uses a CO_2 sensor attached to an airway adapter directly inserted into the patient's breathing system.
- Sidestream/Microstream measurement samples expired patient gas at a constant sample flow from the patient's airway and analyzes it with a CO_2 sensor built into the CO_2 module.

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

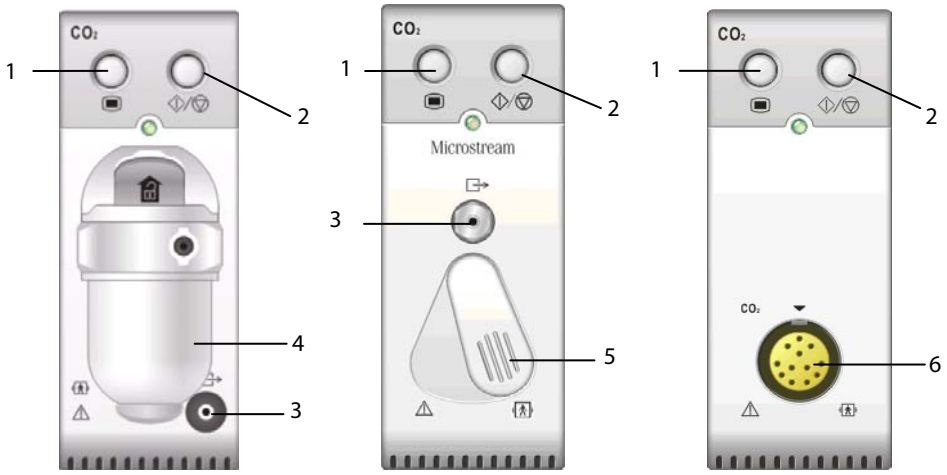
The measurement provides:

1. A CO_2 waveform
2. End tidal CO_2 value ($EtCO_2$): the CO_2 value measured at the end of the expiration phase.
3. Fraction of inspired CO_2 ($FiCO_2$): the smallest CO_2 value measured during inspiration.
4. Airway respiration rate (awRR): the number of breaths per minute, calculated from the CO_2 waveform.



15.2 Identifying CO_2 Modules

This monitor uses an external module to perform CO_2 monitoring. From left to right are sidestream CO_2 module, microstream CO_2 module and mainstream CO_2.



1. Setup key to enter the CO_2 setup menu
2. Measure/standby
3. Gas outlet
4. CO_2 watertrap seat
5. Connector for sampling line
6. Connector for CO_2 transducer

15.3 Preparing to Measure CO2

⚠WARNING

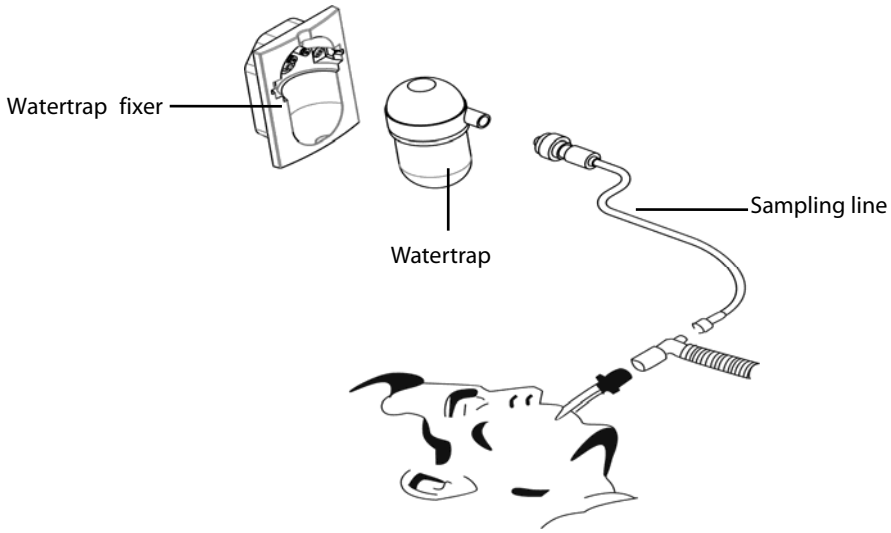
- **Eliminate the exhausted gas before performing the measurement.**
- **Check that the alarm limit settings are appropriate before taking measurement.**

NOTE

- **Perform the measurement in a well-ventilated environment.**

15.3.1 Using a Sidestream CO_2 Module

Attach the watertrap to the module and then connect the CO_2 components as shown below. The message [**CO2 Sensor Warmup**] is displayed. If you perform CO_2 measurements during warm-up, the measurement accuracy may be compromised. After warm-up is finished, you can perform CO_2 measurements.



⚠WARNING

- **Do not apply adult watertrap to the neonate patient. Otherwise, patient injury could result.**

⚠CAUTION

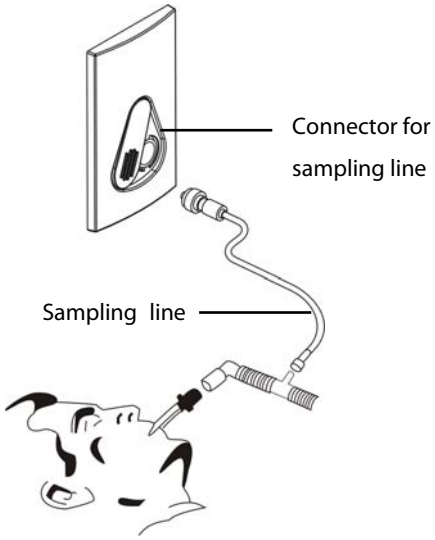
- **The watertrap collects water drops condensed in the sampling line and therefore prevents them from entering the module. If the collected water reaches a certain amount , you should drain it to avoid blocking the airway. Dispose of accumulated fluids in accordance with the hospital policy or your local regulations.**
- **The watertrap has a filter preventing bacterium, water and secretions from entering the module. After a 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. It is recommended to replace the watertrap once a month, or when the watertrap is found leaky, damaged or contaminated.**

NOTE

- **To extend the lifetime of the watertrap and module, disconnect the watertrap and set the operating mode to standby mode when CO_2 monitoring is not required.**

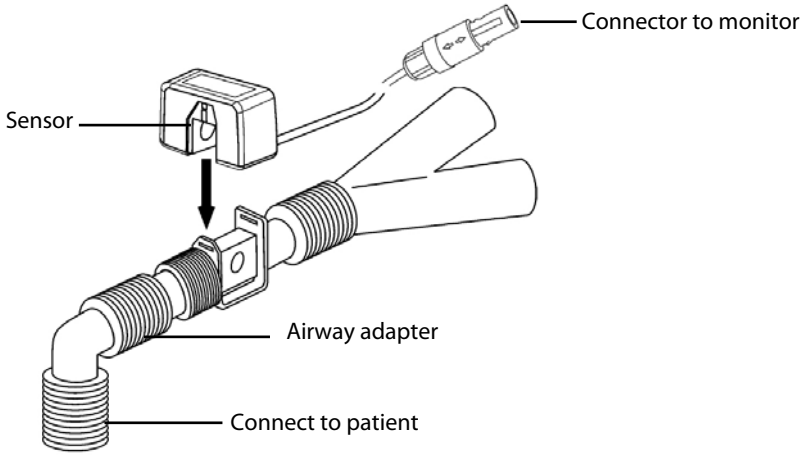
15.3.2 Using a Microstream CO_2 Module

Connect the sampling line to the module and then connect the CO_2 components as shown below. The message [**CO2 Sensor Warmup**] is displayed. After warm-up, you can perform CO_2 measurements. The message [**CO2 Sensor Warmup**] is displayed.



15.3.3 Using a Mainstream CO_2 Module

1. Connect the sensor to the module. The message [**CO2 Sensor Warmup**] is displayed.
2. After warm-up is finished, connect the transducer to the airway adapter.
3. Perform a zero calibration per ***15.9 Zeroing the Sensor***.
4. After the zero calibration is finished, connect the airway as shown below.



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

NOTE

- **Always position the sensor with the adapter in an upright position to avoid collection of fluids on the windows of the adapter. Large concentrations of fluids at this point will obstruct gas analysis.**

15.4 Changing CO_2 Settings

15.4.1 Setting the CO_2 Unit

Select [**Unit Setup >>**] from the [**User Maintenance**] menu. In the popup menu, select [**CO2 Unit**] and toggle between [**mmHg**], [**%**] and [**kPa**].

15.4.2 Accessing CO_2 Menus

By selecting the CO_2 parameter window or waveform, you can access the [**CO2 Setup**] menu.

15.4.3 Setting up Gas Compensations

WARNING

- **Make sure that the appropriate compensations are used. Inappropriate compensations may cause inaccurate measurement values and result in misdiagnosis.**

For the sidestream CO_2 module:

1. Select [**CO2 Setup**].
2. According to the actual condition, set the concentration required for the following compensations:
   - [**O2 Compen**]
   - [**N2O Compen**]
   - [**Des Compen**]

For the mainstream CO_2 module, in the [**CO2 Setup**] menu, respectively select:

- [**Balance Gas**] and toggle between [**Room Air**] and [**N2O**]. Select [**Room Air**] when air predominates in the ventilation gas mixture and select [**N2O**] when N_2O predominates in the ventilation gas mixture and select [**He**] when He predominates in the ventilation gas mixture.
- [**O2 Compen**] and then select [**Off**] or an appropriate setting according to the amount of O_2 in the ventilation gas mixture. When the amount of O_2 is less than 30%, you'd better switch this compensation off.
- [**AG Compen**] and enter the concentration of anesthetic gas present in the ventilation gas mixture. This could compensate for the effect of AG on the readings.

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

15.4.4 Setting up 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).

1. ATPD: $P_{co2}(mmHg) = CO_2(vol\%) \times P_{amb} / 100$
2. BTPS: $P_{CO2}(mmHg) = CO_2(vol\%) \times (P_{amb} - 47) / 100$

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

As the mainstream CO_2 module has a built-in heating component to prevent water vapour from condensing, setting humidity compensation is not needed. 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:

1. In the [**CO2 Setup**] menu, select [**BTPS Compen**].
2. Select either [**On**] for BTPS or [**Off**] for ATPD, depending on which compensation applies.

15.4.5 Setting the Apnea Alarm Delay

In the [**CO2 Setup**] menu, select [**Apnea Delay**] and then select the appropriate setting. The monitor will alarm if the patient has stopped breathing for longer than the preset apnea time. The [**Apnea Delay**] of Resp and CO_2 keeps consistent with each other.

⚠WARNING

- **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.**

15.4.6 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 $FiCO_2$.

In the [**CO2 Setup**] menu, select [**Max Hold**] and toggle between [**Single Breath**], [**10 s**], [**20 s**] and [**30 s**] (for microstream CO_2 module only).

- [**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.

15.4.7 Setting the Flow Rate

For the sidestream CO_2 module, you can change the sampling rate of respiratory gas in the patient's airway by setting the flow rate. To set the flow rate, enter the [**CO2 Setup**] menu and select an appropriate setting from [**Flow Rate**].

⚠WARNING

- **Please consider the patient's actual bearing capability and select the appropriate flow rate when setting the flow rate.**

15.4.8 Setting up the CO_2 Wave

In the [**CO2 Setup**] menu, you can:

- Select [**Wave Type**] and toggle between [**Draw**] and [**Fill**]:
  - [**Draw**]: The CO_2 wave is displayed as a curved line.
  - [**Fill**]: The CO_2 wave is displayed as a filled area.
- Select [**Sweep**] and then select the appropriate setting. The faster the wave sweeps, the wider the wave is.
- Change the size of the CO_2 waveform by adjusting the wave [**Scale**].

15.4.9 Setting RR Source

To set RR source:

1. Enter the [**CO2 Setup**] menu.
2. Select [**RR Source**] and then select a source or [**Auto**] from the dropdown list.

The [**RR Source**] settings of Resp and CO_2, are linked. For details, please refer to ***Setting RR Source of chapter Resp***.

15.4.10 Setting Barometric Pressure Compensation

Both sidestream and microstream CO_2 modules have the function of automatic barometric pressure compensation (the system automatically measures the barometric pressure which the patient monitor is exposed to). 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 as follows:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Module Maintenance >>**]→[**Maintain CO2 >>**]→[**Calibrate CO2 >>**].
2. Select [**Barometric Pressure**] and then enter the value of barometric pressure to which the patient monitor is exposed to.

⚠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.**

15.4.11 Entering the Standby Mode

By default, the CO_2 module is in measure mode. To enter or exit the standby mode manually, select [**Operating Mode**] in the [**CO2 Setup**] menu and then toggle between [**Standby**] and [**Measure**].

The standby mode of the CO_2 module relates to the standby mode of the monitor as follows:

- If the monitor enters the standby mode, the CO2 module will also enter the standby mode.
- If the monitor exits the standby mode, the CO2 module will also exit the standby mode.
- If the CO2 module enters or exits the standby mode, it will not affect the monitor.

When you set the sidestream CO_2 module to the strandby mode, the CO_2 gas sample intake pump automatically sets the sample flow rate to zero. When exiting the standby mode, the CO_2 module continues to work at the preset sample flow rate

For the sidestream CO_2 module, you can set the delay time. After the delay time the CO_2 module enters the standby mode if no breath is detected.

For the microstream CO_2 module, you can also set a period of time after which the CO_2 module enters the standby mode if no breath is detected since the CO_2 module is powered on or the CO_2 module switches to the measuring mode or the automatic standby time is re-set. To set the standby time, in the [**CO2 Setup**] menu, select [**Auto Standby**] and then select the appropriate setting.

15.5 Measurement Limitations

The following factors may influence the accuracy of measurement:

- Leaks or internal venting of sampled gas
- Mechanical shock
- Cyclic pressure up to 10 kPa (100 cmH2O)
- Other sources of interference, if any

Measurement accuracy of the sidestream CO_2 module may be affected by the breath rate and I/E ratio as follow:

- $etCO_2$ is within specification for breath rate ≤ 60 bpm and I/E ratio ≤ 1:1;
- $etCO_2$ is within specification for breath rate ≤ 30 bpm and I/E ratio ≤ 2:1.

Measurement accuracy of the microstream CO_2 module may be affected by the breath rate as follows:

- $EtCO_2$ value is within specification for breath rate ≤ 80 rpm.
- $EtCO_2$ accuracy is 4 mmHg or ±12% of the reading, whichever is greater, for breath rate > 80 rpm and $EtCO_2$ > 18 mmHg.

15.6 Leakage test

When the modules need maintenance, the monitor will prompt on the CO_2 waveform window: [**Need maintenance. Enter CO2 setup menu.**] Then, select [**User Maintenance >>**]→ [**Module Maintenance >>**]→ [**Maintain CO2 >>**], and perform leakage test according to the prompt messages on the menu.

15.7 Troubleshooting the Sidestream CO_2 Sampling System

When the sampling system of the sidestream CO_2 module works incorrectly, check if the sampling line is kinked. If not, remove it from the watertrap. If the monitor gives a message indicating the airway still works incorrectly, it indicates that the watertrap must have been blocked, and you should replace with a new one. Otherwise, you can determine that the sampling line must have been blocked. Replace with a new sampling line.

15.8 Removing Exhaust Gases from the System

⚠WARNING

- **When using the Sidestream or Microstream CO_2 measurement on patients who are receiving or have recently received anesthetics, connect the outlet to a scavenging system to avoid exposing medical staff to anesthetics.**

To remove the sample gas to a scavenging system, connect an exhaust tube to the gas outlet connector of the module.

15.9 Zeroing the Sensor

The zero calibration eliminates the effect of baseline drift during CO_2 measurement exerted on the readings and therefore maintains the accuracy of the CO_2 measurements.

15.9.1 For Sidestream and Microstream CO_2 Modules

For sidestream and microstream CO_2 modules, a zero calibration is carried out automatically when necessary. You can also start a manual zero calibration if necessary. To manually start a zero calibration, from the [**User Maintenance**] menu, select [**Module Maintenance >>**]→ [**Maintain CO2 >>**]→ [**Calibrate CO2 >>**]→[**Start Zero Cal.**]. Disconnecting the patient airway is not required when performing a zero calibration.

15.9.2 For Mainstream CO_2 Modules

For mainstream CO_2 modules, zero the sensor whenever:

- A new adapter is used;
- You reconnect the sensor to the module;
- You see the message [**CO2 Zero Required**]. 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 Setup**] menu, set the [**Operating Mode**] to [**Measure**]. The message [**CO2 Sensor Warmup**] is displayed.
3. 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.

4. Select [**Start Zero Cal.**] in the [**CO2 Setup**] menu. The message [**CO2 Zero Running**] is displayed.
5. Zero calibration 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 transducer from the patient's airway first.**
- **Please do not rely on the readings during zeroing.**

15.10 Calibrating the Sensor

For sidestream or microstream CO_2 modules, a calibration should be performed once every year or when the readings go far beyond the range. For mainstream CO_2 modules, no calibration is required. For details, refer to ***23 Maintenance***.

15.11 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

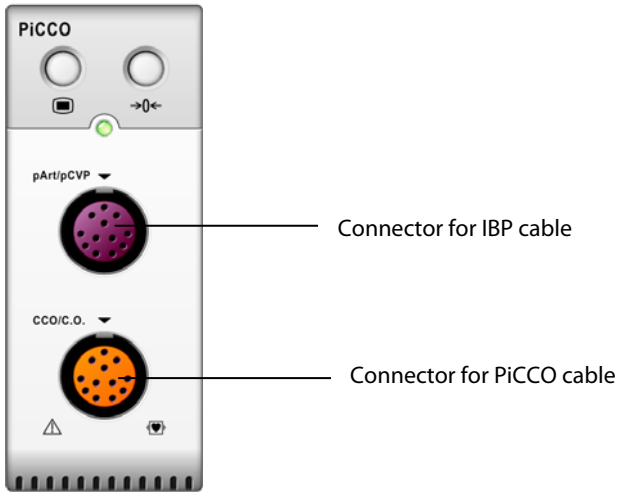
Possession or purchase of this device does not convey any express or implied license to use the device with unauthorized CO_2 sampling consumables which would, alone, or in combination with this device, fall within the scope of one or more of the patents relating to this device and/or CO_2 sampling consumable.

16 Monitoring CCO

16.1 Introduction

The monitor uses PiCCO method to perform CCO monitoring.

The PiCCO method combines transpulmonary thermodilution and pulse contour analysis on the blood pressure waveform. A cold bolus (e.g. normal saline 0.9%) with a known volume and temperature is injected into the right atrium through a central venous catheter. The cold bolus mixes with the blood in the heart and the change in blood temperature is measured with a thermistor at the distal end of the arterial thermodilution catheter placed in one of the bigger systemic arteries, for example, the femoral artery. The monitor uses the transpulmonary thermodilution method to measure C.O., GEDV (Global End Diastolic Volume) and EVLW (Extra Vascular Lung Water). With the C.O. value measured with the transpulmonary thermodilution method and the result of the pulse contour analysis, a patient-specific calibration factor is calculated. The monitor uses this value to compute CCO and the other continuous hemodynamic parameters.



16.2 Safety Information

⚠ WARNING

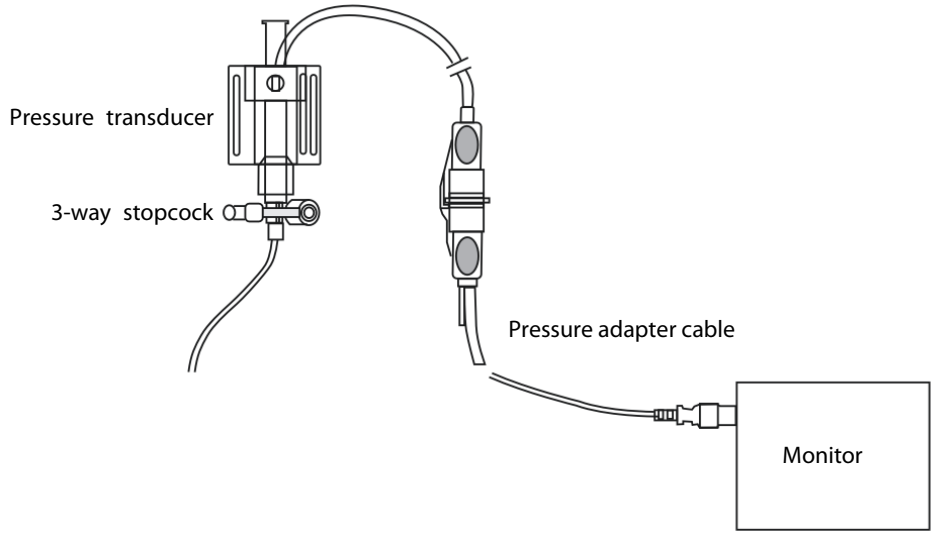
- **CCO monitoring is restricted to adult and pediatric patients.**
- **Use only pressure transducers specified in this manual. Never reuse disposable pressure transducers.**
- **Make sure that the applied parts never contact other conductive parts.**
- **To reduce the hazard of burns during high-frequency 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 details, refer to instructions for use of accessories.**

16.3 Zeroing the Transducer

To avoid inaccurate pressure readings, the monitor requires a valid zeroing. Zero the transducer in accordance with your hospital policy (at least once per shift). Zero whenever:

- A new transducer or adapter cable is used.
- You reconnect the transducer cable to the monitor.
- The monitor restarts.
- You doubt the readings.

1. Turn off the stopcock to the patient.

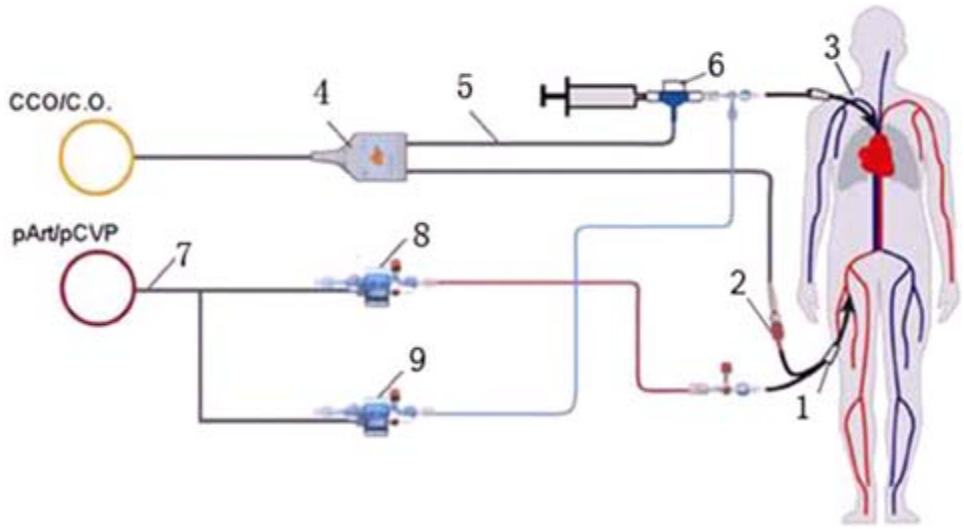


2. Vent the transducer to the atmospheric pressure by turning on the stopcock to the air.
3. In the [**pArt Setup**] menu, select [**pArt Zero >>**]→[**Zero**].

   During zero calibration, the [**Zero**] button appears dimmed. It recovers after the zero calibration is completed.
4. If [**pCVP Measure**] is set to [**Auto**], zeroing pCVP is also a must. To zero pCVP, enter the [**pCVP Setup**] menu, select [**pCVP Zero >>**]→[**Zero**].
5. After the zero calibration is completed, close the stopcock to the air and open the stopcock to the patient.

16.4 Preparation for CCO Monitoring

Please refer to the following figure and procedure to set up the CCO monitoring:



1. Arterial thermodilution catheter
2. Blood temperature sensor
3. Central venous catheter
4. PiCCO cable
5. Injectate temperature sensor cable
6. Injectate temperature sensor
7. IBP cable
8. Arterial pressure transducer
9. CVP transducer

1. Place the arterial thermodilution catheter.

⚠WARNING

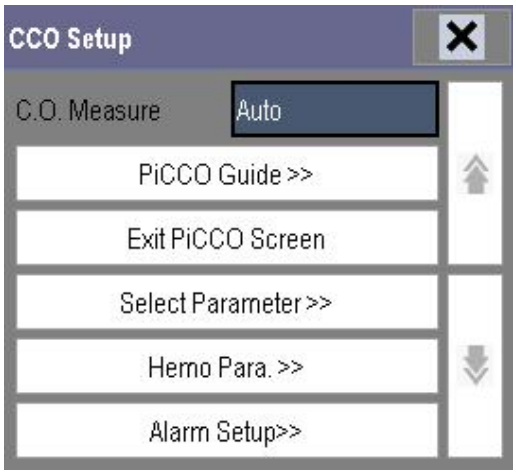
- **The arterial thermodilution catheter must be placed in one of the bigger systemic arteries, for example, the femoral, the brachial or the axillary artery.**
- **You must use the approved catheters and puncture locations.**

2. Place the central venous catheter.
3. Connect the injectate temperature sensor to the central venous catheter.
4. Plug the PiCCO cable into the CCO/C.O. connector on the PiCCO module, and connect the following devices to the PiCCO cable:
   - ◆ Injectate temperature sensor probe
   - ◆ Blood temperature sensor connector.
5. Connect one end of the arterial pressure transducer to the arterial thermodilution catheter and the other end to the IBP cable marked with pArt.

⚠WARNING

- **If air bubbles appear in the tubing system, flush the system with the infusion solution again. Air bubble may lead to wrong pressure reading.**

6. Connect one end of the CVP transducer to the central venous catheter and the other end to the IBP cable marked with pCVP (neglect this procedure if CVP measurement is not performed). Then plug the IBP cable to the pArt/pCVP connector on the PiCCO module.
7. Access the [**CCO Setup**] menu by
   - ◆ selecting [**Main Menu**]→[**Parameters>>**]→[**CCO Setup>>**], or
   - ◆ selecting [**Setup>>**] in the CCO screen.



8. Set up the patient information in by selecting [**PiCCO Guide>>**] in the [**CCO Setup**] menu.

NOTE

- **Correct input of height, weight, category and gender is mandatory for the accuracy of the displayed parameters as well as for the correct indexing of some parameters.**
- **Input a proper pCVP value if CVP is not measured. The system adopts 5mmHg by default if the pCVP value is neither measured nor input manually.**

9. Check that the correct arterial catheter constant is displayed at [**Cat.Type**] in the [**PiCCO Guide>>**] menu. The monitor can recognize the arterial catheter automatically when the PiCCO cable is connected to the CCO/C.O. connector.

NOTE

- **If the catheter constant is not recognized, enter the correct value for the catheter in the [**Cat.Type**] edit box. The catheter constant is usually written either on the catheter or on the catheter packaging.**

10. Enter the [**PiCCO Guide>>**] menu to select the injectate volume. If the injectate volume is not selected, the system sets the volume by default, which is 15ml for adult and 10 ml for pediatric. The following table displays the recommended injectate volume depending on body weight and ELWI (Extravascular Lung Water Index):

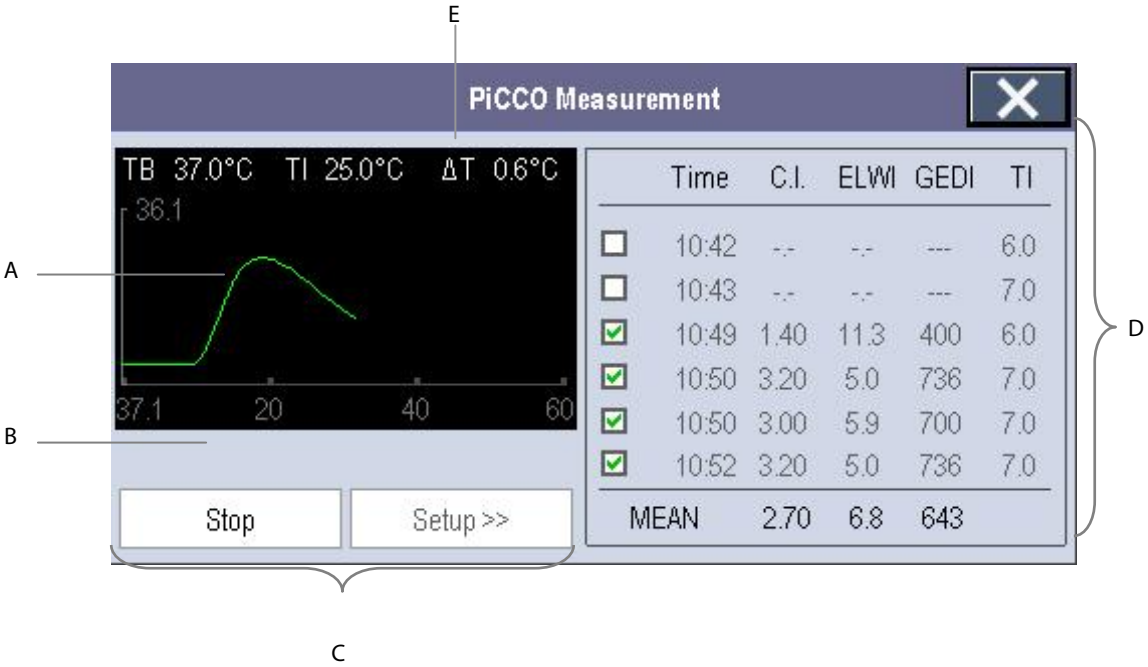
	ELWI < 10	ELWI > 10	ELWI < 10
Patient Weight (kg)	**Iced Injectate**	**Iced Injectate**	**Room Temperature Injectate**
<3	2ml	2ml	3ml
<10	2ml	3ml	3ml
<25	3ml	5ml	5ml
<50	5ml	10ml	10ml
<100	10ml	15ml	15ml
≥100	15ml	20ml	20ml

11. Set up the C.O. measure mode by selecting [**C.O. Measure**] from the [**CCO Setup**] menu, and toggling between [**Auto**] and [**Manual**].
    - If you select [**Manual**], you should start each measurement manually by pressing the [**Start**] key in the [**PiCCO Measurement**].
    - If you select [**Auto**], the C.O. measurements can be performed consecutively, without the need for pressing the [**Start**] key.

16.5 Performing CCO Monitoring and CCO Calibration

Please perform CCO monitoring according to the following procedure:

1. Enter the [**PiCCO Measurement**] window.



A. Thermodilution curve

B. Prompt message area

C. Buttons

D. History window

E. Measurement quality: △T

2. Select the [**Start**] button and inject the bolus rapidly (<7sec) and smoothly as soon as the message [**Inject xx ml!**] and prompt tone appear.

   As shown in the figure above, during the measurement, the currently measured thermodilution curve is displayed. At the end of the measurement, the measured values are displayed in the history window and the monitor prompts you to wait for a certain period of time before starting a new measurement. The △T value should be greater than 0.15°C to ensure high accuracy. A low △T can be caused by a very high ELWI or an extreme low CI. If △T is too low, you can try to increase it by

   - Injecting more volume (remember to reenter the injectate volume in [**PiCCO Guide>>**] menu before injecting).
   - Injecting colder bolus.
   - Injecting the bolus in a shorter time.

3. Perform 3 to 5 single measurements direct after each other within a maximum of 10 minutes as described in Step 2. A new measurement is available when you see the blood temperature is steady in the [**PiCCO Measurement**] window.

   - If you've selected [**Manual**] measure in the [**PiCCO Guide>>**] menu, you should repeat Step 2 manually.
   - If you've selected [**Auto**] measure in the [**PiCCO Guide>>**] menu, the C.O. measurements can be performed consecutively, without the need for pressing the [**Start**] button between measurements. A new thermodilution measurement is possible as soon as [**Inject xx ml!**] is displayed on the screen. The patient monitor automatically detects further thermodilution measurements.

A maximum of 6 measurements can be stored. If you perform more than six measurements without rejecting any, the oldest will be automatically deleted when a seventh curve is stored. Select the measurement values and the system will automatically perform calibration and calculate the averaged CCO and CCI values.

⚠ CAUTION

- **Three to five single thermodilution measurements within 10 minutes are recommended. For a stable patient it is recommended to perform a thermodilution measurement every 8 hours. For an unstable patient it may be necessary to perform thermodilution measurements more frequently in order to determine the patient's volume status and to recalibrate the continuous determination of C.O.**
- **As the pulse contour cardiac output of children has not been sufficiently validated thus far, the C.O. should be checked by thermodilution before therapeutic interventions.**
- **If the system can not get a reliable pArt value during a C.O. measure, the corresponding C.O. value is invalid for CCO calibration.**
- **Recalibration is recommended with significant changes in hemodynamic conditions, such as volume shifts or changes to medication.**
- **If the option of the auto pCVP measurement is not used, pCVP should be updated as soon as a new value is obtained to accurately calculate SVR and CCO.**
- **If the displayed continuous parameters are not plausible, they should be checked by a thermodilution measurement. The CCO measurement will be recalibrated automatically.**
- **Faulty measurements can be caused by incorrectly placed catheters, interfering signal transmission e.g. of arterial pressure, defective connections or sensors, or by electromagnetic interference (e.g. electric blankets, electric coagulation).**
- **Aortic aneurysms may cause the displayed blood volume (GEDV/ITBV) derived by thermodilution measurement to be erroneously high if the arterial thermodilution catheter is placed in the femoral artery.**

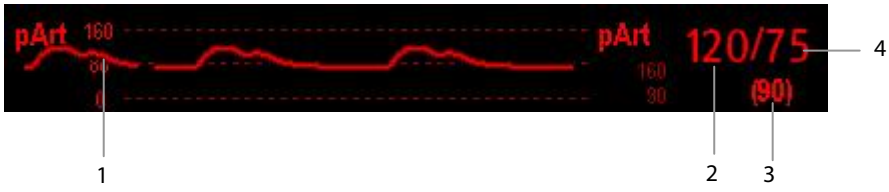
16.6 Understanding the Displayed CCO Parameters

16.6.1 Understanding the CCO Display

1. Prompt message area
2. Label and value for main parameter
3. Labels and values for secondary parameters

16.6.2 Understanding the pArt Display

The artery pressure is displayed on the monitor as a waveform and numeric pressures. The figure below shows the pArt waveform and numerics.



1. Waveform
2. Systolic pressure
3. Mean pressure
4. Diastolic pressure

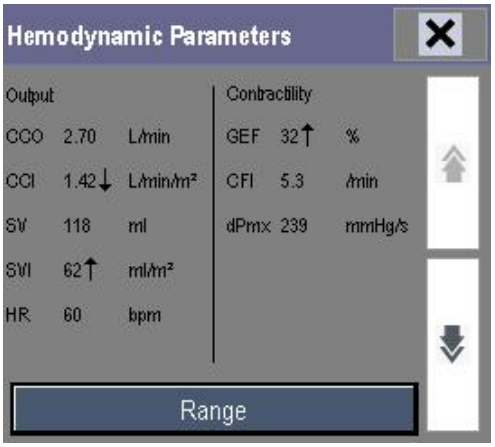
16.6.3 Understanding the pCVP Display

The central venous pressure is displayed on the monitor as a waveform and numeric pressures. The figure below shows the pCVP waveform and numerics.

1. Waveform
2. Central venous pressure

16.7 Hemodynamic Parameters

You can enter the [Hemodynamic Parameters] menu by accessing the [**CCO Setup**] menu and selecting [**Hemo Para.>>**].



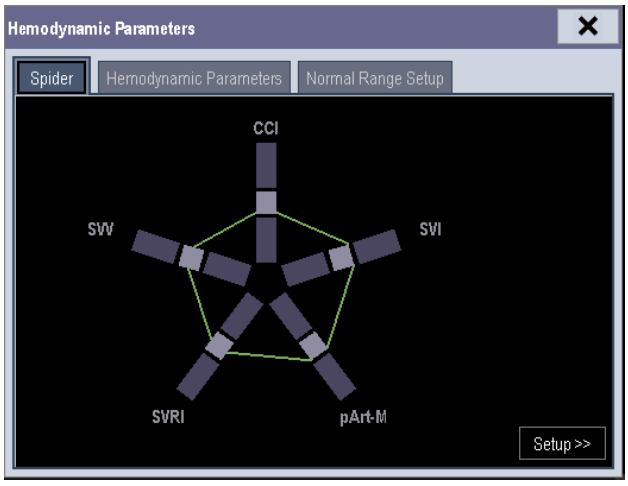
16.8 Hemodynamic Parameters(only available for the external display)

16.8.1 Spider Vision

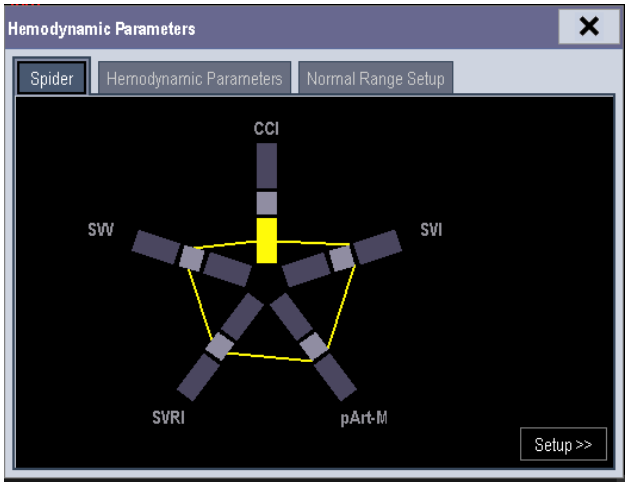
16.8.1.1 Spider Vision Diagram

The spider vision diagram shows all continuous parameters in dynamic conjunction.

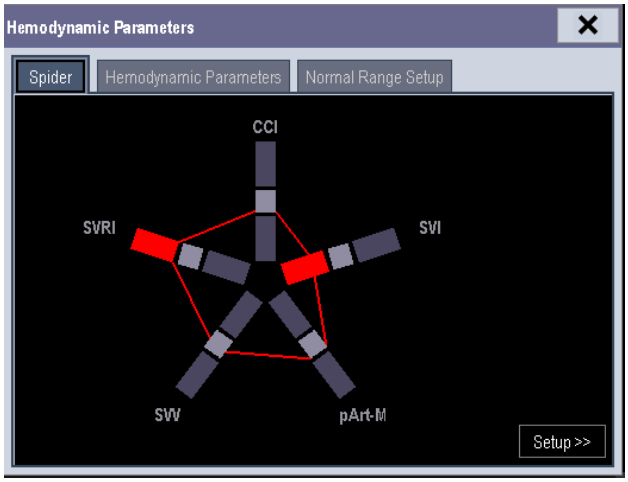
Each spider leg is divided into 3 segments indicating different value ranges for the respective parameters. The segment in the middle indicates the normal range for the respective parameter. The outer segment will be highlighted when corresponding parameter value exceeds the upper limit. The inner segment will be highlighted when its corresponding parameter value exceeds the lower limit.



The diagram is displayed GREEN when all displayed parameters are within the normal range.



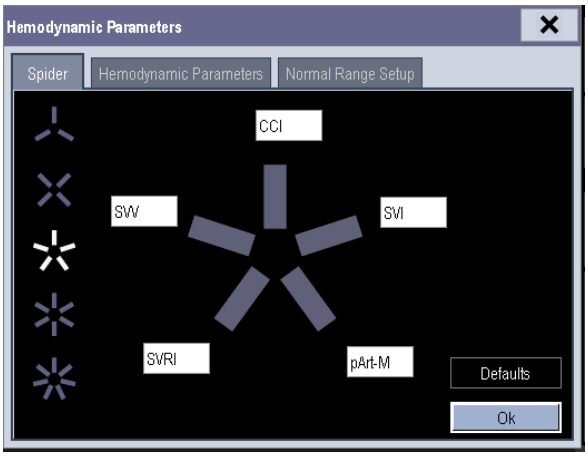
The diagram is displayed YELLOW immediately when one of the displayed parameters goes outside the normal range.



The diagram appears RED when two or more displayed parameters are outside the normal range.

The parameter whose default normal range is changed will be marked with the symbol  .

16.8.1.2 Spider Configuration

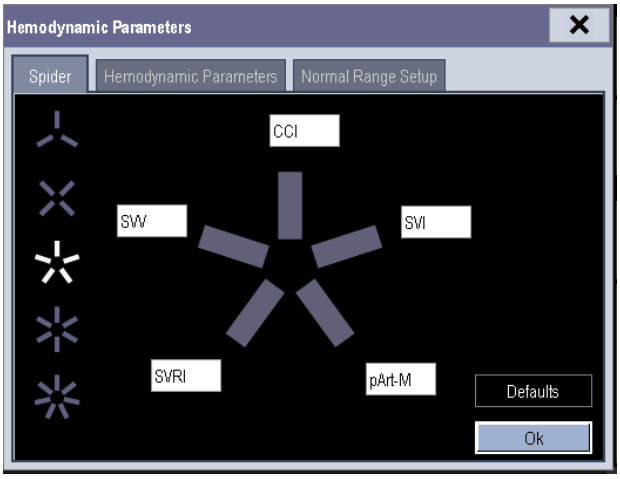


The spider vision diagram can be configured individually. You can select [**Setup>>**] in the spider vision screen and set the diagram by the following procedure:

1. Select the number of spider legs (3to7).
2. Select the parameter to be displayed.

16.8.2 Hemodynamic Parameters

Select [**Hemodynamic Parameters**] tab from the [**Hemodynamic Parameters**] menu to view the patient's hemodynamic parameters. In the [**Hemodynamic Parameters**] menu, you can select [**Range**] to view the referential normal range of each parameter. If a parameter value exceeds its normal range, the system will add a "↑" or "↓" to the right of the parameter.



	Abbreviation	Full Spelling	Unit	Default Normal Range
Output	CCO	Continuous Cardiac Output	L/min	/
	CCI	Continuous Cardiac Index	L/min/m^2	3.0-5.0
	SV	Stroke Volume	ml	/
	SVI	Stroke Volume Index	ml/m^2	40-60
	HR	Heart Rate	bpm	60-80
Contractility	GEF	Global Ejection Fraction	%	25-35
	CFI	Cardiac Function Index	1L/min	4.5-6.5
	dPmx	Left Ventricular Contractility	mmHg/s	/
Preload Volume	GEDV	Global End Diastolic Volume	ml	/
	GEDI	Global End Diastolic Volume Index	ml/m^2	680-800
	ITBV	Intrathoracic Blood Volume	ml	/
	ITBI	Intrathoracic Blood Volume Index	ml/m^2	850-1000
	SVV	Stroke Volume Variation	%	0-10
	PPV	Pulse Pressure Variation	%	0-10
Afterload	SVR	Systemic Vascular Resistance	DS/cm^5 or kPa-s/l	/
	SVRI	Systemic Vascular Resistance Index	DS·m^2/cm^5 or kPa-s-m^2/l	1700-2400
	pArt-M	Mean Artery Pressure	mmHg/kPa or cmH_2O	70-90
	pArt-D	Diastolic Artery Pressure	mmHg/kPa or cmH_2O	60-80
	pArt-S	Systolic Artery Pressure	mmHg/kPa or cmH_2O	100-140
Organ Function	EVLW	Extravascular Lung Water	ml	/

	Abbreviation	Full Spelling	Unit	Default Normal Range
	ELWI	Extravascular Lung Water Index	ml/kg	3.0-7.0
	CPO	Cardiac Power Output	W	/
	CPI	Cardiac Power Index	W/ m^2	0.5-0.7
	PVPI	Pulmonary Vascular Permeability Index	no unit	1.0-3.0
	TB	Blood Temperature	ºC	/

16.9 Changing CCO Settings

16.9.1 Selecting the Displayed Parameters

Select [**Select Parameter>>**] from the [**CCO Setup**] menu. In the pop-up menu, select the parameters to be displayed.

16.9.2 Selecting Alarm Properties

Select [**Alarm Setup >>**] from the [**CCO Setup**] menu to set the alarm properties for the relevant parameters.

FOR YOUR NOTES

17 Review

17.1 Accessing Respective Review Windows

Select [**Main Menu**]→[**Review >>**]. Then select [**Graphic Trends**], [**Tabular Trends**], [**Events**], or [**Full Disclosure**] to access their respective review windows.

17.2 Reviewing Graphic Trends

In the [**Review**] menu, select [**Graphic Trends**] to access the following window.

1. Event mark area 2. Time axis 3. Graphic trends area
4. Parameter area 5. Cursor

Events are marked with colors in the event mark area. Red represents high level alarm event. Yellow represents medium/low level alarm event. Green represents manual event.

In this review window:

- Select a parameter scale in the graphic trends area to enter the corresponding scale menu. You can set the [**Upper Scale**] or [**Lower Scale**] of Resp, ECG, SpO_2, Temp, IBP, or NIBP when [**Auto Scale**] is [**Off**].
- Select [**Trend Group**] and you can select a trend group for viewing in the popup menu. If [**Custom 1**] or [**Custom 2**] is selected, you can further select [**Define Trend Group**]. Then you can select the parameters for viewing in the popup menu.
- You can set the time length of the review window by selecting [**Zoom**].
- You can set the number of waves displayed in one page by selecting [**Waves**].
- To browse the graphic trends, select or to move the cursor one page to the left or right to navigate through the graphic trends.

A time indicating your current position is displayed above the parameter area. Numeric measurement values corresponding to the cursor location change as the cursor is moved. The measurement value that triggered high level alarm has red background. The one that triggered medium/low level alarm has yellow background.

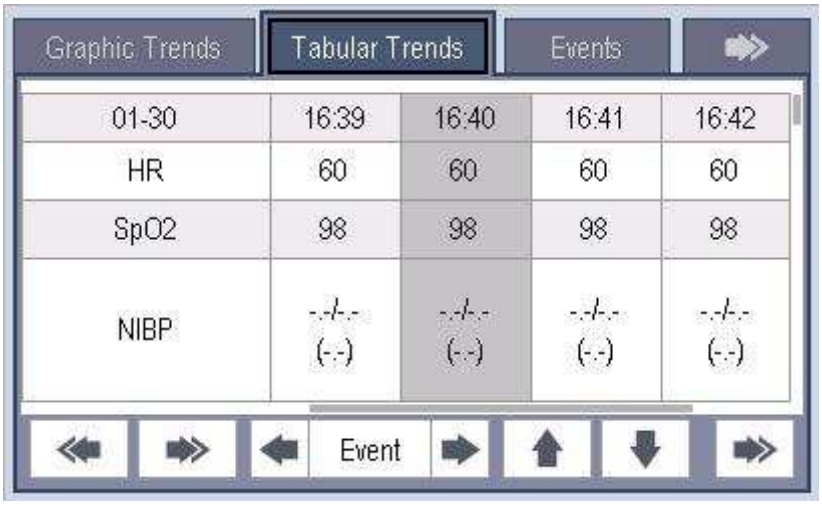
- By selecting or beside [**Event**], you can position the cursor to different event time.
- By selecting the [**Print**] button, you can set and print out the graphic trends report by the printer. For how to set the graphic trends report, please refer to ***19 Printing***.

NOTE

- **The scales of the graphic trends restore to auto adjustment when you discharge a patient, change a unit or restart the monitor.**
- **Only the scales of Resp, ECG, SpO_2, Temp, IBP and NIBP support manual adjustment.**

17.3 Reviewing Tabular Trends

In the [**Review**] menu, select [**Tabular Trends**] to access the following window.



Events are marked with colors in window's top area. Red represents high level alarm event. Yellow represents medium/low level alarm event. Green represents manual event.
In this review window:

- Select [**Trend Group**] and you can select a trend group for viewing in the popup menu. If [**Custom 1**] or [**Custom 2**] is selected, you can further select [**Define Trend Group**]. Then you can select the parameters for viewing in the popup menu.
- You can change the resolution of the trend data by selecting [**Interval**] and then selecting the appropriate setting:
  - [**5 s**] or [**30 s**]: select to view up to 4 hours of tabular trends at 5- or 30-second resolution.
  - [**1 min**], [**5 min**], [**10 min**], [**15 min**], [**30 min**], [**1 h**], [**2 h**] or [**3 h**]: select to view up to 120 hours of tabular trends at your selected resolution.
  - [**NIBP**]: select to view the tabular trends when NIBP measurements were acquired.

- To browse the tabular trends, you can select  or  to scroll left or right to navigate through the trend database. The measurement value that triggered high level alarm has red background. The one that triggered medium/low level alarm has yellow background.
- By selecting  or  beside [**Event**], you can position the cursor to different event time.
- By selecting the [**Print**] button, you can set and print out the tabular trends report by the printer. For how to set the tabular trends report, please refer to the ***Print*** chapter.

17.4 Reviewing Events

17.4.1 Marking Events

During patient monitoring, some events may exert effects on the patient and as a result change the waveforms or numerics displayed on the monitor. To help analysing the waveforms or numerics at that time, you can mark these events.

Select [**Main Menu**]→[**Mark Event >>**]. In the popup menu, you can select the waves to be stored when a manual event is triggered. You can select [**Trigger Manual Event**] from the [**Mark Event**] menu or the [**Manual Event**] from the [**Main Menu**] to trigger a manual event and store it at the same time.

When you are reviewing graphic trends, tabular trends or full-disclosure waveforms, the manual event symbol is displayed at the time the event is triggered.

17.4.2 Reviewing Events

The monitor saves the events in real time. You can review these events.

In the [**Review**] menu, select [**Events**] to access the following window. The events that can be reviewed include parameter alarm events, arrhythmia alarm events and manual events. When an event occurs, all the measurement numerics at the event trigger time and related waveforms 4 seconds, 8 seconds, or 16 seconds, as per the setting of recording length, respectively before and after the event trigger time are stored.

In this window:

- You can view the desired events by selecting [**Event**].
- You can view the desired events according to the alarm priority by selecting [**Level**].

After selecting the desired event, you can select [**Details**] to access the following window. In this window, the waveform area displays the waveforms related to the event, and the parameter area displays the parameter values happened at the event trigger time.

NOTE

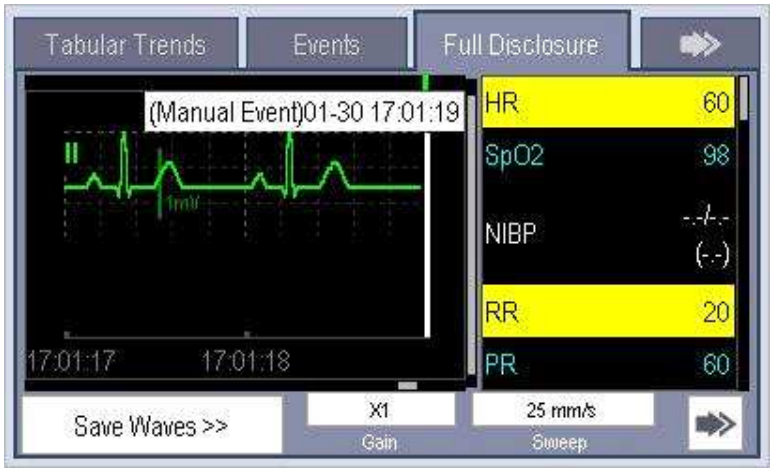
- **Pausing or switching off alarms will not be recorded as events. The time of these operations will not be recorded in the system log.**
- **Earlier-recorded events might be overwritten by later ones if it reaches capacity.**
- **A total loss of power has no impact on the saved events.**

In this window:

- You can select ◄ or ► to navigate through the waveforms.
- You can select ◄ or ► beside the [**Event**] button to switch between events.
- You can set the desired [**Gain**] for ECG waveform.
- You can set the desired [**Sweep**].
- By selecting the [**Events List**] button, you can view the events list.
- By selecting the [**Print**] button, you can print out the currently displayed alarm events by the printer.

17.5 Reviewing Waveforms

In the [**Review**] menu, select [**Full Disclosure**] to access the following window.

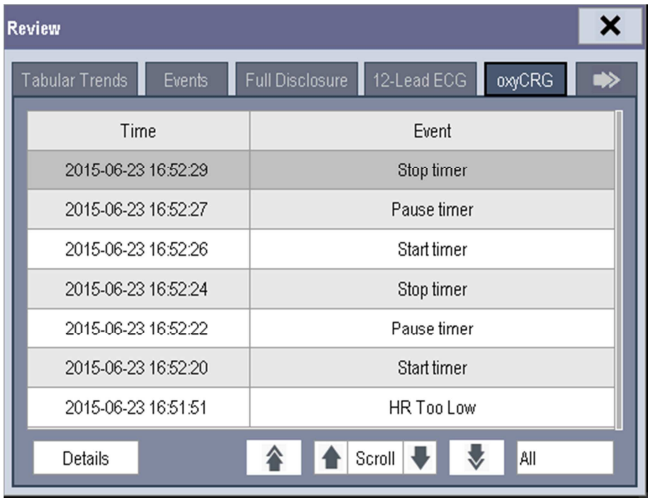


To review full-disclosure waveforms, you need to save waveforms first. Select [**Save Waves >>**] and then select the parameters whose waveforms you want to view.

To save full-disclosure waveform, your monitor must be equipped with a SD storage card.

17.6 Reviewing OxyCRG（only available for the external display）

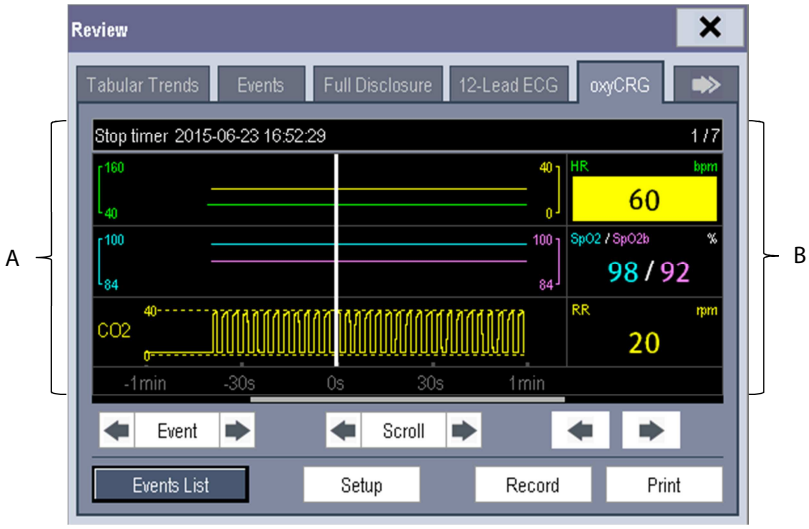
In the [**Review**] menu, select [**OxyCRG**] tab to access the following window.



In this window:

- Select [**Details**] to view the trends, waveform and measurement numerics of selected parameters.
- Select ▲ or ▼ beside the [**Scroll**] button to switch between events.
- Select ⇑ or ⇓ to switch between pages.
- Select the button at the lower right corner of this window to change the parameter events to be displayed.

After selecting the [**Details**] button, you can access the following window. In this window, the waveform area displays the trends and waveform of the OxyCRG, and the parameter area displays the parameter values happened at the event trigger time.



A. Waveform area B. Parameter area

In this window:

- Select [**Events List**] to switch to the OxyCRG events list.
- Select [**Setup**] to change the displayed parameters.
- Select ◀ or ▶ beside the [**Event**] button, you can position the cursor between events.
- Select ◀ or ▶ beside the [**Scroll**] button to move the cursor one step left or right to navigate through the trends and waveform.
- Select ◀ or ▶ to navigate through the parameter trends and waveform.
- Select the [**Record**] button to print out the currently displayed trends, waveform, and measurement numerics by the recorder.
- Select the [**Print**] button to print to the independent printer.

NOTE

- **Pausing or switching off alarms will not be recorded as events. The time of these operations will not be recorded in the system log.**
- **Earlier-recorded OxyCRG events might be overwritten by later ones if it reaches capacity.**
- **A total loss of power has no impact on the saved events.**

18 Calculations

18.1 Introduction

The calculation feature is available with your patient monitor. The calculated values, which are not directly measured, are computed based on the values you provide.

Your can perform the following calculations:

- Dose calculations
- Oxygenation calculations
- Ventilation calculations
- Hemodynamic calculations
- Renal calculations

To perform a calculation, select [**Main Menu**] → [**Calc >>**], or the [**Calculations**] QuickKey and then select the calculation you want to perform.

NOTE

- **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 monitoring by the local patient monitor.**

⚠ WARNING

- **After the calculation is finished, verify 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.**

18.2 Dose Calculations

18.2.1 Performing Calculations

To perform a dose calculation:

1. Select [**Main Menu**]→[**Calculations >>**]→[**Dose >>**], or select [**Calculations**] QuickKey→[**Dose >>**].
2. Select, in turn, [**Patient Cat.**] and [**Drug Name**] and then select the appropriate settings. The dose calculation program has a library of commonly used drugs, of which Drug A through Drug E are for those not specified in this library.

   - Drug A, B, C, D, E
   - Aminophylline
   - Dobutamine
   - Dopamine
   - Epinephrine
   - Heparin
   - Isuprel
   - Lidocaine
   - Nipride
   - NItroglycerin
   - Pitocin

3. The system gives a set of default values when the above steps are finished. However, these values cannot be used as the calculated values. The user must enter values following the doctor's instructions, and then the calculated values can only be used
4. Enter the patient's weight.
5. Enter other values.
6. Verify if the calculated values are correct.

18.2.2 Selecting the Proper Drug Unit

Each drug has its fixed unit or unit series. Among a unit series, one unit may change to another automatically depending on the entered value.

The units for each drug are as follows:

- Drug A, B, C, Aminophylline, Dobutamine, Dopamine, Epinephrine, Isuprel, Lidocaine, Nipride and NItroglycerin use the unit series: g, mg and mcg.
- Drug D, Heparin and Pitocin use the unit series: Unit, KU (kilo units) and MU (million units).
- Drug E uses the unit: mEq (milli-equivalents).

You must select the proper drug name (A, B, C, D or E) according to the units when you define a drug not listed in this library.

NOTE

- **For neonate patients, [Drip Rate] and [Drop Size] are disabled.**

18.2.3 Titration Table

To open the titration table, select [**Titration Table >>**] in the [**Dose Calculation**] window after the dose calculation is finished.

In the titration table, when you change:

- [**Reference**]
- [**Interval**]
- [**Dose Type**]

The titrated values change accordingly.

You can also:

- Select or , or or beside the vertical scrollbar to view more values.
- Select [**Record**] to print out the currently displayed titrated values by the recorder.

18.2.4 Drug Calculation Formulas

Abbreviation	Unit	Formula
Conc.	g/ml, unit/ml or mEq/ml	Amount / Volume
Dose	Dose/hr, Dose/kg/min	Rate × Conc.
Volume	ml	Rate × Duration
Amount	g, unit, mEq	Rate × Duration
Duration	h	Amount/Dose
Drip Rate	gtt/min	INF Rate × Drop Size / 60

18.3 Oxygenation Calculations

18.3.1 Performing Calculations

To perform an oxygenation calculation:

1. Select [**Main Menu**]→[**Calculations >>**]→[**Oxygenation >>**], or select [**Calculations**] QuickKey→ [**Oxygenation >>**].
2. Enter values for calculation.
3. Select the [**Calculate**] button. The system performs a calculation per the current settings and displays the calculated values.
   - ◆ If a calculated value is outside the range, its background will highlight in yellow. You can select [**Range**] to view its normal range in the unit field.
   - ◆ Invalid values are displayed as [**---**].

In the [**Oxygenation Calculation**] window, you can:

- Change the pressure unit, Hb unit and oxygen content unit by selecting [**Press. Unit**], [**Hb Unit**] and [**OxyCont Unit**] and then selecting the appropriate settings. The changes take effect automatically.
- Trigger a recording by selecting the [**Record**] button. The currently displayed oxygenation calculations are printed out by the recorder.
- Review the previously performed calculations by selecting [**Review**].

18.3.2 Entered Parameters

Abbreviation	Unit	Full spelling
C.O.	L/min	cardiac output
FiO_2	%	percentage fraction of inspired oxygen
PaO_2	mmHg	partial pressure of oxygen in the arteries
$PaCO_2$	mmHg	partial pressure of carbon dioxide in the arteries
SaO_2	%	arterial oxygen saturation
PvO_2	mmHg	partial pressure of oxygen in venous blood
SvO_2	%	venous oxygen saturation
Hb	g/L	hemoglobin
CaO_2	ml/L	arterial oxygen content
CvO_2	ml/L	venous oxygen content
VO_2	ml/min	oxygen consumption
RQ	None	respiratory quotient
ATMP	mmHg	atmospheric pressure
Height	cm	height
Weight	kg	weight

18.3.3 Calculated Parameters and Formulas

Abbreviation	Unit	Full spelling	Formula
BSA	m^2	body surface area	$Wt^{0.425} \times Ht^{0.725} \times 0.007184$
VO_2 calc	ml/min	oxygen consumption	$C(a\text{-}v)O_2 \times$ C.O.
$C(a\text{-}v)O_2$	ml/L	arteriovenous oxygen content difference	$CaO_2 - CvO_2$
O_2ER	%	oxygen extraction ratio	$100 \times C(a\text{-}v)O_2 / CaO_2$
DO_2	ml/min	oxygen transport	C.O. $\times CaO_2$
PAO_2	mmHg	partial pressure of oxygen in the alveoli	$FiO_2 / 100 \times (ATMP - 47) - PaCO_2 \times [FiO_2 / 100 + (1 - FiO_2 / 100) / RQ]$
$AaDO_2$	mmHg	alveolar-arterial oxygen difference	$PAO_2 - PaO_2$
CcO_2	ml/L	capillary oxygen content	$Hb \times 1.34 + 0.031 \times PAO_2$
Qs/Qt	%	venous admixture	$100 \times [1.34 \times Hb \times (1 - SaO_2 / 100) + 0.031 \times (PAO_2 - PaO_2)] / [1.34 \times Hb \times (1 - SvO_2 / 100) + 0.031 \times (PAO_2 - PvO_2)]$
C.O. calc	L/min	calculated cardiac output	$VO_2 / (CaO_2 - CvO_2)$

18.4 Ventilation Calculations

18.4.1 Performing Calculations

To perform a ventilation calculation:

1. Select [**Main Menu**]→[**Calculations >>**]→[**Ventilation >>**], or select [**Calculations**] QuickKey→ [**Ventilation >>**].
2. Enter values for calculation. If the patient monitor is connected to an anesthesia machine or a ventilator, the system automatically loads the supported parameter values to the [**Ventilation Calculation**] window.
3. Select the [**Calculate**] button. The system performs a calculation per the current settings and displays the calculated values.
   - ◆ If a calculated value is outside the range, its background will highlight in yellow. You can select [**Range**] to view its normal range in the unit field.
   - ◆ Invalid values are displayed as [**---**].

In the [**Ventilation Calculation**] window, you can:

- ■ Change the pressure unit by selecting [**Press. Unit**] and then selecting the appropriate setting. Corresponding pressure values shall convert and update automatically.
- ■ Trigger a recording by selecting the [**Record**] button. The currently displayed ventilation calculations are printed out by the recorder.
- ■ Review the previously performed calculations by selecting [**Review**].

18.4.2 Entered Parameters

Abbreviation	Unit	Full spelling
FiO_2	%	percentage fraction of inspired oxygen
RR	rpm	respiration rate
$PeCO_2$	mmHg	partial pressure of mixed expiratory CO_2
$PaCO_2$	mmHg	partial pressure of carbon dioxide in the arteries
PaO_2	mmHg	partial pressure of oxygen in the arteries
TV	ml	tidal volume
RQ	None	respiratory quotient
ATMP	mmHg	atmospheric pressure

18.4.3 Calculated Parameters and Formulas

Abbreviation	Unit	Full spelling	Formula
PAO_2	mmHg	partial pressure of oxygen in the alveoli	(ATMP－47) × FiO_2 /100 －$PaCO_2$ × [FiO_2 /100 ＋ (1－FiO_2 /100) / RQ]
$AaDO_2$	mmHg	alveolar-arterial oxygen difference	PAO_2 － PaO_2
Pa/FiO_2	mmHg	oxygenation ratio	100 × PaO_2 / FiO_2
a/AO_2	%	arterial to alveolar oxygen ratio	100 × PaO_2 / PAO_2
MV	L/min	minute volume	(TV × RR) / 1000
Vd	ml	volume of physiological dead space	TV × (1 － $PeCO_2$ / $PaCO_2$)
Vd/Vt	%	physiologic dead space in percent of tidal volume	100 × Vd/TV
VA	L/min	alveolar volume	(TV－ Vd) × RR / 1000

18.5 Hemodynamic Calculations

18.5.1 Performing Calculations

To perform a hemodynamic calculation:

1. Select [**Main Menu**]→[**Calculations >>**]→[**Hemodynamic >>**], or select [**Calculations**] QuickKey→ [**Hemodynamic >>**].
2. Enter values for calculation.
   - ◆ For a patient who is being monitored, [**HR**], [**Art mean**], [**PA mean**] and [**CVP**] are automatically taken from the currently measured values. If you just have performed C.O. measurements, [**C.O.**] is the average of multiple thermodilution measurements. [**Height**] and [**Weight**] are the patient's height and weight you have entered. If the monitor does not provide these values, their fields appear blank.
   - ◆ For a patient who is not being monitored, confirm the values you have entered.
3. Select the [**Calculate**] button. The system performs a calculation per the current settings and displays the calculated values.
   - ◆ If a calculated value is outside the range, its background will highlight in yellow. You can select [**Range**] to view its normal range in the unit field.
   - ◆ Invalid values are displayed as [**---**].

In the [**Hemodynamic Calculation**] window, you can:

- ■ Trigger a recording by selecting the [**Record**] button. The currently displayed renal calculations are printed out by the recorder.
- ■ Review the previously performed calculations by selecting [**Review**].

18.5.2 Entered Parameters

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

18.5.3 Calculated Parameters and Formulas

Abbreviation	Unit	Full spelling	Formula
BSA	m^2	body surface area	$Wt^{0.425} \times Ht^{0.725} \times 0.007184$
C.I.	$L/min/m^2$	cardiac index	C.O. / BSA
SV	ml	stroke volume	C.O. / HR × 1000
SI	ml/m^2	stroke index	SV/ BSA
SVR	DS/cm^5	systemic vascular resistance	79.96 × (AP MAP — CVP) / C.O.
SVRI	$DS{\cdot}m^2/cm^5$	systemic vascular resistance index	SVR × BSA
PVR	DS/cm^5	pulmonary vascular resistance	79.96 × (PAMAP — PAWP) / C.O.
PVRI	$DS{\cdot}m^2/cm^5$	pulmonary vascular resistance index	PVR × BSA
LCW	kg·m	left cardiac work	0.0136 × APMAP × C.O.
LCWI	$kg{\cdot}m/m^2$	left cardiac work index	LCW / BSA
LVSW	g·m	left ventricular stroke work	0.0136 × APMAP× SV
LVSWI	$g{\cdot}m/m^2$	left ventricular stroke work index	LVSW / BSA
RCW	kg·m	right cardiac work	0.0136 × PAMAP × C.O.
RCWI	$kg{\cdot}m/m^2$	right cardiac work index	RCW / BSA
RVSW	g·m	right ventricular stroke work	0.0136 × PAMAP × SV
RVSWI	$g{\cdot}m/m^2$	right ventricular stroke work index	RVSW / BSA
EF	%	ejection fraction	100 × SV / EDV

18.6 Renal Calculations

18.6.1 Performing Calculations

To perform a renal calculation:

1. Selecting [**Main Menu**]→[**Calculations >>**]→[**Renal >>**], or select [**Calculations**] QuickKey→[**Renal >>**].
2. Enter values for calculation.
3. Select the [**Calculate**] button. The system performs a calculation per the current settings and displays the calculated values.
   - ◆ If a calculated value is outside the range, its background will highlight in yellow. You can select [**Range**] to view its normal range in the unit field.
   - ◆ Invalid values are displayed as [**---**].

In the [**Renal Calculation**] window, you can:

- ■ Trigger a recording by selecting the [**Record**] button. The currently displayed renal calculations are printed out by the recorder.
- ■ Review the previously performed calculations by selecting [**Review**].

18.6.2 Entered Parameters

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

18.6.3 Calculated Parameters and Formulas

Abbreviation	Unit	Full spelling	Formula
URNaEx	mmol/24h	urine sodium excretion	Urine × URNa / 1000
URKEx	mmol/24h	urine potassium excretion	Urine × URK / 1000
Na/K	%	sodium potassium ratio	100 × URNa / URK
CNa	ml/24h	clearance of sodium	URNa × Urine / SerNa
Clcr	ml/min	creatinine clearance rate	Ucr × Urine / Cr / (BSA / 1.73) / 1440
FENa	%	fractional excretion of sodium	100 ×（URNa × Cr) / (SerNa × Ucr)
Cosm	ml/min	osmolar clearance	Uosm × Urine / Posm / 1440
CH_2O	ml/h	free water clearance	Urine × (1－Uosm / Posm) / 24
U/P osm	None	urine to plasma osmolality ratio	Uosm / Posm
BUN/Cr	None*	blood urea nitrogen creatinine ratio	1000 × BUN / Cr
U/Cr	None	urine-serum creatinine ratio	Ucr / Cr

*: BUN/Cr is a ratio under the unit of mol.

18.7 Understanding the Review Window

With the review feature, you can review oxygenation, ventilation, hemodynamic and renal calculations. The review window for each calculation is similar. Take the hemodynamic calculations review window for example, you can access it by selecting [**Review**] in the [**Hemodynamic Calculation**] window.

In this review window:

- You can select ◀, ▶, ◀◀ or ▶▶ to view more values.
- The values that exceed the range are displayed in yellow background. The [**Unit**] field displays parameter units. If some parameter values are outside of their normal ranges, you can view their normal range in the [**Unit**] field by selecting [**Range**].
- You can review an individual calculation by selecting its corresponding column and then selecting [**Original Calc**]. You can record the currently displayed calculations or perform another calculation is this window.

FOR YOUR NOTES

19 Printing

19.1 Printer

The monitor can output patient reports via a connected printer. So far, the monitor supports the following printer:

- HP LaserJet 1505n
- HP LaserJet P2035n
- HP LaserJet P4015n
- HP LaserJet Pro 400 M401n
- HP LaserJet 600 M602
- HP LaserJet M202DW

The specifications of the reports the monitor prints are:

- Paper: A4, Letter
- Resolution: 300 dpi

For more details about the printer, see the document accompanying the printer. With the upgrading of products, the monitor will support more printers and no prior notice will be given. If you have any doubt about the printer you have purchased, contact our company.

19.2 Connecting a printer

To print the reports or the trend data of a patient, you can directly connect the T1 to a printer via the T1 docking station through the network, and then start printing what you want.

19.3 Setting the Printer

To set the printer's properties, select [**Main Menu**]→[**Print Setup >>**]→[**Printer Setup >>**]. In the [**Printer Setup**] menu, you can:

- Select a connected printer

  Select [**Printer**] and then select a connected printer as the monitor's printer.

- Search for a printer

  If your selected printer is not in the list or a new printer is added into the network, you can select the [**Search Printer**] to re-search for all printers in the network.

- Set up the paper size

  Select [**Paper Size**] and toggle between [**A4**] and [**Letter**].

19.4 Starting Report Printouts

Reports	Contents	Procedures
ECG reports	ECG waveforms and relevant parameter values	Select [**Main Menu**]→[**Print Setup >>**]→[**ECG Reports >>**]→[**Print**]
Tabular trends	Depend on the selected parameter group, resolution and time period	Select [**Main Menu**]→[**Print Setup >>**]→[**Tabular Trends Reports >>**]→[**Print**], or select [**Main Menu**]→[**Review >>**]→[**Tabular Trends**]→[**Print**]→[**Print**]
Graphic trends	Depend on the selected parameter group, resolution and time period	Select [**Main Menu**]→[**Print Setup >>**]→[**Graphic Trends Reports >>]**→[**Print**], or select [**Main Menu**]→[**Review >>**]→[**Graphic Trends**]→[**Print**]→[**Print**]
Arrh. events	ECG waveforms and relevant parameter values	Select [**Main Menu**]→[**Review >>**]→[**Events**] →[**Arrh. Events**] →[**Details**] →[**Print**].
Parameter alarm review	Depend on the selected alarms	Select [**Main Menu**]→[**Alarm Setup >>**]→[**Parameters**] → [**Print**]
Realtime waves	Depend on the selected waveforms	Select [**Main Menu**]→[**Print Setup >>**]→[**Realtime Reports >>**]→[**Print**]

19.5 Stopping Reports Printouts

To stop report printouts, select [**Main Menu**]→[**Print Setup >>**]→[**Stop All Reports**].

19.6 Setting Up Reports

19.6.1 Setting Up ECG Reports

You can print out ECG reports only under 7-lead or12-lead full screen. To set up ECG reports, select [**Main Menu**]→[**Print Setup >>**]→[**ECG Reports >>**].

- [**Amplitude**]: set the amplitude of the ECG waveforms.
- [**Sweep**]: set the wave print speed to 25 mm/s or 50 mm/s.
- [**Auto Interval**]: If [**Auto Interval**] is set to [**On**], the system will automatically adjust the space between waveforms to avoid overlapping.
- [**Gridlines**]: choose whether to show gridlines.

19.6.2 Setting Up Tabular Trends Reports

To set up tabular trends reports, select [**Main Menu**]→[**Print Setup >>**]→[**Tabular Trends Reports >>**].

- Start time: You can set a time period whose trend data will be printed out by setting [**From**] and [**Back**]. For example, if you set [**From**] as 2007-4-2 10:00:00 and [**Back**] as [**2 h**], the outputted data will be from 2007-4-2 08:00:00 to 2007-4-2 10:00:00. In addition, the [**Back**] can be set to either:
  - [**Auto**]: If [**Report Layout**] is set to [**Time Oriented**], the report will be printed by time. If [**Report Layout**] is set to [**Parameter Oriented**], the report will be printed by parameters.
  - [**All**]: If you select [**All**], all trend data will be printed out. In this case, it is no need to set [**From**].
- [**Interval**]: choose the resolution of the tabular trends printed on the report.
- [**Report Layout**]: If you select [**Time Oriented**], the report will be printed by time. If you select [**Parameter Oriented**], the report will be printed by parameters.
- [**Select Parameter >>**]: from the popup menu, you can:
  - [**Currently Displayed Trended Parameters**]: print the parameter trend data selected from the [**Tabular Trends**].
  - [**Standard Parameter Group**]: select the standard parameter group for printing.
  - [**Custom**]: You can define a parameter group for printing from the parameters displayed in the low part of the menu.

19.6.3 Setting Up Graphic Trends Reports

To set up graphic trends reports, select [**Main Menu**]→[**Print Setup >>**]→[**Graphic Trends Reports >>**]. As setting up graphic trends reports is similar with tabular trends reports, you can refer to the ***Setting Up Tabular Trend Reports*** section for details.

19.6.4 Setting Up Realtime Reports

To set up realtime reports, select [**Main Menu**]→[**Print Setup >>**]→[**Realtime Reports >>**].

- [**Sweep**]: set the wave print speed to 12.5 mm/s, 25 mm/s, 50 mm/s, or Auto.
- [**Select Wave >>**]: from the popup menu, you can:
  - [**Current**]: select the currently displayed waves for printing.
  - [**Select Wave**]: select the desired waves for printing.

19.7 End Case Reports

ECG reports, tabular trends reports, graphic trends reports, NIBP review reports and realtime reports can be set as end case reports. When you discharge a patient, the system will automatically print out all contents that are set as end case reports.

For example, to set ECG report as end case report:

1. select [**Main Menu**]→[**Print Setup >>**]→[**ECG Report >>**].
2. select [**End Case Report**]→[**Set as End Case Report**] and then select [**Ok**] from the popup dialog box.
3. set as described in the ***19.6.1 Setting Up ECG Reports***.

19.8 Printer Statuses

19.8.1 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.

19.8.2 Printer Unavailable

If the monitor prompts that selected printer is not available, check that the printer is switched on, correctly connected, and installed with paper.

20 Other Functions

20.1 Analog Output

The monitor is configured with a multifunction connector for analog output. You can contact your service personnel for more details.

20.2 Exporting the Log

The monitor stores system status information, including failures, abnormity, and technical alarms, into the log. You can export the log to a USB drive.

To export the log,

1. Connect a USB drive to the monitor's USB connector.
2. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Others >>**].
3. Select [**Export Log**].

20.3 Transferring Data

You can transfer the patient data saved in the monitor to a PC via a crossover network cable or SD storage card, or within a LAN for data management, review or print.

20.3.1 Data Export System

You must install the data export system on the intended PC before performing the data transfer operation. Refer to the document accompanying the installation CD-ROM for installation instructions.

The data transfer feature supports patient management, data review, data format conversion, print, etc. in addition to data transfer. Refer to the help file of the system software for more details.

20.3.2 Transferring Data by Different Means

NOTE

- **Never enter the data transfer mode when the patient monitor is in normal operation or performs monitoring. You must re-start the patient monitor to exit the data transfer mode.**

Transfer data via a crossover network cable

Before transferring data using a crossover network cable, do as follows:

1. Connect the T1 to the T1 docking station.
2. Connect one end of the crossover network cable to the T1 docking station and the other end to the PC.
3. Set the IP address of the PC. This IP address must be in the same network segment with that of the patient monitor.
4. Make sure that the data export system is active on the PC.

Then, follow this procedure to transfer data:

1. Select [**Main Menu**]→[**Patient Data >>**]→[**Transfer Data**].
2. Select [**Yes**] from the popup message box.
3. Input the IP address already set on the PC.
4. Select [**Start**] to start transferring data.

Transfer data within a LAN

Before transferring data within a LAN, do as follows:

1. Connect the patient monitor and the intended PC into the same LAN and acquire the PC's IP address.
2. Make sure that the data export system is active on the PC.

Follow the same procedure as via a crossover network cable to transfer data.

20.4 Network Connection

20.4.1 Setting the Monitor Network

The patient monitor supports both wired and wireless network. To set the monitor network:

1. Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Network Setup >>**]→[**Monitor Network Setup >>**].
2. In the Monitor Network Setup menu, set the [**Network Type**] or [**Address Type**].

The network type can be set to [**WLAN**] or [**LAN**].

The address type can be set to [**DHCP**] or [**Manual**].

- If [**Address Type**] is set to [**DHCP**], the monitor can automatically acquire network parameters.
- If [**Address Type**] is set to [**Manual**], you need to manually input the monitor IP address, subnet mask and gateway address.

20.4.2 Wireless Network

The patient monitors can be connected to a wireless network via a built-in Wi-Fi module. To set the wireless network:

1. Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Network Setup >>**]→[**Monitor Network Setup >>**].
2. In the Monitor Network Setup menu, set the [**Network Type**] to [**WLAN**].
3. Select [**WLAN Setup >>**] to access the [**WLAN Setup**] menu.
4. Configure the [**Network Name (SSID)**], [**Security**], [**EAP Method**], [**AUT Protocol**], [**Identify**], [**Anonymity**], [**Password**] and [**CA Certificate**].
5. Click [**OK**] to confirm the setting.

20.4.3 WLAN Test

To test the availability of the wireless network, follow this procedure:

1. Select [**WLAN Test >>**] in the [**Network Setup**] menu.
2. Enter the [**IP Address**] of wireless AP in the [**WLAN Test >>**] menu.
3. Click [**Connection Test**].

The Wi-Fi device used in the monitor is in compliance with IEEE 802.11a/b/g/n.

You should not change the patient monitor's IP address randomly. If you want to know details about IP address setup, contact the technical personnel in charge of the CMS.

NOTE

- **The design, installation, restruction and maintenance of the wireless network's distribution shall be performed by authorized service personnel of our company.**
- **The existence of obstacles (such as wall) will exert impact on data transferring or even cause network interruption.**
- **The Central Monitoring System is capable of connecting up to 32 bedside monitors via the wireless network.**

20.4.4 WLAN Setup

To set the properties of wireless network, follow this procedure:

1. Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Network Setup >>**]→[**WLAN Setup >>**].
2. Set [**WLAN Band**], [**Aut. Server Type**], [**BG Channel**] and [**A Channel**]

WLAN band can be set to: AUTO, 5G and 2.4G.

20.4.5 Viewing the MAC Address

You can get the MAC address from the monitor for network management.

To view the MAC address:

1. Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→select [**Ok**].
2. Select [**Network Setup** >>].
3. Select [**Monitor Network Setup** >>].

20.4.6 Enabling the Data Encryption

If you enable the data encryption, the patient's MRN (Medical Record Number), visit number, first name and last name are encrypted when transferring data to the CMS or eGateway.

To enable the data encryption:

1. Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→select [**Ok**].
2. Select [**Network Setup** >>].
3. Set [**Network Encrypt Switch**] to [**On**].

20.4.7 Setting DNS

You can set DNS for connectiong the server using domain name. Only ADT and MLDAP services support the domain name method.

To set DNS:

1 Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→select [**Ok**].

2 Select [**Network Setup** >>].

3 Select [**Monitor Network Setup** >>]→[**DNS Setup** >>].

4 Set the desired [**Address Type**].

- [**Manual**]: the address of the DNS server must be manually entered.
- [**DHCP**]: the monitor will automatically acquire the address of the DNS server. This is only avaliable when [**Address Type**] is set to [**DHCP**] in the [**Monitor Network Setup** >>] menu.

5. If [**Manual**] was selected in Step 4, set [**Preferred DNS Server**] and [**Alternate DNS Server**].

20.4.8 Certificates Maintenance

You can import or delete the monitor's certificates.

1. Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Network Setup >>**]→[**Certificates Maintenance >>**].
2. Select [Import certificates] or [Delete certificates].

20.4.9 Setting the Multicast Parameters

Whether the equipment is presented by broadcast or multicast is defined before the equipment leaves the factory. If [**Multicast**] is selected, you need to set the multicast parameters.

To do so,

1 Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Network Setup >>**]→[**Multicast Setup >>**].

2. Set [**Multicast Addr**] and [**TTL**].

20.4.10 Connecting the monitor to the CMS

To connect the monitor to the CMS, proceed as follows:

1 Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Network Setup >>**]→[**Monitor Network Setup >>**].

2. In the [**Monitor Network Setup**] menu, set [**Network Type**] and [**Address Type**].
3. Input the monitor IP address, subnet mask and gateway address if the [**Address Type**] is set to [**Manual**]
4. Connect the monitor to the CMS through either of the following methods:
   - Admit the monitor on the CMS. Refer to the *Hypervisor VI Operator's Manual (PN: H-300B-20-47610)* for details of admitting a monitor.
   - Setting the CMS (refer to section ***20.4.10.1 Setting the CMS*** for details), and then selecting a CMS (refer to section ***20.4.10.2 Selecting a CMS*** for details).

20.4.10.1 Setting the CMS

You can configure up to 30 central stations (CMS) for your monitor. To set the CMSs,

1 Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password.→[**Network Setup >>**].

2. Set [**Select CMS**] to [**On**].
3. Select [**Central Station Setup >>**].
4. Set CMS names and corresponding IP addresses.

20.4.10.2 Selecting a CMS

If [**Select CMS**] is enabled, you can select the CMS for the current monitoring.

To select the CMS, select the prompt message area at the bottom of the screen. Then the selected CMS name will display.

If the CMS you select does not have a name, this area displays "???".

20.4.10.3 Clearing the Selected CMS at Startup

You can clear the selected CMS each time the monitor restarts after being powered off for more than 2 minutes.

To clear the selected CMS,

1 Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Others >>**].

2. Set [**Clear CMS IP at startup**] to [**On**]

The selected CMS will not be cleared when only one CMS is configured, or the monitor is restarted within 2 minutes.

This function is switched off by default.

21 Battery

21.1 Overview

The equipment is designed to operate on battery power when external power supply is not available. The monitor uses external power supply as primary power source. In case of power failure, the equipment will automatically run power from battery. So we recommend you always install a fully charged battery in the equipment.

On-screen battery symbols indicate the battery status as follows:

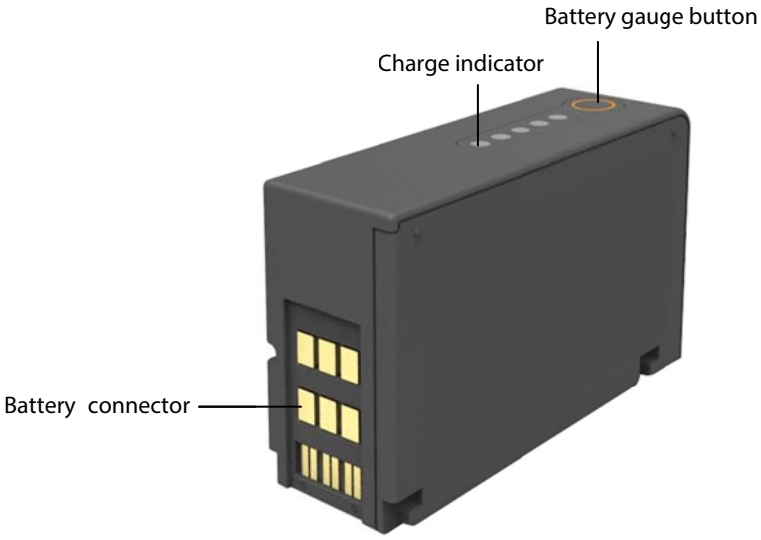

Indicates that battery works correctly. The solid portion represents the current charge level.


Indicates that the battery has low power and needs to be charged.


Indicates that the battery is almost depleted and needs to be charged immediately.


Indicates that no battery is installed.

You can also check the battery's charge status by pressing the battery gauge button at the top of the battery to illuminate the charge indicators. The charge indicators consist of 5 LEDs, each representing 20% of the total power.



If the battery charge is too low, a technical alarm will be triggered and the message [**Low Battery**] or [**Battery Depleted**] will be displayed in the Technical Alarm Area. At this moment, change the battery or connect the external power to the monitor. Otherwise, the monitor will power off automatically before the battery is completely depleted.

21.2 Safety

⚠ WARNING

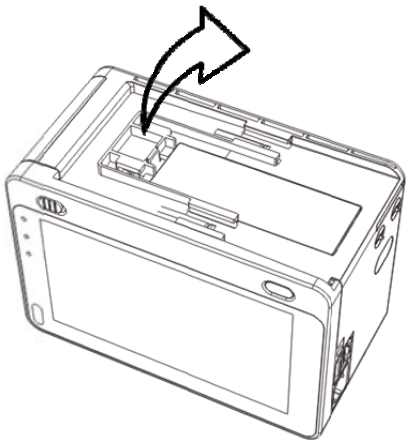
- **Keep batteries out of children's reach.**
- **Use only specified batteries.**
- **Keep the batteries in their original package until you are ready to use them.**
- **Do not expose batteries to liquid.**
- **Do not crush, drop or puncture the battery. Mechanical abuse can lead to internal damage and 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 a battery shows signs of damage or signs of leakage, replace it immediately. Use caution in removing the battery. Avoid contact with skin. Refer to qualified service personnel.**
- **Batteries should be charged in this monitor or in the spcified charger.**
- **Extremely high ambient temperature may cause battery overheat protection.**
- **The Lithium-ion battery has a service life. Please replace your battery when it reaches the end of its service life. Failure to replace the battery may cause serious damage to your device from battery overheating.**

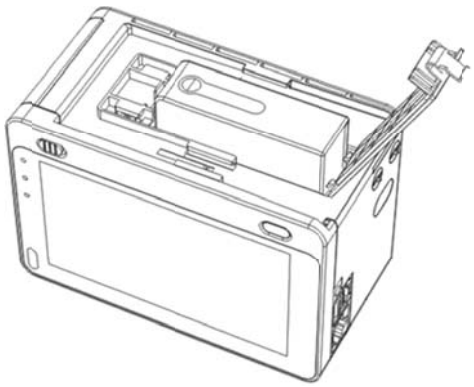
⚠ CAUTION

- **Remove the battery before transporting the equipment or if the equipment will not be used for a long time**

21.3 Installing the Battery

1. Pull the battery door latch rightwards and lift it to open the battery door.
2. Insert the battery into the battery compartment as indicated.





3. Close the battery door.

To replace a battery, remove the battery as per the instructions on the battery door, and then insert a new battery into the battery compartment.

21.4 Charging the Battery

To optimize performance, a fully (or nearly fully) discharged battery should be charged as soon as possible. The batteries can be charged in either of the following methods:

1. Install the battery in the monitor and the monitor is connected with the external DC adapter or T1 docking station.
2. Install the battery in the monitor and the monitor is in use with a host monitor.
3. Use the battery charger specified by the equipment manufacturer.

For method 1 and 2, the battery is charged whenever the monitor is connected to an external power supply in regardless of whether or not the monitor is currently turned on.

21.5 Conditioning the Battery

The performance of rechargeable batteries may deteriorate over time. You should condition the batteries every two months.

Taking using the monitor as an example, to condition a battery, follow this procedure:

1. Disconnect the monitor from the patient and stop all monitoring and measuring procedures.
2. Turn off the monitor. Disconnect the monitor from the external power supply if DC adapter or T1 docking station is connected.
3. Install the battery to be conditioned in the monitor. Connect the external power supply and allow the battery to be charged uninterruptedly till it is fully charged.
4. Disconnect the external power supply. Remove the battery from the monitor. Keep the battery in room temperature for two hours.
5. Allow the monitor to run from the battery until the battery is completely depleted and the monitor automatically shuts off.
6. Fully charge the battery again for use or charge it to 40 – 60% for storage.

CAUTION

- **Do not use the monitor to monitor the patient during battery conditioning.**
- **Do not interrupt battery conditioning.**

You can also use the specified battery charger to condition a battery.

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. Keeping the battery continuously fully charged without conditioning will speed up battery aging and shorten its life time.

21.6 Checking Battery Performance

Life expectancy of a battery depends on how frequent and how long it is used. When properly cared for, the lithium-ion

battery has a useful life of approximately two years. For improper use models, life expectancy can be less. We recommend replacing lithium-ion batteries every two years.

The performance of a rechargeable battery may deteriorate over time. You should check the battery performance every two months or if you doubt the battery may fail.

Refer to Steps 1 to 5 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, discard the batteries or contact your service personnel.

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 the device configuration and operation. For example, high display brightness or measuring NIBP repeatedly will shorten the battery operating time.**

21.7 Storing the Battery

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 (3 LEDs illuminated).

Stored batteries should be conditioned every 2 months. Refer to ***21.5 Conditioning the Battery*** for details.

NOTE

- **Storing batteries at high temperature for an extended period of time will significantly shorten their life expectancy.**
- **Storing batteries in a cool place will slow the aging process. Ideally the batteries should be stored at 15. Do not stored the batteries in an environment above 60 ℃ or lower than -20 ℃.**

21.8 Recycling the Batteries

Discard the battery in the following situations:

- The battery has visual signs of damage.
- The battery fails.
- The battery is aged and its runtime significantly less than the specification.
- The battery has been used for more than two years.

Properly dispose of batteries according to local regulations.

⚠WARNING

- **Do not open batteries, heat above 60 ℃, incinerate batteries, or short the battery terminals. They may ignite, explode, or leak or heat up, causing personal injury.**

FOR YOUR NOTES

22 Care and Cleaning

Use only the substances approved by us and methods listed in this chapter to clean or disinfect your equipment. Warranty does not cover damage caused by unapproved substances or methods.

We make no claims regarding the efficacy of the listed chemicals or methods as a means for controlling infection. For the method to control infection, consult your hospital's Infection Control Officer or Epidemiologist.

In this chapter we only describe cleaning and disinfection of the main unit, T1 handle and T1 docking station. To clean or disinfect reusable accessories, refer to the instructions delivered with the accessories.

22.1 General Points

Keep you equipment and accessories free of dust and dirt. To avoid damage to the equipment, follow these rules:

- Always dilute according the manufacturer's instructions or use lowest possible concentration.
- Do not immerse part of the equipment into liquid.
- Do not pour liquid onto the equipment or accessories.
- Do not allow liquid to enter the case.
- Never use abrasive materials (such as steel wool or silver polish), or erosive cleaners (such as acetone or acetone-based cleaners).

⚠ WARNING

- **Be sure to shut down 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 procedure specified in this chapter.**

⚠ CAUTION

- **If you spill liquid on the equipment or accessories, contact us or your service personnel.**

NOTE

- **To clean or disinfect reusable accessories, refer to the instructions delivered with the accessories.**
- **Avoid the external connectors and thermovent during cleaning or disinfection procedures.**

22.2 Cleaning

Your equipment should be cleaned on a regular basis. If there is heavy pollution or lots of dust and sand in your place, the equipment should be cleaned more frequently. Before cleaning the equipment, consult your hospital's regulations for cleaning the equipment.

Recommended cleaning agents are:

- Water
- Sodium hypochlorite bleach (10%, Sodium hypochlorite)
- Hydrogen peroxide (3%)
- Ethanol (70%)
- Isopropyl alcohol (70%)
- 1-Propanol (50%)
- Virkon
- Descosept forte
- Descosept AF
- Dismozon® plus
- Mikrozid® AF liquid
- Terralin Liquid
- Perform® classic concentrateOXY ($KHSO_4$ solution)

To clean your equipment, follow these rules:

1. Shut down the patient monitor and disconnect it from the power line.
2. Clean the display screen using a soft, clean cloth dampened with a glass cleaner.
3. Clean the exterior surface of the equipment using a soft cloth dampened with the cleaner.
4. Wipe off all the cleaning solution with a dry cloth after cleaning if necessary.
5. Dry your equipment in a ventilated, cool place.

22.3 Disinfecting

Disinfect the equipment as required in your hospital's servicing schedule. Cleaning equipment before disinfecting is recommended.

22.4 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.

23 Maintenance

⚠ WARNING

- **Failure on the part of the responsible individual hospital or institution employing the use of this equipment to implement a satisfactory maintenance schedule may cause undue equipment failure and possible health hazards.**
- **The safety checks or maintenance involving any disassembly of the equipment should be performed by professional servicing personnel. Otherwise, undue equipment failure and possible health hazards could result.**
- **No modification of this equipment is allowed.**
- **Do not open the equipment housings. All servicing and future upgrades must be carried out by the service personnel.**
- **The service personnel must be properly qualified and thoroughly familiar with the operation of the equipment.**
- **If you discover a problem with any of the equipment, contact your service personnel or us.**

23.1 Regular Inspection

Before the first use, after your patient monitor has been used for 6 to 12 months, or whenever your patient monitor is repaired or upgraded, a thorough inspection should be performed by qualified service personnel to ensure the reliability.

Follow these guidelines when inspecting the equipment:

- Make sure that the environment and power supply meet the requirements.
- Inspect the equipment and its accessories for mechanical damage.
- Inspect all power cords for damage, and make sure that their insulation is in good condition.
- Make sure that only specified accessories are applied.
- Inspect if the alarm system functions correctly.
- Make sure that the batteries meet the performance requirements.
- Make sure that the patient monitor is in good working condition.

In case of any damage or abnormity, do not use the patient monitor. Contact the hospital's biomedical engineers or your service personnel immediately.

23.2 Maintenance and Testing Schedule

The following maintenance and tests, except for visual inspection, power on test, touchscreen calibration, and battery check, shall be carried out by the service personnel only. Contact your service personnel if any maintenance is required. Make sure to clean and disinfect the equipment before any test and maintenance.

Check/Maintenance Item		Recommended Frequency
Preventative Maintenance Tests		
Visual inspection		1. When first installed or reinstalled.
NIBP test	Pressure check	1. If the user suspects that the measurement is incorrect. 2. Following any repairs or replacement of relevant module. 3. At least once a year.
	Leakage test	
Sidestream and Microstream CO2 tests	Leakage test	
	Performance test	
	Calibration	
Performance Tests		
ECG test and calibration	Performance test	1. If the user suspects that the measurement is incorrect. 2. Following any repairs or replacement of relevant module. 3. At least once every two years. Note: At least once a year is recommended for NIBP and CO2.
	Calibration	
Resp performance test	/	
SpO2 test	/	
NIBP test	Pressure check	
	Leakage test	
Temp test	/	
IBP test and calibration	Performance test	
	Pressure calibration	
Mainstream CO2 test and calibration	/	
Sidestream and Microstream CO2 tests and calibration	Leakage test	
	Performance test	
	Calibration	
PiCCO test		
Analog output performance test	/	If the user suspects that the analog output does not work well.
Electrical Safety Tests		
Electrical safety tests		At least once every two years.
Other Tests		
Power on test		1. When first installed or reinstalled. 2. Following any maintenance or the replacement of any main unit parts.
Touchscreen calibration	/	1. When the touchscreen appears abnormal. 2. After the touchscreen is replaced.
Battery check	Functionality test	1. When first installed. 2. Whenever a battery is replaced.
	Performance test	Every two months or if the battery run time reduced significantly.

23.3 Checking Monitor and Module Information

To view the information about system start time, selftest, etc., select [**Main Menu**]→[**Maintenance >>**]→[**Monitor Information >>**]. The information will not be saved after the patient monitor is shut down.

You can also view the information about the monitor configuration and system software version by selecting [**Main Menu**]→[**Maintenance >>**]→[**Software Version >>**].

23.4 Calibrating ECG

The ECG signal may be inaccurate due to hardware or software problems. As a result, the ECG wave amplitude becomes greater or smaller. In that case, you need to calibrate the ECG module.

1. Select the ECG parameter window or waveform area→[**Filter**]→[**Diagnostic**].
2. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Module Maintenance >>**]→[**Calibrate ECG**]. A square wave appears on the screen and the message [**ECG Calibrating**] is displayed.
3. Compare the amplitude of the square wave with the wave scale. The difference should be within 5%.
4. After the calibration is completed, select [**Stop Calibrating ECG**]

You can print out the square wave and wave scale and then measure the difference between them if necessary. If the difference exceeds 5%, contact your service personnel.

23.5 NIBP Leakage Test

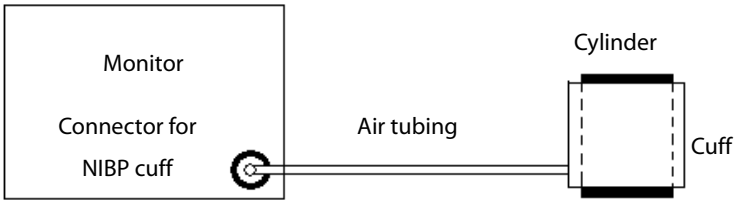
The NIBP leakage test checks the integrity of the system and of the valve. It is required at least once a year or when you doubt the measured NIBP. If the test failed, corresponding prompt messages will be given. If no message is displayed, it means no leakage is detected.

Tools required:

- An adult cuff
- An air tubing
- A correct sized cylinder

Follow this procedure to perform the leakage test:

1. Set the patient category to [**Adu**].
2. Connect the cuff to the NIBP connector on the monitor.
3. Wrap the cuff around the cylinder as shown below.



4. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]. Enter the required password and then select [**OK**].
5. Select [**Module Maintenance >>**]→[**NIBP Leakage Test**]. The NIBP display shows [**Leakage Testing…**].

After about 20 seconds, the monitor will automatically deflate. This means the test is completed. If the message [**NIBP Pneumatic Leak**] is displayed, it indicates that the NIBP airway may have leakages. Check the tubing and connections for leakages. If you ensure that the tubing and connections are all correct, perform a leakage test again.

If the problem persists, contact your service personnel.

23.6 NIBP Accuracy Test

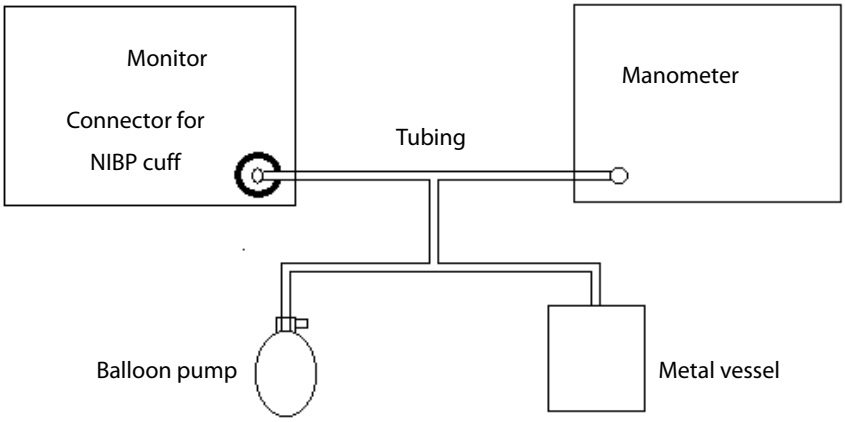
The NIBP accuracy test is required at least once a year or when you doubt the measured NIBP.

Tools required:

- T-piece connector
- Approprating tubing
- Balloon pump
- Metal Vessel (volume 500±25 ml)
- Reference manometer (calibrated with accuracy equal to or better than 0.75 mmHg)

Follow this procedure to perform the accuracy test:

1. Connect the equipment as shown.



2. Before inflation, check that the reading of the manometer should be 0. If not, open the valve of the balloon pump to let the whole airway open to the atmosphere. Close the valve of the balloon pump after the reading is 0.
3. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]. Enter the required password and then select [**OK**].
4. Select [**Module Maintenance >>**]→→[**NIBP Accuracy Test**].
5. Check the manometer values and the monitor values. Both should be 0mmHg.
6. Raise the pressure in the metal vessel to 50 mmHg with the balloon pump. Then, wait for 10 seconds until the measured values become stable.
7. Compare the manometer values with the displayed values. The difference between the manometer and displayed values should be within ± 3 mmHg.
8. Raise the pressure in the metal vessel to 200 mmHg with the balloon pump. Then, wait for 10 seconds until the measured values become stable and repeat step 6.

If the difference between the manometer and displayed values is greater than 3 mmHg, contact your service personnel.

23.7 CO_2 Leakage Test

For sidestream and microstream CO_2 modules, leakage test is needed every year or when you suspect the measurement. Follow this procedure to perform the test:

1. Connect the CO_2 module with the patient module.
2. Wait until CO_2 warmup is finished and then use your hand or other objects to completely block the gas inlet of the module or watertrap. The sidestream and microstream CO_2 modules will behave as follows:
   - Sidestream: The alarm message [**CO2 FilterLine Err**] is displayed on the screen after certain time. Block the gas inlet for another 30 s. If the alarm message does not disappear, it indicates that the module does not leak.
   - Microstream: The alarm message [**CO2 Purging**] is displayed on the screen after certain time. Block the gas inlet for another 30s. If alarm message [**CO2 FilterLine Err**] is shown, it indicates that the module does not leak.

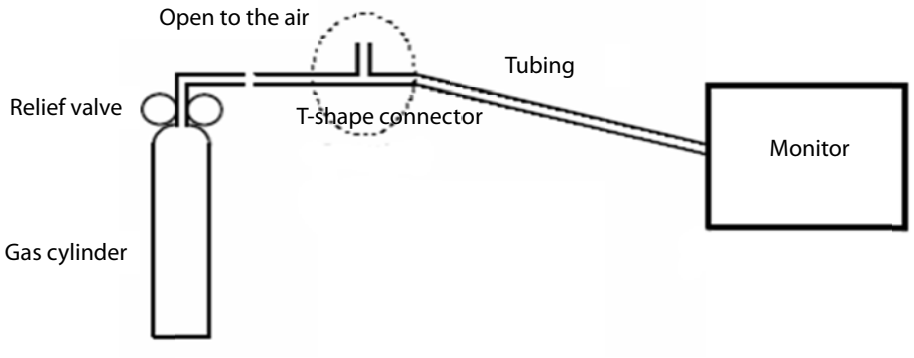
23.8 CO_2 Accuracy Test

For sidestream and microstream CO_2 modules, leakage test is needed every year or when you suspect the measurement. Tools required:

- A steel gas cylinder with 6±0.05% CO_2 and balance gas N_2
- T-shape connector
- Tubing

Follow this procedure to perform the test:

1. Connect the CO_2 module with the patient module.
2. Wait until the CO_2 module warmup is finished, and check the airway for leakage and perform a leakage test as well to make sure the airway has no leakage.
3. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Module Maintenance >>**]→[**Maintain CO2 >>**]→[**Calibrate CO2 >>**].
4. Connect the test system as follows:



5. Open the relief valve to vent standard CO_2 and make sure that there is an excess gas flow through the T-shape connector to air.
6. Check the realtime CO_2 value is within 6.0±0.3% in the [**Calibrate CO2**] menu.

23.9 Calibrating CO_2

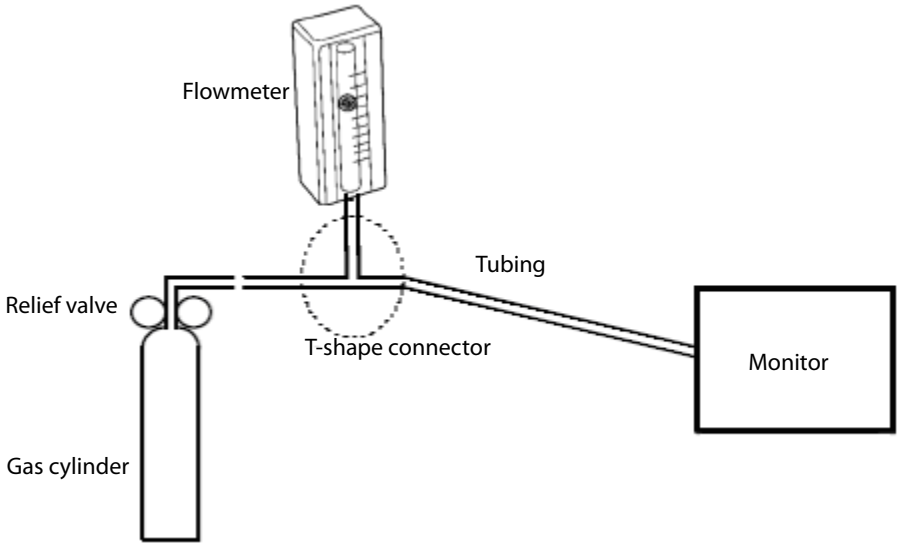
For sidestream and microstream CO_2 modules, a calibration is needed every year or when the measured values have a great deviation. For maintream CO_2 module, no calibration is needed. Calibration for sidestream CO_2 module can be performed only when the sidestream module enters the full accuracy mode.

Tools required:

- A steel gas cylinder with 6±0.05% CO2 and balance gas N2
- T-shape connector
- Tubing

Follow this procedure to perform a calibration:

1. Make sure that the sidestream or microstream CO_2 module has been warmed up or started up.
2. Check the airway for leakage and perform a leakage test as well to make sure the airway has no leakage.
3. Select [**Main Menu**]→ [**Maintenance >>**]→ [**User Maintenance** >>]→ enter the required password→ [**Maintain CO_2 >>**]→ [**Calibrate CO_2 >>**].
4. In the [**Calibrate CO_2**] menu, select [**Zero**].
5. After the zero calibration is finished successfully, connect the equipment as follows:



6. Turn on and adjust the relief valve to make the flowmeter reads within 10-50 mL/min and keeps stable as well.
7. In the [**Calibrate CO_2**] menu, enter the vented CO_2 concentration in the [**CO_2**] field.
8. In the [**Calibrate CO_2**] menu, the measured CO_2 concentration is displayed. After the measured CO_2 concentration becomes stable, select [**Calibrate CO_2**] to calibrate the CO_2 module.

If the calibration is finished successfully, the message [**Calibration Completed!**] is displayed in the [**Calibrate CO_2**] menu. If the calibration failed, the message [**Calibration Failed!**] is displayed. In this case, perform another calibration.

WARNING

- **Connect an exhaust tube to the gas outlet connector of the monitor to vent the calibration gases to a scavenging system.**

23.10 Calibrating the Touchscreen

1. Select [**Main Menu**]→[**Maintenance >>**]→[**Cal. Touchscreen**]. The  symbol will appear at different positions of the screen.
2. Select, in turn the central point of the  symbol. After the calibration is completed, the message [**Screen Calibration Completed!**] is displayed.
3. Select [**Ok**] to confirm the completion of the calibration.

You cannot calibrate the touchscreen if it is locked.

23.11 Electrical Safety Tests

Refer to ***E Electrical Safety Test***.

24 Accessories

The accessories listed in this chapter comply with the requirements of IEC 60601-1-2 when in use with the patient monitor. The accessory material that contacts the patients has undertaken the bio-compatibility test and is verified to be in compliance with ISO 10993-1. For details about the accessories, refer to the instructions for use provided with the accessory.

⚠WARNING

- **Use accessories specified in this chapter. Using other accessories may cause damage to the patient monitor or not meet the claimed specifications.**
- **Single-use accessories are not designed to be reused. Reuse may cause a risk of contamination and affect the measurement accuracy.**
- **Check the accessories and their packages for any sign of damage. Do not use them if any damage is detected.**

24.1 ECG Accessories

ECG Electrodes

Model	Quantity	Patient Category	Part No.
31499224	10 pieces	Adult	0010-10-12304
2245	50 pieces	Pediatric	9000-10-07469
H124SG	3 pieces	Neonate	900E-10-04880

12-Pin Trunk Cables

Leadwire supported	Compatible with	Type	Patient Category	Model	Part No.
5-leadwire	AHA	Snap, Defibrillation-proof	Adult, pediatric	EA6251B	040-000961-00
5-leadwire	IEC			EA6252B	040-000963-00
3-leadwire	AHA			EA6231B	040-000965-00
3-leadwire	IEC			EA6232B	040-000967-00
5-leadwire	AHA	Clip, Defibrillation-proof		EA6251A	040-000960-00
5-leadwire	IEC			EA6252A	040-000962-00
3-leadwire	AHA			EA6231A	040-000964-00
3-leadwire	IEC			EA6232A	040-000966-00

12-Pin Separable Trunk Cables

Leadwire supported	Compatible with	Type	Patient Category	Model	Part No.
3-leadwire	AHA, IEC	Defibrillation-proof	Infant, neonate	EV 6202	0010-30-42720
3-leadwire	AHA, IEC	ESU-proof		EV 6212	0010-30-42724
3-leadwire	/	Defibrillation-proof, DIN	Infant, neonate	EV 6222	040-000754-00
3/5-leadwire	AHA, IEC	Defibrillation-proof	Adult, pediatric	EV 6201	0010-30-42719
3/5-leadwire	AHA, IEC	Defibrillation-proof		EV6201	009-004728-00
3/5-leadwire	AHA, IEC	ESU-proof		EV 6211	0010-30-42723
12-leadwire	AHA	Defibrillation-proof		EV 6203	0010-30-42721
12-leadwire	IEC	Defibrillation-proof		EV 6204	0010-30-42722

Cable Sets

3-Electrode Cable Sets						
Type	**Compatible with**	**Model**	**Patient Category**	**Part No.**	**Length**	**Remark**
Clip	IEC	EL6304A	Adult, pediatric	0010-30-42732	1m	Long
		EL6302A		0010-30-42725	0.6m	/
		EL6308A	Pediatric	0010-30-42899	0.6m	/
		EL6306A	Infant, neonate	0010-30-42897	1m	Long
		EL6312A		040-000149-00	1m	Long
	AHA	EL6303A	Adult, pediatric	0010-30-42731	1m	Long
		EL6301A		0010-30-42726	0.6m	/
		EL6307A	Pediatric	0010-30-42898	0.6m	/
		EL6305A	Infant, neonate	0010-30-42896	1m	Long
		EL6311A		040-000148-00	1m	Long
Snap	IEC	EL6302B	Adult, pediatric	0010-30-42733	1m	Long
		EL6308B	Pediatric	0010-30-42901	0.6m	/
		EL6312B	Infant, neonate	040-000147-00	1m	Long
	AHA	EL6301B	Adult, pediatric	0010-30-42734	1m	Long
		EL6307B	Pediatric	0010-30-42900	0.6m	/
		EL6311B	Infant, neonate	040-000146-00	1m	Long

5-Electrode Cable Sets						
Type	**Compatible with**	**Model**	**Patient Category**	**Part No.**	**Length**	**Remark**
Clip	IEC	EL6502A	Adult, pediatric	0010-30-42728	0.6m	/
		EL6504A		0010-30-42730	1m to 1.4m	Long
	AHA	EL6501A		0010-30-42727	0.6m	/
		EL6503A		0010-30-42729	1m to 1.4m	Long
Snap	IEC	EL6502B		0010-30-42736	1.4m for F and N; 1m for others	Long
				009-004730-00		
	AHA	EL6501B		0010-30-42735	1.4m for RL and LL; 1m for others	Long
				009-004729-00		

12-Electrode Cable Sets						
Type	**Compatible with**	**Model**	**Patient Category**	**Part No.**	**Length**	**Remark**
Clip	IEC	EL 6802A	Adult, pediatric	0010-30-42903	0.8m	Limb
		EL 6804A		0010-30-42905	0.6m	Chest
	AHA	EL 6801A		0010-30-42902	0.8m	Limb
		EL 6803A		0010-30-42904	0.6m	Chest
Snap	IEC	EL 6802B	Adult, pediatric	0010-30-42907	0.8m	Limb
		EL 6804B		0010-30-42909	0.6m	Chest
	AHA	EL 6801B		0010-30-42906	0.8m	Limb
		EL 6803B		0010-30-42908	0.6m	Chest

24.2 SpO_2 Accessories

Extension Cable

Module type	Remarks	Part No.
Mindray	7 pins	0010-20-42710
	7 pins	009-004600-00
Masimo	8 pins, purple connector	040-000332-00
Nellcor	8 pins	0010-20-42712

SpO_2 Sensors

Mindray SpO_2 Module				
Type	**Model**	**Patient Category**	**Part No.**	**Application Site**
Disposable	MAXAI	Adult (>30Kg)	0010-10-12202	Finger
	MAXPI	Pediatric (10 to 50Kg)	0010-10-12203	Finger
	MAXII	Infant (3 to 20Kg)	0010-10-12204	Toe
	MAXNI	Neonate (<3Kg), Adult (>40Kg)	0010-10-12205	Foot, Finger
Disposable	520A	Adult	520A-30-64101	Finger
	520A		009-005087-00	
	521A		009-005091-00	
	520P	Pediatric	520P-30-64201	Finger
	520P		009-005088-00	
	521P		009-005092-00	
	520I	Infant	520I-30-64301	Toe
	520I		009-005089-00	
	521I		009-005093-00	
	520N	Neonate	520N-30-64401	Foot
	520N		009-005090-00	
	521N		009-005094-00	
Reusable	DS-100A	Adult	9000-10-05161	
	OXI-P/I	Pediatric, infant	9000-10-07308	

Mindray SpO_2 Module				
Type	**Model**	**Patient Category**	**Part No.**	**Application Site**
	OXI-A/N	Adult Neonate	9000-10-07336	Finger Foot
	ES-3212-9	Adult	0010-10-12392	
	518B	Adult Pediatric Neonate	518B-30-72107	Finger Finger Foot
	518C	Neonate	040-000330-00	Multi-sites
	512E	Adult	512E-30-90390	Finger
	512E		115-027653-00	Finger
	512F		512F-30-28263	Finger
	512G	Pediatric	512G-30-90607	Finger
	512H		512H-30-79061	Finger

Masimo SpO_2 Module			
Disposable	LNCS NeoPt	Pediatric, neonate	0600-00-0156
	LNCS Neo	Neonate	0600-00-0157
	LNCS Inf	Infant	0600-00-0158
	LNCS Pdtx	Pediatric	0600-00-0122
	LNCS Adtx	Adult	0600-00-0121
Reusable	LNCS DCI	Adult	0600-00-0126
	LNCS DCIP	Pediatric	0600-00-0127
	LNCS TC-I	> 30 kg	0600-00-0128

Nellcor SpO_2 Module			
Type	**Model**	**Patient Category**	**Part No.**
Disposable	MAXAI	Adult (>30Kg)	0010-10-12202
	MAXPI	Pediatric (10 to 50Kg)	0010-10-12203
	MAXII	Infant (3 to 20Kg)	0010-10-12204
	MAXNI	Neonate (<3Kg), Adult (>40Kg)	0010-10-12205
Reusable	DS-100A	Adult	9000-10-05161
	OXI-P/I	Pediatric, infant	9000-10-07308
	OXI-A/N	Adult, neonate	9000-10-07336
	D-YS	Adult, pediatric, infant, neonate	0010-10-12476

- 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.

24.3 NIBP Accessories

Tubing

Type	Patient Category	Part No.
Reusable	Adult, pediatric, infant	6200-30-09688
	Neonate	6200-30-11560

Reusable Cuff

Model	Patient Category	Measurement Site	Limb Circumference (cm)	Bladder Width (cm)	Part No.
CM1200	Small infant	Arm	7 to 13	5.8	115-002480-00
CM1201	Infant		10 to 19	9.2	0010-30-12157
CM1202	Pediatric		18 to 26	12.2	0010-30-12158
CM1203	Adult		24 to 35	15.1	0010-30-12159
CM1204	Large adult		33 to 47	18.3	0010-30-12160
CM1205	Adult thigh	Thigh	46 to 66	22.5	0010-30-12161
CM1300	Small infant	Arm	7 to 13	5.8	040-000968-00
CM1301	Infant		10 to 19	9.2	040-000973-00
CM1302	Pediatric		18 to 26	12.2	040-000978-00
CM1303	Adult		24 to 35	15.1	040-000983-00
CM1304	Large adult		33 to 47	18.3	040-000988-00
CM1305	Adult thigh	Thigh	46 to 66	22.5	040-000993-00
CM1306	Adult	Arm	24 to 35	15.1	115-015930-00
CM1307	Large adult	Arm	33 to 47	18.3	115-015931-00

Single-Patient Cuff

Model	Patient Category	Measurement Site	Limb Circumference (cm)	Bladder Width (cm)	Part No.
CM1500A	Neonate	Arm	3.1 to 5.7	2.2	001B-30-70677
CM1500B			4.3 to 8.0	2.9	001B-30-70678
CM1500C			5.8 to 10.9	3.8	001B-30-70679
CM1500D			7.1 to 13.1	4.8	001B-30-70680
CM1500E			8 to 15	/	001B-30-70681
CM1501	Infant		10 to 19	7.2	001B-30-70682
CM1502	Pediatric		18 to 26	9.8	001B-30-70683
CM1503	Adult		25 to 35	13.1	001B-30-70684
CM1504	Large adult		33 to 47	16.5	001B-30-70685
CM1505	Adult	Thigh	46 to 66	20.5	001B-30-70686
CM1506	Adult	Arm	25 to 35	13.1	115-016969-00
CM1507	Adult	Arm	33 to 47	16.5	115-016709-00

24.4 Temp Accessories

Temp Cable

Type	Model	Remark	Part No.
Extension cable (reusable)	MR420B	Applicable to sensor MR411 and MR412	0011-30-37391
Transition cable	MR421	/	0010-30-43056

Temp Probes

Type	Model	Patient Category	Measurement Site	Part No.
Reusable	MR401B	Adult	Esophageal/Rectal	0011-30-37392
	MR403B		Skin	0011-30-37393
	MR402B	Pediatric, infant	Esophageal/Rectal	0011-30-37394
	MR404B		Skin	0011-30-37395
Disposable	MR411	Adult, pediatric, infant	Esophageal/Rectal	0011-30-37398
	MR412		Skin	0011-30-37397

24.5 IBP/ICP Accessories

IBP		
Accessories Kit No.	**Components**	**Part No.**
6800-30-50876 (Hospira)	IM2201 12Pin IBP Cable	001C-30-70759
	Disposable Transducer	0010-10-42638
	Steady Rest for IBP Transducer and Clamp	M90-000133---
	Steady Rest for IBP Transducer and Clamp	M90-000134---
6800-30-50877 (BD)	IM2202 12Pin IBP Cable	001C-30-70757
	Disposable Pressure Transducer	6000-10-02107
	Transducer/Manifold Mount	0010-10-12156
115-020884-00 (Mindray)	IBP accessory kit, 12 pin	/
ICP		
Model	**Material**	**Part No.**
Gaeltec TYPE.S13	12Pin ICP cable	0010-30-42742
Gaeltec ICT/B	Intracranial Pressure Transducer	0010-10-12151
82-6653	ICP sensor kit, disposable	040-002336-00
IBP adapter cable		
Model	**Material**	**Part No.**
/	IBP extended cable with dual-receptacle	040-001029-00

It is proved through tests that the following accessories are compatible with the patient monitor. Only the accessories proceeded by "*" are available from our company. If you want to purchase other accessories, contact respective manufacturers and make sure if these accessories are approved for sale in local.

Manufacturer	Accessories
Smith Medical (Medex)	MX961Z14 Logical Cable, to be used in connection with the Adapter Cable (0010-20-42795) MX960 Reusable Transducer Kit MX261 Logical Clamp For Transducer Bracket MX262 Logical Clamp For 2 Transducer Mount Plates MX960E6441 Logical Transducer Mounting Plate (More Logical Clamps are available from Medex. For detailed information, contact Medex.)
Braun	IBP Reusable Cable (REF: 5203511), to be used in connection with the Adapter Cable (0010-20-42795) Combitrans Monitoring Set (contact Braun for detailed information) Combitrans Attachment Plate Holder (REF:5215800) Combitrans Attachment Plate (contact Braun for detailed information)
Memscap	*Truck cable (0010-21-43082) SP844 Physiological Pressure Transducer 844-26 Monitoring Line Set 84X-49 Mounting Bracket
Utah	Reusable Blood Pressure Monitor Interface Cable (REF: 650-206) Deltran Disposable Pressure Transducer System (More Deltran sensors are available from Utah. For detailed information, contact Utah.) Pole Mount Unit (ERF: 650-150) Deltran Three Slot Organizer, Attaches to I.V. Pole Mount (REF: 650-100) Deltran Four Slot Organizer, Attaches to I.V. Pole Mount (REF: 650-105)
Edwards	* IBP Truwave Reusable Cable (0010-21-12179) Pressure Monitoring Kit With Truwave Disposable Pressure Transducer. (More Truwave sensors are available from Edwards. For detailed information, contact Edwards.) DTSC IV Pole Clamp for Model DTH4 Backplate Holder DTH4 Disposable Holder for DPT

24.6 CO_2 Accessories

Sidestream CO_2 module

Material	Patient Category	Remark	Part No.
DRYLINE Ⅱ Water Trap	Adult, pediatric	Reusable	100-000080-00
DRYLINE Ⅱ Water Trap	Neonate		100-000081-00
Sampling Line, Adult 2.5m	Adult, pediatric	Disposable	9200-10-10533
Sampling Line, Neonate, 2.5m	Neonate		9200-10-10555
Adult Nasal CO_2 Sample Cannula	Adult		M02A-10-25937
Pediatric Nasal CO_2 Sample Cannula	Pediatric		M02A-10-25938
Infant Nasal CO_2 Sample Cannula	Neonate		M02B-10-64509
DRYLINE Airway Adapter	Adult, pediatric	Straight, disposable	9000-10-07486
DRYLINE Airway Adapter	Neonate		040-001187-00
DRYLINE Airway Adapter	Adult, pediatric	Elbow, disposable	9000-10-07487

Microstream CO_2 Module

Disposable Airway Sampling Line			
Model	**Patient Category**	**Remark**	**Part No.**
XS-04620	Adult, pediatric	/	0010-10-42560
XS-04624		Humidified	0010-10-42561
007768		Long	0010-10-42563
007737		Long, humidified	0010-10-42564
006324	Infant, Neonate	Humidified	0010-10-42562
007738		Long, humidified	0010-10-42565

Disposable Nasal Sampling Line			
Model	**Patient Category**	**Remark**	**Part No.**
009818	Adult, intermediate	/	0010-10-42566
009822		Plus O_2	0010-10-42568
009826		Long, plus O_2	0010-10-42570
008174	Adult	/	0010-10-42577
008177		Humidified	0010-10-42572
008180		Humidified, plus O_2	0010-10-42575
007266	Pediatric	/	0010-10-42567
008175		/	0010-10-42578
008178		Humidified	0010-10-42573
008181		Humidified, plus O_2	0010-10-42576
007269		Plus O_2	0010-10-42569
007743		Long, plus O_2	0010-10-42571
008179	Infant, Neonate	Humidified	0010-10-42574

Mainstream CO_2 Module

Material	Model	Patient Category	Remark	Part No.
Airway adapter	6063	Adult, pediatric	Disposable	0010-10-42662
	6421		Disposable, with mouthpiece	0010-10-42663
	7007		Reusable	0010-10-42665
	6312	Neonate, pediatric	Disposable	0010-10-42664
	7053		Reusable	0010-10-42666
Mask	9960STD	Adult	/	0010-10-42670
	9960LGE		Adult large	0010-10-42669
	9960PED	Pediatric	/	0010-10-42671
Cable management straps	6934-00	/	/	0010-10-42667
Sensor holding clips	8751	/	/	0010-10-42668
Sensor	1022386	Adult, pediatric, neonate	Reusable	6800-30-50760

24.7 PiCCO Accessories

Material	Model	Part No.	Remark
12-pin IBP Y Cable	IM2203	040-000815-00	Reusable
12-pin PiCCO Cable	CO7701	040-000816-00	Reusable
2-pin Injectate Temperature Sensor Cable	PC80105	040-000817-00	Reusable
Arterial Thermodilution Catheter	PV2015L20	040-000921-00	Disposable, adult
	PV2013L07	040-000922-00	Disposable, pediatric
PiCCO Monitoring Kits	PV8115	040-000918-00	Disposable

24.8 Others

Material	Part No.
Lithium battery, LI12I002A	022-000185-00
Three-core power cable	509B-10-05996
Power cord (India)	0000-10-10903
Domestic power cord (America)	DA8K-10-14452
Three-wire power cord (Britain)	DA8K-10-14453
Three-wire power cord (Europe)	DA8K-10-14454
AC/DC adapter	022-000059-00
	022-000102-00
BeneView data output package	6800-30-51213
USB drive, 4G	023-000217-00
	023-000218-00
Bedrail hook kit	115-010857-00
Pole mounting kit	115-010858-00
Monitor handle	115-011824-00
BeneView T1 connecting cable	009-002234-00
Display, 19", touchscreen	023-000692-00
Display, 19"	023-001129-00
9261 roll stand	045-000924-00
Wall mount bracket for 6800 keyboard	045-000934-00
T1 dock wall mount kit	045-001228-00
T1 dock wall mount bracket	045-001231-00
Display wall mount bracket	045-001229-00
T1 dock data cable, 1 m	009-003591-00
T1 dock data cable, 4 m	009-003592-00
Cable protecting tube	009-003648-00
Accessories management tape	009-003903-00

A Product Specifications

A.1 Classifications

The patient monitor is classified, according to IEC60601-1:

Type of protection against electrical shock	Class I, equipment energized from an external and internal electrical power source.
Degree of protection against electrical shock	Type BF defibrillation proof for CO_2 monitoring Type CF defibrillation proof for ECG, RESP, TEMP, SpO2, NIBP, IBP, and CCO.
Mode of operation	Continuous
Degree of protection against harmful ingress of water	Main unit: IPX2 (Protected against vertically falling water drops when ENCLOSURE tilted up to 15°) T1 docking station, handle: IPX1 (Protected against vertically falling water drops)
Degree of protection against hazards of explosion	Not suitable: Equipment not suitable for use in the presence of a flammable anesthetic mixture with air with oxygen or nitrous oxide.

A.2 Environmental Specifications

WARNING

- **The equipment may not meet the performance specifications if stored or used outside the specified temperature and humidity ranges.**

Main unit		
Item	**Operating conditions**	**Storage conditions**
Temperature (℃)	0 to 40	-30 to 70
Relative humidity (noncondensing)	15% to 95%	10% to 95%
Barometric (kPa)	57.0 to 107.4	16.0 to 107.4

Microstream CO_2 module		
Item	**Operating conditions**	**Storage conditions**
Temperature (℃)	0 to 40	-20 to 60
Relative humidity (noncondensing)	15% to 95%	10% to 95%
Barometric (mmHg)	57.3 to 105.3	57.3 to 105.3

Sidestream CO_2 module		
Item	**Operating conditions**	**Storage conditions**
Temperature (℃)	5 to 40	-20 to 60

Relative humidity (noncondensing)	15% to 95%	10% to 95%
Barometric (mmHg)	57.3 to 105.3	57.3 to 105.3
Mainstream CO_2 module		
Item	**Operating conditions**	**Storage conditions**
Temperature (℃)	0 to 40	-20 to 60
Relative humidity (noncondensing)	15% to 90%	10% to 90%
Barometric (mmHg)	57.0 to 107.4	53.3 to 107.4

PiCCO module		
Item	**Operating conditions**	**Storage conditions**
Temperature (℃)	10 to 40	-20 to 60
Relative humidity (noncondensing)	15% to 75%	10% to 90%
Barometric (mmHg)	57.0 to 107.4	16.0 to 107.4

Battery charger, T1 handle, T1 docking station		
Item	**Operating conditions**	**Storage conditions**
Temperature (℃)	0 to 40	-20 to 60
Relative humidity (noncondensing)	15% to 95%	10% to 95%
Barometric (mmHg)	57.0 to 107.4	16.0 to 107.4

NOTE

- **The environmental specifications of unspecified parameters are the same as those of the main unit.**

A.3 Power Supply Specifications

External DC power supply	
Input voltage	12 VDC (±10%)
Input current	2 A
DC adapter	
Input	100 to 240 VAC (±10%), 50/60 Hz (±3 Hz)
Output	12VDC, minimum 2A
T1 docking station	
Input voltage	100 to 240VAC (±10%)
Input current	0.65A to 0.35A
Frequency	50/60Hz (±3Hz)
Battery	
Battery Type	Chargeable Lithium-Ion
Capacity	2500 mAh
Charge time	**Charge battery with the patient monitor:** Less than 3 hours to 90% and less than 4 hours to 100% with equipment power off; Less than 12 hours to 90% and less than 14 hours to 100% with equipment power on. **Charge battery with the battery charger:** Less than 3 hours to 90% Less than 4 hours to 100%
Run time	when powered by a new fully-charged battery at 25℃ with ECG and SpO_2 cable connected, and auto NIBP measurements at an interval of 15 minutes: 5 h if charged by a battery charger 4.5 h if charged by installing in the monitor Battery run time varies as per system configuration and settings.
Shutdown delay	at least 20 minutes (after a low battery alarm first occurs)

A.4 Physical Specifications

	Size	Weight
Patient monitor	≤142 mm×81 mm×102 mm	≤1 kg
Battery	≤74 mm×47 mm×24 mm	≤0.15 kg
T1 handle	≤165 mm×130mm×168mm	≤1.6kg (with the T1 and battery)
T1 docking station	≤190mm×125mm×155mm	≤0.95kg
Sidestream CO_2 module	136.5×40×102 mm	<0.60 kg
Microstream CO_2 module	136.5×40×102 mm	<0.37 kg
Mainstream CO_2 module	136.5×40×102 mm	<0.50 kg
PiCCO module	136.5×40×102 mm	<0.28 kg

A.5 Hardware Specifications

A.5.1 Display

Host display	
Screen type	Color TFT LCD
Screen Size	5 inch
Resolution	480×272 pixels
External display	
Screen type	Color TFT LCD
Screen Size	19 inch
Resolution	800×600 pixels

A.5.2 Equipment connector

Main unit

Multifunctional connector	1
DC input	1
Main unit multi-pin connector	1

T1 handle

T1 handle multi-pin connector 1	1
T1 handle multi-pin connector 2	1
Infrared filter	1
Contact	2
Pogo pin	3

T1 docking station

Network connector	1
Equipotential grounding terminal	1
AC power input	1
VGA connector	1
External device connector	1
USB connector:	2
T1 docking station multi-pin connector	1

A.5.3 LEDs

Main unit

Alarm lamp	1 (two colors: yellow and red)
Power on LED	1 (green)
External power LED	1 (green)
Battery LED	1 (green)

T1 docking station

Connection status indicator	1 (green)
External power supply indicator	1 (green)

A.5.4 Audio Indicator

Speaker	Give alarm tones (45 to 85 dB), key tones, QRS tones; support PITCH TONE and multi-level tone modulation; alarm tones comply with IEC60601-1-8.

A.5.5 Outputs

Analog Output		
Standard	Meets the requirements of IEC60601-1 for short-circuit protection and leakage current	
ECG Analog Output		
Bandwidth (-3dB; reference frequency: 10Hz)	Diagnostic mode: Monitor mode: Surgical mode: ST mode:	0.05 to 150 Hz 0.5 to 40 Hz 1 to 20 Hz 0.05 to 40 Hz
QRS delay	≤ 25 ms (in diagnostic mode, and with Paced off)	
Sensitivity	1V/mV ±5%	
PACE rejection/enhancement	Pace enhancement Signal amplitude: Voh≥2.5V Pulse width: 10ms±5% Signal rising and falling time: ≤100μs	
IBP Analog Output		
Bandwidth (-3dB; reference frequency:1Hz)	DC to 40 Hz	
Max transmission delay	30 ms	
Sensitivity	1 V/100 mmHg ±5%	
Defib Sync Pulse		
Output impedance	≤100Ω	
Max time delay	35 ms (R-wave peak to leading edge of pulse)	
Amplitude	High level: 3.5 to 5 V, 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%	
Rising and falling time	≤1 ms	

Alarm output (RJ45 connector)	
Alarm delay time from patient monitor to remote equipment	The alarm delay time from the patient monitor to remote equipment is ≤2 seconds, measured at the patient monitor's signal output terminal.

A.6 Data Storage

Trends	Trends: 120 hours, at 1 min resolution Mid-length trends: 4 hours, at 5 s resolution Minitrends: 1 hour, at 1 s resolution
Alarm events	100 physiological alarms and manual events and related parameter waveforms.
Arrh. events	100 arrhythmia events and relate waveforms and parameters.
NIBP measurements	1000 sets
Full-disclosure waveforms	48 hours at maximum. The specific storage time depends on the waveforms stored and the number of stored waveforms.

A.7 Wireless Network

Standards	WM1010BGN Wireless Module: IEEE 802.11b/g/n, support Wi-Fi MSD45N Wireless Module: IEEE 802.11a/b/g/n, support Wi-Fi

A.8 Measurement Specifications

The adjustable range of alarm limits is the same with the measurement range of signals unless otherwise specified.

A.8.1 ECG

ECG		
Standards	IEC60601-2-27 and IEC60601-2-25	
Lead set	3-lead: I, II, III 5-lead: I, II, III, aVR, aVL, aVF, V 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) Accuracy: ±5%	
Sweep speed	6.25 mm/s, 12.5 mm/s, 25 mm/s, 50 mm/s Accuracy: ±10%	
Bandwidth (-3dB)	Diagnostic mode: Monitor mode: Surgical mode: ST mode:	0.05 to 150 Hz 0.5 to 40 Hz 1 to 20 Hz 0.05 to 40 Hz

Common mode rejection ratio (with Notch off)	Diagnostic mode: >90 dB Monitor mode: >105 dB Surgical mode: >105 dB ST mode: >105 dB
Notch	50/60 Hz
Differential input impedance	≥5 MΩ
Input signal range	±8 mV (peak-to-peak value)
Accuracy of reappearing input signal	Use A and D methods based on EC11 to determine system total error and frequency response.
Electrode offset potential tolerance	±500 mV
Lead-off detection current	Measuring electrode: <0.1 μA Drive electrode: <1 μA
Input offset current	Measuring electrode: ≤0.1 μA Drive electrode: ≤1 μA
Baseline recovery time	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 μA
Calibration signal	1mV (peak-to-peak value) Accuracy: ±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 IEC60601-2-27
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
Pace pulse rejection	When tested in accordance with theIEC60601-2-27: 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
Sampling rate	500 samples/s (A/D) 500 samples/s (ECG algorithm)
Accuracy	2.44 μV/LSB
HR	
Measurement range	Neonate: 15 to 350 bpm Pediatric: 15 to 350 bpm Adult: 15 to 300 bpm
Resolution	1 bpm
Accuracy	±1 bpm or ±1%, whichever is greater.
Sensitivity	200μV (lead II)

<table>
<tr><td>HR averaging method</td><td>Mindray algorithm</td><td>Mortara algorithm</td></tr>
<tr><td></td><td>In compliance with the requirements in Clause 201.7.9.2.9.101 b) 3) of IEC60601-2-27, 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 every second.</td><td>In compliance with the requirements in Clause 201.7.9.2.9.101 b) 3) of IEC60601-2-27, the following method is used:
Heart rate is computed by averaging the most recent 16 RR intervals, unless the HR by averaging the most recent 4 heart beats is less than or equals to 48.
The HR value displayed on the monitor screen is updated every second.</td></tr>
<tr><td>Response to irregular rhythm</td><td colspan="2">In compliance with the requirements in Clause 201.7.9.2.9.101 b) 4) of IEC60601-2-27, the heart rate after 20 seconds of stabilization is displayed as follows:
Ventricular bigeminy (3a): 80±1 bpm
Slow alternating ventricular bigeminy (3b): 60±1 bpm
Rapid alternating ventricular bigeminy (3c): 120±1 bpm
Bidirectional systoles (3d): 90±2 bpm</td></tr>
<tr><td>Response time to heart rate change</td><td colspan="2">Meets the requirements of IEC60601-2-27: 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</td></tr>
<tr><td>Time to alarm for tachycardia
(not available in USA)</td><td colspan="2">Waveform
4ah - range: < 11 s
4a - range: < 11 s
4ad - range: < 11 s
4bh - range: < 11 s
4b - range: < 11 s
4bd - range: < 11 s</td></tr>
<tr><td>Tall T-wave rejection capability</td><td colspan="2">When the test is performed based on Clause 201.7.9.2.9.101 b) 2)of IEC60601-2-27, the heart rate meter will reject all 100 ms QRS complexes with less than 1.2 mV of amplitude, and T waves with T-wave interval of 180 ms and those with Q-T interval of 350 ms.</td></tr>
<tr><td>Arrhythmia Analysis Classifications</td><td>Mindray algorithm</td><td>Mortara algorithm</td></tr>
<tr><td></td><td>Asystole, VFib/VTac, Vtac, Vent. Brady, Extreme Tachy, Extreme Brady, PVC, Couplet, Bigeminy, Trigeminy, R on T, Run PVCs, PVCs, Tachy, Brady, Missed Beats, Vent. Rhythm, PNP, PNC, Multif. PVC, Nonsus. Vtac, Pause, Irr. Rhythm, Afib</td><td>Asystole, Vfib, Vtac, Vent. Rhythm, Couplet, Run PVCs, Bigeminy, Trigeminy, R on T, Multif. PVC, Irr. Rhythm, Tachy, Brady, Missed Beats, PNP, PNC</td></tr>
</table>

ST Segment Analysis		
Measurement range	-2.0 to +2.0 mV RTI	
Accuracy	-0.8 to +0.8 mV: ±0.02 mV or ±10%, whichever is greater Beyond this range: Not specified	
Refreshing rate	10 s (Mindray algorithm), or per 16 heartbeats (Mortara algorithm)	
Resolution	0.01 mV	
QT/QTc Analysis		
Measurement range	QT: 200 to 800 ms QTc: 200 to800 ms QT-HR: 15 to 150 bpm for adult, 15 to 180 bpm for pediatric and neonate	
QT Accuracy	±30 ms	
Resolution	QT: 4 ms QTc: 1 ms	
Alarm limit	**Range**	**Step**
HR High	(low limit + 2) to 300 bpm	1 bpm
HR Low	15 to (high limit – 2) bpm	
ST High	(low limit +0.2) to 2.0 mV	0.1 mV
ST Low	-2.0 to (high limit – 0.2) mV	
QTc High	200 to 800 ms	10 ms
∆ QTc High	30 to 200 ms	

A.8.2 Resp

Technique	Trans-thoracic impedance	
Lead	Options are lead I and II. The default is lead II.	
Respiration excitation waveform	<300 μA RMS, 62.8 kHz (±10%)	
Baseline impedance range	200 to 2500Ω (using an ECG cable with 1kΩ resistance)	
Bandwidth	0.2 to 2.5 Hz (-3 dB)	
Sweep speed	3mm/s, 6.25 mm/s, 12.5 mm/s, 25 mm/s, or 50 mm/s Accuracy: ±10%	
Respiration Rate		
Measurement range	0 to 200 rpm	
Resolution	1 rpm	
Accuracy	0 to 120 rpm: ±1 121 to 200 rpm: ±2	
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	Adult, pediatric: (low limit + 2) to 100 Neonate: (low limit + 2) to 150	1
RR Low	0 to (high limit – 2)	

A.8.3 SpO_2

Alarm limit	Range (%)	Step (%)
SpO2 High	(low limit + 2) to 100	1
SpO2 Low	Mindray, Masimo: Desat to (high limit – 2) Nellcor: Desat or 20 (whichever is greater) to (high limit – 2)	
Desat	0 to (high limit – 2)	

Mindray SpO_2 Module

Standards	Meet standards of ISO80601-2-61
*Measurement accuracy verification: The SpO_2 accuracy has been verified in human experiments by comparing with arterial blood sample reference measured with a CO-oximeter. Pulse oximeter measurements are statistically distributed and about two-thirds of the measurements are expected to come within the specified accuracy range compared to CO-oximeter measurements.	
SpO_2 measurement range	0 to 100%
PI measurement range	0.05% to 20%
SpO_2 resolution	1%
Response time	≤ 30 s (PI > 0.3, no disturbance, SpO_2 value sudden change within 70% - 100%)
Accuracy	70% to 100%: ±2% (adult/pediatric mode) 70% to 100%: ±3% (neonate mode) 0 to 69%: Not specified.

*Studies were performed to validate the accuracy of Pulse Oximeter with neonatal SpO_2 sensors by contrast with a CO-Oximeter. Some neonates aged from 1 day to 30 days with a gestation age of 22 weeks to full term were involved in this study. The statistical analysis of data of this study shows the accuracy (Arms) is within the stated accuracy specification. Please see the following table.

Sensor type	Totally neonates	Data	Arms
518B	97 (51 male & 46 female)	200 pairs	2.38%
520N	122 (65 male & 57 female)	200 pairs	2.88%

The Pulse Oximeter with neonatal SpO_2 sensors was also validated on adult subjects.	
Refreshing rate	1 s

Masimo SpO_2 Module

Standards	Meet standards of ISO9919
SpO_2 measurement range	1% to 100%
PI measurement range	0.02% to 20%
SpO_2 resolution	1%
Response time	≤ 20 s (PR 75 bpm, average time 8 s, SpO_2 value rises from 60% to 95%)
Accuracy [1]	70% to 100%: ±2% (measured without motion in adult/pediatric mode) 70% to 100%: ±3% (measured without motion in neonate mode) 70% to 100%: ±3% (measured with motion) 1% to 69%: Not specified.
Refreshing rate	≤ 2 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]	±2%

[1] The Masimo pulse oximeter with sensors have been validated for no motion accuracy in human blood studies on healthy adult volunteers in induced hypoxia studies in the range of 70% to 100% SpO_2 against a laboratory co-oximeter and ECG monitor. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population. One percent was added to the accuracies for neonatal sensors to account for accuracy variation due to properties of fetal hemoglobin.

The Masimo pulse oximeter with sensors has been validated for motion accuracy in human blood studies on healthy adult volunteers in induced hypoxia studies while performing rubbing and tapping motions at 2 to 4 Hz. At an amplitude of 1 to 2 cm and non-repetitive motion between 1 to 5 Hz. At an amplitude of 2 to 3 cm in induced hypoxia studies in the range of 70% to 100% SpO_2 against a laboratory co-oximeter and ECG monitor. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

[2] The Masimo pulse oximeter has been validated for low perfusion accuracy in bench top testing against a Biotek Index 2 simulator and Masimo's simulator with signal strengths of greater than 0.02% and a % transmission of greater than 5% for saturations ranging from 70 to 100%. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

Nellcor SpO_2 Module

Standards	Meet standards of ISO9919
Measurement range	0 to 100%
Resolution	1%
Response time	≤ 30 s (PI > 0.3, no disturbance, SpO_2 value sudden change within 70% - 100%)
Accuracy	70% to 100%: ±2% (adult/pediatric) 70% to 100%: ±3% (neonate) 0 to 69%: Not specified.
When the SpO_2 sensor is applied for neonatal patients as indicated, the specified accuracy range is increased by ±1%, to compensate for the theoretical effect on oximeter measurements of fetal hemoglobin in neonatal blood.	

Information of the Test Subjects of the Clinical Study Report:

Skin color	Gender	Number	Age (years)	Health
Black	Male	1	28.2±9.19	Healthy
	Female	1		
Yellow	Male	3		
	Female	9		

A.8.4 PR

Alarm limit	Range (bpm)	Step (bpm)
PR High	(low limit +2) to 300	1
PR Low	15 to (high limit-2)	

PR from Mindray SpO_2 Module

Measurement range	20 to 300 bpm
Resolution	1 bpm
Response time	≤ 30 s (PI > 0.3, no disturbance, PR value sudden change within 25 – 250 bpm)
Accuracy	±3 bpm
Refreshing rate	1 s

PR from Masimo SpO_2 Module

Measurement range	25 to 240 bpm
Resolution	1 bpm
Response time	≤ 30 s (PI > 0.3, no disturbance, PR value sudden change within 25 – 240 bpm)
Accuracy	±3 bpm (measured without motion) ±5 bpm (measured with motion)
Refreshing rate	≤ 2 s
Low perfusion conditions	Pulse amplitude: >0.02% Light penetration: >5%
Low perfusion PR accuracy	±3 bpm

PR from Nellcor SpO_2 Module

Measurement range	20 to 300 bpm
Resolution	1 bpm
Response time	≤ 30 s (PI > 0.3, no disturbance, PR value sudden change within 25 – 250 bpm)
Accuracy	20 to 250 bpm: ±3 bpm 251 to 300 bpm, not specified
Refreshing rate	≤ 2 s

PR from IBP Module

Measurement range	25 to 350 bpm
Resolution	1 bpm
Accuracy	±1 bpm or ±1%, whichever is greater
Refreshing rate	1 s

PR from NIBP Module

Measurement range	30 to 300 bpm
Resolution	1 bpm
Accuracy	±3bpm or ±3%, whichever is greater

A.8.5 NIBP

Standards	Meet standards of IEC80601-2-30, ISO 81060-2			
Technique	Oscillometry			
Mode of operation	Manual, Auto and STAT			
Auto mode repetition intervals	1 min, 2 min, 2.5 min, 3 min, 5 min, 10 min, 15 min, 20 min, 30 min, 1 h, 1.5 h, 2 h, 3 h, 4 h, 8 h60, 90, 120, 180, 240 or 480 min			
STAT mode cycle time	5 min			
Max measurement time	Adult, pediatric: 180 s			
	Neonate: 90 s			
Measurement ranges (mmHg)		**Adult**	**Pediatric**	**Neonate**
	Systolic:	25 to 290	25 to 240	25 to 140
	Diastolic:	10 to 250	10 to 200	10 to 115
	Mean:	15 to 260	15 to 215	15 to 125
Accuracy	Max mean error: ±5 mmHg Max standard deviation: 8 mmHg			
Static pressure measurement range	0mmHg to 300mmHg			
Static pressure measurement accuracy	±3mmHg			
Resolution	1mmHg			
Initial cuff inflation pressure range (mmHg)	Adult: 80 to 280 Pediatric: 80 to 210 Neonate: 60 to 140			
Default initial cuff inflation pressure (mmHg)	Adult: 160 Pediatric: 140 Neonate: 90			
Software overpressure protection	Adult: 297±3 mmHg Pediatric: 297±3 mmHg Neonate: 147±3 mmHg			
Hardware overpressure protection	Adult: ≦330 mmHg Pediatric: ≦330 mmHg Neonate: ≦165 mmHg			

Alarm limit	**Range (mmHg)**	**Step (mmHg)**
Sys High	Adult: (low limit+5) to 270 Pediatric: (low limit+5) to 200 Neonate: (low limit+5) to 135	NIBP ≤ 50: 1 NIBP > 50: 5
Sys Low	40 to (high limit-5)	
Mean High	Adult: (low limit+5) to 230 Pediatric: (low limit+5) to 165 Neonate: (low limit+5) to 110	
Mean Low	20 to (high limit-5)	
Dia High	Adult: (low limit+5) to 210 Pediatric: (low limit+5) to 150 Neonate: (low limit+5) to 100	
Dia Low	10 to (high limit-5)	

*Measurement accuracy verification: In adult and pediatric modes, the blood pressure measurements measured with this device are in compliance with the Standard for Non-invasive sphygmomanometers (ISO 81060-2) in terms of mean error and standard deviation by comparing with intra-arterial or auscultatory measurements (depending on the configuration) in a typical patient population. For auscultatory reference, the 5th Korotkoff sound was used to determine the diastolic pressure. In neonatal mode, the blood pressure measurements measured with this device are in compliance with the Standard for Non-invasive sphygmomanometers (ISO 81060-2) in terms of mean error and standard deviation by comparing with intra-arterial measurements (depending on the configuration) in a typical patient population.

A.8.6 Temp

Standards	Meet standard of ISO 80601-2-56
Technique	Thermal resistance
Operating mode	Direct mode
Measurement range	0 to 50 ℃ (32 to 122 ℉)
Resolution	0.1 ℃
Accuracy	±0.1 ℃ (without probe)
Refreshing rate	1 s
Response time	<5 s
Minimum time for accurate measurement	Body surface: <100 s Body cavity: <80 s
Minimum time between measurements	Body surface probe: <100 s Body cavity probe: <80 s

Alarm limit	**Range**	**Step**
T1/T2 High	(low limit +1) to 50 ℃	0.1 ℃
T1/T2 Low	0.1 to (high limit -1) ℃	
TD High	0.1 to 50 ℃	

A.8.7 IBP

Standards	Meet standard of IEC60601-2-34.
Technique	Direct invasive measurement
IBP	
Measurement range	-50 to 360 mmHg
Resolution	1 mmHg
Accuracy	±2% or ±1 mmHg, whichever is greater (without sensor)
Refreshing rate	1 s
Pressure transducer	
Excitement voltage	5 VDC, ±2%
Sensitivity	5 μV/V/mmHg
Zero adjustment range	±200 mmHg
Impedance range	300 to 3000Ω

Alarm limit	**Range (mmHg)**	**Step (mmHg)**
Sys High	(low limit + 2) to 360	1
Mean High		
Dia High		
Sys Low	-50 to (high limit – 2)	
Mean Low		
Dia Low		

A.8.8 CO_2

Measurement mode	Sidestream, microstream, mainstream
Technique	Infrared absorption

Sidestream CO_2 Module

Standard	Meet standard of ISO 80601-2-55
CO_2 Measurement range	0 to 99 mmHg
Accuracy*	0 to 40 mmHg: ±2 mmHg 41 to 76 mmHg: ±5% of the reading 77 to 99 mmHg: ±10% of the reading
*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.	
Accuracy drift	Meet the requirement for measurement accuracy within 6 hours
Resolution	1 mmHg
Sample flowrate(module PN: 115-020189-00)	Adult: 70 ml/min, 100 ml/min, 120 ml/min, 150 ml/min Pediatric, neonate: 70 ml/min, 100 ml/min
Sample flowrate (module PN: 115-027545-00)	Connected a DRYLINE II watertrap for adult and pediatric patient: 120 ml/min Connected a DRYLINE II watertrap for neonatal patient: 90 ml/min
Sample flowrate tolerance	±15% or ±15 ml/min, whichever is greater.
Warm-up time	Iso accuracy mode: ≤45s Full accuracy mode: ≤10 min
Response time (module PN: 115-020189-00)	Measured with a neonatal watertrap and a 2.5-meter neonatal sampling line: <3.5 s @ 100 ml/min <4 s @ 70 ml/min Measured with an adult watertrap and a 2.5-meter adult sampling line: <4.5 s @ 150 ml/min <5.5 s @ 120 ml/min <5.5 s @ 100 ml/min <7 s @ 70 ml/min
Response time (module PN: 115-027545-00)	Measured with a DRYLINE II neonatal watertrap and a 2.5-meter neonatal sampling line: <4.5 s @ 90 ml/min Measured with a DRYLINE II adult watertrap and a 2.5-meter adult sampling line: <5.5 s @ 120 ml/min
Rise time(module PN: 115-020189-00)	Measured with a neonatal watertrap and a 2.5-meter neonatal sampling line, or an adult watertrap and a 2.5-meter adult sampling line: <400 ms @ 70 ml/min <330 ms @ 100 ml/min <300 ms @ 120 ml/min <240 ms @ 150 ml/min

Rise time (module PN: 115-027545-00)	Measured with a DRYLINE II neonatal watertrap and a 2.5-meter neonatal sampling line: <330 ms@90 ml/min. Measured with a DRYLINE II adult watertrap and a 2.5-meter adult sampling line: <300 ms@120 ml/min
awRR measurement range	0 to 120 rpm
awRR measurement precision	±2 rpm
Apnea time	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s

Note: The response time is the sum of the rise time and the delay time.

Effect of interference gases on CO_2 measurements		
Gas	**Concentration (%)**	**Quantitive 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 - 40mmHg. 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.		

Alarm limit	**Range**	**Step**
$EtCO_2$ High (mmHg)	(low limit + 2) to 99	1
$EtCO_2$ Low (mmHg)	1 to (high limit - 2)	
$FiCO_2$ High (mmHg)	1 to 99	
awRR High (rpm)	Adult, pediatric: (low limit + 2) to 100 Neonate: (low limit + 2) to 150	1
awRR Low (rpm)	0 to (high limit - 2)	

Microstream CO_2 Module

Standard	Meet standard of ISO 21647
CO_2 Measurement range	0 to 99 mmHg
Accuracy*	0 to 38 mmHg: ±2 mmHg 39 to 99 mmHg: ±5% of the reading+0.08% of (the reading-38)
Accuracy drift	Meet the requirement for measurement accuracy within 6 hours
* Accuracy applies for respiration rate up to 80 rpm. For respiration rate above 80 rpm, the accuracy is 4 mmHg or ±12% of the reading, whichever is greater, for $EtCO_2$ exceeding 18 mmHg. For respiration rate above 60 rpm, the above accuracy can be achieved by using the CapnoLine H Set for Infant/Neonatal. In the presence of interfering gases, the above accuracy is maintained to within 4%.	
Resolution	1 mmHg
Sample flow rate	$50^{-7.5}_{+15}$ ml/min
Initialization time	30 s (typical)

Response time	Measured with a FilterLine of standard length: 2.9 s (typical), 4.5 s (Maximum) The response time is the sum of the rise time and the delay time 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
Apnea alarm time	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s

Alarm limit	Range	Step
$EtCO_2$ High (mmHg)	(low limit + 2) to 99	1
$EtCO_2$ Low (mmHg)	1 to (high limit - 2)	
$FiCO_2$ High (mmHg)	1 to 99	
awRR High (rpm)	Adult, pediatric: (low limit + 2) to 100 Neonate: (low limit + 2) to 150	1
awRR Low (rpm)	0 to (high limit - 2)	

Mainstream CO_2 Module

Standard	Meet standard of ISO 21647
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
Rise time	<60 ms
awRR measurement range	0 to 150 rpm
awRR measurement accuracy	±1 rpm
Apnea alarm time	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s
Accuracy (of the measured CO_2 partial pressure) applies for breath rates of up to 80 bpm. For breath rates above 80 bpm, accuracy is 4 mmHg or ±12 % of reading whichever is greater for $EtCO_2$ values exceeding 18 mmHg	

Alarm limit	Range	Step
$EtCO_2$ High (mmHg)	(low limit + 2) to 99	1 mmHg
$EtCO_2$ Low (mmHg)	1 to (high limit - 2)	
$FiCO_2$ High (mmHg)	1 to 99	
awRR High (rpm)	Adult, pediatric: (low limit + 2) to 100 Neonate: (low limit + 2) to 150	1 rpm
awRR Low (rpm)	0 to (high limit - 2)	

A.8.9 CCO

	Measurement range	Coefficient of variation
CCO	0.25 l/min to 25.0 l/min	≤2%
C.O.	0.25 l/min to 25.0 l/min	≤2%
GEDV	40ml to 4800 ml	≤3%
SV	1ml to 250 ml	≤2%
EVLW	10ml to 5000 ml	≤6%
ITBV	50ml to 6000 ml	≤3%
	Measurement range	**Measurement accuracy**
TB	25 ℃ to 45 ℃	±0.1 ℃ (without sensor)
TI	0 ℃ to 30 ℃	±0.1 ℃ (without sensor)
pArt	-50 mmHg to 300 mmHg	±2% or ±1 mmHg, whichever is greater (without sensor)
pCVP	-50 mmHg to 300 mmHg	±2% or ±1 mmHg, whichever is greater (without sensor)

* Coefficient of variation is measured using synthetic and/or database wave forms (laboratory testing).

Alarm limit	Range	Step
CCO High (L/min)	(low limit + 0.1) to 25	0.1
C.O. High (L/min)		
CCO Low (L/min)	0.3 to (high limit – 0.1)	
C.O. Low (L/min)		
CI High (L/min)	(low limit + 0.1) to 15	
CCI High (L/min)		
CI Low (L/min)	0.1 to (high limit – 0.1)	
CCI Low (L/min)		
pArt-S High (mmHg)	(low limit +2) to 300	1
pArt-D High (mmHg)		
pArt-M High (mmHg)		
pArt-S Low (mmHg)	-50 to (high limit – 2)	
pArt-D Low (mmHg)		
pArt-M Low (mmHg)		
pCVP-S High (mmHg)	(low limit +2) to 300	1
pCVP-D High (mmHg)		
pCVP-M High (mmHg)		
pCVP-S Low (mmHg)	-50 to (high limit – 2)	
pCVP-D Low (mmHg)		
pCVP-M Low (mmHg)		

FOR YOUR NOTES

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 device could result in increased electromagnetic emissions or decreased electromagnetic immunity of this device and result in improper operation.**
- **Use of this device adjacent to or stacked with other device should be avoided because it could result in improper operation. If such use is necessary, this device and the other device should be observed to verify that they are operating normally.**
- **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 device could result.**
- **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.**
- **This device is intended for use in professional healthcare facility EMC environment and home healthcare EMC environment only. 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.**

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 test	**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 device.
Conducted and radiated RF EMISSIONS CISPR 11	Class B (during patient transport)	The device is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Conducted and radiated RF	Class A	The device is suitable for use in all establishments other than domestic and those directly connected to

EMISSIONS CISPR 11		the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic distortion IEC 61000-3-2	Class A	The device is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Voltage fluctuations and flicker IEC 61000-3-3	Complies	

NOTE

- **The device needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided in Annex B.**
- **Other devices may affect 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.**
- **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.**

If the device 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**

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	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	±8 kV contact ±15kV air	±8 kV contact ±15kV 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 (length greater than 3 m)	±2 kV for power supply lines ±1 kV for input/output lines (length greater than 3 m)	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±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 0 % U_T for 1 cycle and 70 % U_T for 25/30 cycles 0 % U_T for 250/300 cycle	0 % U_T for 0,5 cycle 0 % U_T for 1 cycle and 70 % U_T for 25/30 cycles 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 A.C. mains voltage prior to application of the test level.			

<table>
<tr><th colspan="4">Guidance and Declaration - Electromagnetic Immunity</th></tr>
<tr><td colspan="4">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.</td></tr>
<tr><th>Immunity test</th><th>IEC 60601 Test level</th><th>Compliance level</th><th>Electromagnetic environment - guidance</th></tr>
<tr><td>Conducted disturbances induced by RF fields IEC61000-4-6</td><td>3 Vrms
150 kHz to 80 MHz</td><td>3 Vrms</td><td rowspan="6">Portable and mobile RF communications equipment should be used no closer to any part of the device, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance:
$d = \left[\frac{3.5}{V}\right]\sqrt{P}$ 150k to 80 MHz
$d = \left[\frac{3.5}{E}\right]\sqrt{P}$ 80 MHz to 800 MHz
$d = \left[\frac{7}{E}\right]\sqrt{P}$ 800 MHz to 2.7 GHz
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).
Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey[b], should be less than the compliance level in each frequency range[c].
Interference may occur in the vicinity of equipment marked with the following symbol:
  </td></tr>
<tr><td></td><td>6 Vrms
in ISM bands[a] between 0,15 MHz and 80 MHz</td><td>6 Vrms</td></tr>
<tr><td></td><td>6 Vrms
in ISM bands and amateur radio bands[a] between 0,15 MHz and 80 MHz</td><td>6 Vrms
(during patient transport)</td></tr>
<tr><td rowspan="3">Radiated RF EM fields IEC61000-4-3</td><td>3V/m
80 MHz to 2.7 GHz</td><td>10V/m</td></tr>
<tr><td>10V/m
80 MHz to 2.7 GHz</td><td>10V/m
(during patient transport)</td></tr>
<tr><td>20V/m
80 MHz to 2.5 GHz
(IEC80601-2-30, ISO80601-2-56, ISO80601-2-61)</td><td>20 V/m
(during patient transport)</td></tr>
<tr><td rowspan="3">Proximity fields from RF wireless communications equipment IEC61000-4-3</td><td>27 V/m
380–390 MHz</td><td>27 V/m</td><td rowspan="3"></td></tr>
<tr><td>28 V/m
430–470 MHz,
800–960 MHz,
1700–1990 MHz,
2400–2570 MHz</td><td>28 V/m</td></tr>
<tr><td>9 V/m
704–787 MHz,
5100–5800 MHz</td><td>9 V/m</td></tr>
<tr><td colspan="4">Note 1: At 80 MHz and 800 MHz, the higher frequency range applies.</td></tr>
</table>

Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

[a] The ISM (industrial, scientific, and medical) bands between 150 kHz and 80 MHz are 6.765 MHz to 6.795 MHz; 13.553 MHz to 13.567 MHz; 26.957 MHz to 27.283 MHz; and 40.66 MHz to 40.70 MHz. The amateur radio bands between 0,15 MHz and 80 MHz are 1,8 MHz to 2,0 MHz, 3,5 MHz to 4,0 MHz, 5,3 MHz to 5,4 MHz, 7 MHz to 7,3 MHz, 10,1 MHz to 10,15 MHz, 14 MHz to 14,2 MHz, 18,07 MHz to 18,17 MHz, 21,0 MHz to 21,4 MHz, 24,89 MHz to 24,99 MHz, 28,0 MHz to 29,7 MHz and 50,0 MHz to 54,0 MHz.

[b] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the device is used exceeds the applicable RF compliance level above, the device should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the device.

[c] Over the frequency ranges 150 kHz to 80 MHz, field strengths should be less than 3V/m.

Recommended Separation Distances between Portable and Mobile RF, Communications Equipment and This Equipment

The equipment is intended for use in an electromagnetic environment in which radiated RF disturbance 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 communication equipment.

Rated Maximum Output power of Transmitter Watts (W)	**Separation Distance According to Frequency of Transmitter (m)**		
	150 kHz to 80 MHz $d = \left[\frac{3.5}{V}\right]\sqrt{P}$	80 MHz to 800 MHz $d = \left[\frac{3.5}{E}\right]\sqrt{P}$	800 MHz to 2.7 GHz $d = \left[\frac{7}{E}\right]\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

For transmitters at a maximum output power not listed above, the recommended separation distanced in meters (m) can be determined using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

Note 1: At 80 MHz and 800 MHz, the higher frequency range applies.

Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

B.2 Radio Regulatory Compliance

RF parameter (WB45NBT Module)

Type of Radio	IEEE 802.11b/g/n (2.4G)	IEEE 802.11a/n (5G)
Modulation mode	DSSS and OFDM	OFDM
Operating frequency	ETSI:2.4 GHz - 2.483 GHz FCC:2.4 GHz - 2.483 GHz MIC:2.4 GHz - 2.495 GHz KC:2.4 GHz - 2.483 GHz	ETSI: 5 .15 GHz - 5.35 GHz, 5.47 GHz - 5.725 GHz FCC: 5 .15 GHz - 5.35 GHz, 5.47- 5.725 GHz， 5.725 GHz - 5.825 GHz MIC: 5.15 GHz - 5.35GH, 5.47- 5.725 GHz KC: 5 .15 GHz - 5.35 GHz, 5.47- 5.725 GHz, 5.725 GHz - 5.825 GHz
Output power	< 30 dBm (Peak Power) < 20 dBm (Average Power)	

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 Configurations

This chapter lists some of the most important factory default settings in configuration management. You cannot change the factory default configuration itself. However, you can make changes to the settings from the factory default configuration and then save the changed configuration as a user configuration.

C.1 Parameters Configuration

C.1.1 ECG

ECG Setup

Item Name		Configurable		Default
		In Config Mode	In Monitor Mode	
Lead Set		Yes	Yes	Auto (automatic lead type identification)
Alm Source		Yes	Yes	HR
Alarm		Yes	Yes	On
Alm Lev		Yes	Yes	Med
HR/PR High	Adu	Yes	Yes	120
	Ped			160
	Neo			200
HR/PR Low	Adu	Yes	Yes	50
	Ped			75
	Neo			100
Sweep		Yes	Yes	25 mm/s
Beat Vol		Yes	Yes	General, OR: 2 ICU, NICU, CCU: 1
Paced		No	Yes	No
Notch Filter		Yes	Yes	Weak
Gain		Yes	Yes	X1
Filter		Yes	Yes	General: Monitor OR: Surgery ICU, NICU: Monitor CCU: Diagnostic
ECG Display		Yes	Yes	Normal
Pacemaker Rate		Yes	Yes	60
Minimum QRS Threshold		No	Yes	0.16 mV

ST Analysis

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
ST Analysis	Yes	Yes	General, OR, ICU, NICU: Off CCU: On
Alarm	Yes	Yes	Off
Alm Lev	Yes	Yes	Med
ST-X High	Yes	Yes	when ST Unit is mV: 0.20 when ST Unit is mm: 2.0
ST-X Low	Yes	Yes	when ST Unit is mV: -0.20 when ST Unit is mm: -2.0
ISO	Yes	Yes	-80 ms
J	Yes	Yes	48 ms
ST	Yes	Yes	J + 60 ms

X represents I, II, III, aVR, aVL, aVF, or V1 to V6.

QT/QTc Analysis

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
QT Analysis	Yes	Yes	Off
QTc Formula	Yes	Yes	Hodges
Analysis Lead	Yes	Yes	All

Arrh. Analysis

Arrhythmia Threshold Settings (Mindray)			
Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
PVCs High	Yes	Yes	10
Asys. Delay	Yes	Yes	5
Vtac Rate	Yes	Yes	130
Vtac PVCs	Yes	Yes	6
Multif. PVC's Window	Yes	Yes	15
Tachy	Yes	Yes	Adu: 120 Ped: 160
Brady	Yes	Yes	Adu: 50 Ped: 75
Extreme Tachy	Yes	Yes	Adu: 160 Ped: 180
Extreme Brady	Yes	Yes	Adu: 35 Ped: 50
Vbrd Rate	Yes	Yes	40
Vbrd PVCs	Yes	Yes	5
Pause Time	Yes	Yes	2

Arrhythmia Threshold Settings (Mortara)			
Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
PVCs high	Yes	Yes	10
Asys. Delay	Yes	Yes	5
Vtac Rate	Yes	Yes	130
Vtac PVCs	Yes	Yes	6
Multif. PVC's Window	Yes	Yes	15
Tachy	Yes	Yes	Adu: 120 Ped: 160
Brady	Yes	Yes	Adu: 50 Ped: 75

Arrhythmia Alarm Settings (Mindray)				
Item Name	Configurable		Default	
	In Config Mode	In Monitor Mode	Alarm Switch	Alarm Level
Asystole Alarm	Yes	Yes	On	High
VFib/VTac Alarm	Yes	Yes	On	High
Vtac Alarm	Yes	Yes	On	High
Vent. Brady Alarm	Yes	Yes	On	High
Extreme Tachy Alarm	Yes	Yes	On	High
Extreme Brady Alarm	Yes	Yes	On	High
PVCs/min Alarm	Yes	Yes	General, OR, ICU, NICU: Off CCU: On	Med
R on T Alarm	Yes	Yes	General, OR, ICU, NICU: Off CCU: On	Med
Run PVCs Alarm	Yes	Yes	Off	Low
Couplet Alarm	Yes	Yes	Off	Prompt
Multif. PVC Alarm	Yes	Yes	Off	Med
PVC Alarm	Yes	Yes	Off	Prompt
Bigeminy Alarm	Yes	Yes	General, OR, ICU, NICU: Off CCU: On	Med
Trigeminy Alarm	Yes	Yes	General, OR, ICU, NICU: Off CCU: On	Med
Tachy Alarm	Yes	Yes	Off	Med
Brady Alarm	Yes	Yes	Off	Med
PNP Alarm	Yes	Yes	Off	Prompt
PNC Alarm	Yes	Yes	Off	Prompt
Missed Beats Alarm	Yes	Yes	Off	Prompt
Nonsus. Vtac Alarm	Yes	Yes	General, OR, ICU, NICU: Off CCU: On	Med
Vent. Rhythm Alarm	Yes	Yes		Med
Pause Alarm	Yes	Yes	Off	Low
Irr. Rhythm Alarm	Yes	Yes	Off	Prompt
Afib Alarm	Yes	Yes	Off	Prompt

Arrhythmia Alarm Settings (Mortara)				
Item Name	Configurable		Default	
	In Config Mode	In Monitor Mode	Alarm Switch	Alarm Level
Asystole Alarm	Yes	Yes	On	High
VFib Alarm	Yes	Yes	On	High
Vtac Alarm	Yes	Yes	On	High
PVCs/min Alarm	Yes	Yes	General, OR, ICU, NICU: Off CCU: On	Med
R on T Alarm	Yes	Yes	General, OR, ICU, NICU: Off CCU: On	Med
Run PVCs Alarm	Yes	Yes	Off	Low
Couplet Alarm	Yes	Yes	Off	Prompt
Vent. Rhythm Alarm	Yes	Yes	General, OR, ICU, NICU: Off CCU: On	Med
Bigeminy Alarm	Yes	Yes	General, OR, ICU, NICU: Off CCU: On	Med
Trigeminy Alarm	Yes	Yes	General, OR, ICU, NICU: Off CCU: On	Med
Tachy Alarm	Yes	Yes	Off	Med
Brady Alarm	Yes	Yes	Off	Med
PNP Alarm	Yes	Yes	Off	Prompt
PNC Alarm	Yes	Yes	Off	Prompt
Missed Beats Alarm	Yes	Yes	Off	Med
Multif. PVC	Yes	Yes	Off	Med
Irr. Rhythm Alarm	Yes	Yes	Off	Prompt

C.1.2 RESP

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
Alarm	Yes	Yes	On
Alm Lev	Yes	Yes	Med
RR High	Yes	Yes	Adu, Ped: 30 Neo: 100
RR Low	Yes	Yes	Adu, Ped: 8 Neo: 30
Apnea Delay	Yes	Yes	Adu, Ped: 20 Neo: 15
Lead	Yes	Yes	II
Gain	Yes	Yes	X2
Sweep	Yes	Yes	6.25 mm/s
Detection Mode	Yes	Yes	Auto
RR Source	No	Yes	Auto

C.1.3 PR

Item Name	Configurable		Default	
	In Config Mode	In Monitor Mode		
Alarm	Yes	Yes	On	
Alm Lev	Yes	Yes	Med	
HR/PR High	Yes	Yes	Adu:	120
			Ped:	160
			Neo:	200
HR/PR Low	Yes	Yes	Adul:	50
			Ped:	75
			Neo:	100
PR Source	Yes	Yes	Auto	
Alm Source	Yes	Yes	Auto	
Beat Vol	Yes	Yes	General, OR: 2 ICU, NICU, CCU: 1	

C.1.4 SpO_2

Item Name	Configurable		Default	
	In Config Mode	In Monitor Mode		
Alarm	Yes	Yes	On	
Alm Lev	Yes	Yes	SpO_2	Med
			Desat	High
SpO_2 High	Yes	Yes	Adu, Ped:	100
			Neo:	95
SpO_2 Low	Yes	Yes	90	
Desat	Yes	Yes	80	
Sensitivity	Yes	Yes	Mindray:	Med
			Masimo:	Normal
Averaging (Masimo)	Yes	Yes	8 s	
Sat-Seconds (Nellcor)	Yes	Yes	0 s	
Sweep	Yes	Yes	25 mm/s	
NIBP Simul	Yes	Yes	Off	
PI Zoom	Yes	Yes	No	

C.1.5 Temp

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
Alarm	Yes	Yes	On
Alm Lev	Yes	Yes	Med
T1/T2 High (°C)	Yes	Yes	38.0
T1/T2 Low (°C)	Yes	Yes	35.0
TD High (°C)	Yes	Yes	2.0

C.1.6 NIBP

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
Alarm	Yes	Yes	On
Alm Lev	Yes	Yes	Med
Interval	Yes	Yes	General: 15 min OR: 5 min ICU: 15 min NICU: 30 min CCU: 15 min
NIBP End Tone	Yes	Yes	Off
Clock	Yes	Yes	On
Initial Pressure (mmHg)	Yes	Yes	Adu: 160 Ped: 140 Neo: 90
Cuff Press. (mmHg)	Yes	Yes	Adu: 80 Ped: 60 Neo: 40
Alarm Limit			
NIBP-S High (mmHg)	Yes	Yes	Adu: 160 Ped: 120 Neo: 90
NIBP-S Low (mmHg)	Yes	Yes	Adu: 90 Ped: 70 Neo: 40
NIBP-M High (mmHg)	Yes	Yes	Adu: 110 Ped: 90 Neo: 70
NIBP-M Low (mmHg)	Yes	Yes	Adu: 60 Ped: 50 Neo: 25
NIBP-D High (mmHg)	Yes	Yes	Adu: 90 Ped: 70 Neo: 60
NIBP-D Low (mmHg)	Yes	Yes	Adu: 50 Ped: 40 Neo: 20

C.1.7 IBP

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
IBP 1 Label	Yes	Yes	Art
IBP 2 Label	Yes	Yes	CVP
Alarm	Yes	Yes	On
Alm Lev	Yes	Yes	Med
P1 Measure	Yes	Yes	All
P2 Measure	Yes	Yes	All
P3 Measure	Yes	Yes	Mean
P4 Measure	Yes	Yes	Mean
PPV Measurement	Yes	Yes	Off
PPV Source	Yes	Yes	Auto
Sensitivity	Yes	Yes	Med
Sweep	Yes	Yes	25 mm/s
Sweep (PAWP measurement window)	Yes	Yes	12.5 mm/s
Filter	Yes	Yes	12.5 Hz
Gridlines	Yes	Yes	Off
IBP Label Order Setup	Yes	Yes	Art, pArt, CVP, pCVP, ICP, PA, Ao, UAP, FAP, BAP, LV, LAP, RAP, UVP, P1, P2, P3, PPa4
Art, Ao, UAP, BAP, FAP, LV, P1-P2 Arterial Pressure Alarm Limits			
IBP-S High (mmHg)	Yes	Yes	Adu: 160 Ped: 120 Neo: 90
IBP-S Low (mmHg)	Yes	Yes	Adu: 90 Ped: 70 Neo: 55
IBP-M High (mmHg)	Yes	Yes	Adu: 110 Ped: 90 Neo: 70
IBP-M Low (mmHg)	Yes	Yes	Adu: 70 Ped: 50 Neo: 35
IBP-D High (mmHg)	Yes	Yes	Adu: 90 Ped: 70 Neo: 60
IBP-D Low (mmHg)	Yes	Yes	Adu: 50 Ped: 40 Neo: 20

PA Alarm Limit			
PA-S High (mmHg)	Yes	Yes	Adu: 35 Ped, Neo: 60
PA-S Low (mmHg)	Yes	Yes	Adu: 10 Ped, Neo: 24
PA-M High (mmHg)	Yes	Yes	Adu: 20 Ped, Neo: 26
PA-M Low (mmHg)	Yes	Yes	Adu: 0 Ped, Neo: 12
PA-D High (mmHg)	Yes	Yes	Adu: 16 Ped, Neo: 4
PA-D Low (mmHg)	Yes	Yes	Adu: 0 Ped, Neo: -4
CVP, LAP, RAP, ICP, UVP, P3-P4 Venous Pressure Alarm Limits			
IBP-M High (mmHg)	Yes	Yes	Adu: 10 Ped, Neo: 4
IBP-M Low (mmHg)	Yes	Yes	0
CPP Alarm Limits			
CPP High (mmHg)	Yes	Yes	Adu: 130 Ped: 100 Neo: 90
CPP Low (mmHg)	Yes	Yes	Adu: 50 Ped: 40 Neo: 30
Art, Ao, BAP, FAP, LV, P1-P2 Arterial Pressure Scale			
Scale (mmHg)	Yes	Yes	0-160
PA Scale			
Scale (mmHg)	Yes	Yes	0-30
CVP, LAP, RAP, ICP, UVP Scale			
Scale (mmHg)	Yes	Yes	0-20
UAP, P3-P4 Venous Pressure Scale			
Scale (mmHg)	Yes	Yes	0-80
IBP Overlapping Left Scale			
Scale (mmHg)	Yes	Yes	0-160
IBP Overlapping Right Scale			
Scale (mmHg)	Yes	Yes	0-20

C.1.8 CO_2

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
Alarm	Yes	Yes	On
Alm Lev	Yes	Yes	Med
Apnea Delay	Yes	Yes	Adu, Ped: 20 Neo: 15
Operating Mode	Yes	Yes	Measure
Sweep	Yes	Yes	6.25 mm/s
Scale (mmHg)	Yes	Yes	50
RR Source	No	Yes	Auto
Sidestream CO_2 Setup			
Flow Rate	Yes	Yes	Adu, 120 ml/min Ped: 100 ml/min Neo: 70 ml/min
BTPS Compen	Yes	Yes	Off
N_2O Compen	Yes	Yes	0
O_2 Compen	Yes	Yes	General: 21 OR: 100 ICU, NICU, CCU: 21
Des Compen	Yes	Yes	0
Microstream CO_2 Setup			
BTPS Compen	Yes	Yes	Off
Max Hold	Yes	Yes	20 s
Auto Standby (min)	Yes	Yes	0
Mainstream CO_2 Setup			
Max Hold	Yes	Yes	10 s
O_2 Compen	Yes	Yes	Off
Balance Gas	Yes	Yes	Room Air
AG Compen	Yes	Yes	0
Alarm Limits			
$EtCO_2$ High (mmHg)	Yes	Yes	Adu, Ped: 50 Neo: 45
$EtCO_2$ Low (mmHg)	Yes	Yes	Adu, Ped: 25 Neo: 30
$FiCO_2$ High (mmHg)	Yes	Yes	Adu, Ped, Neo: 4
RR High	Yes	Yes	Adu, Ped: 30 Neo: 100
RR Low	Yes	Yes	Adu, Ped: 8 Neo: 30

C.1.9 CCO

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
Inj. Volume	No	Yes	Adu: 15 ml Ped: 10 ml
pCVP Measure	No	Yes	Unselected
pCVP	No	Yes	/
C.O. Measure	No	Yes	On
CCO Parameters			
Main Parameter	Yes	Yes	CCI, CCO
Secondary Parameter	Yes	Yes	GEDI, GEDV
pArt/pCVP Setup			
Scale (mmHg)	Yes	Yes	pArt: 0 mmHg to 160mmHg pCVP: 0 mmHg to 20mmHg
Sweep	Yes	Yes	25 mm/s

C.2 Routine Configuration

C.2.1 Alarm

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
Alm Volume	Yes	Yes	General: 2 OR: 1 ICU, NICU, CCU: 2
Reminder Vol	Yes	Yes	Low
Recording Length	Yes	Yes	16 s
Apnea Delay	Yes	Yes	Adu, Ped: 20 s Neo: 15 s
Alarm Delay	Yes	Yes	6 s
ST Alarm Delay	Yes	Yes	30 s

C.2.2 Screens

Item Name		Configurable		Default
		In Config Mode	In Monitor Mode	
Choose Screen		Yes	Yes	Normal Screen
Select Wave Sequence for Normal Screen	1	Yes	Yes	ECG1
	2			ECG2
	3			SpO_2 + PR
	4			Any IBP
	5			Any IBP
	6			CO_2
	7			Resp
Select Parameters for Big Numerics Screen	Parameter 1	Yes	Yes	ECG
	Parameter 2			SpO_2 + PR
	Parameter 3			Resp
	Parameter 4			NIBP

C.2.3 Parameter/Wave Color

Item Name		Configurable		Default
		In Config Mode	In Monitor Mode	
Parameter/ Wave Colour	ECG	No	Yes	Green
	NIBP			White
	SpO_2			Cyan
	TEMP			White
	Art/Ao/UAP/FAP /BAP/LV/P1~P4 (arterial pressure)			Red
	CVP/ICP/P1~P4 (venous pressure)			Blue
	CO_2			Yellow
	RESP			Yellow

Night Mode

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
Brightness	No	Yes	1
Alm Volume	No	Yes	2
QRS Volume	No	Yes	1
Key Volume	No	Yes	0
Stop NIBP	No	Yes	Unselected

Outdoor Mode

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
Measurement Color	No	Yes	White
Brightness	No	Yes	10
Key Volume	No	Yes	5
Alm Volume	No	Yes	5
Reminder Tone	No	Yes	High
QRS Volume	No	Yes	5

C.2.4 Review

Item Name		Configurable		Default
		In Config Mode	In Monitor Mode	
Tabular Trends	Interval	No	Yes	General: 30 min OR: 5 min ICU, NICU, CCU: 30 min
	Trend Group	No	Yes	Standard
Graphic Trends	Trend Group	No	Yes	Standard
	Zoom	No	Yes	90 min
	Waves	No	Yes	2
Full Disclosure	Save Waves	No	Yes	Save ECG1 by default.
	Gain	No	Yes	x 1
	Sweep	No	Yes	25 mm/s

C.2.5 Event

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
Waveform 1	No	Yes	II
Waveform 2	No	Yes	General, OR, ICU: I NICU: Pleth CCU: I
Waveform 3	No	Yes	General, OR, ICU: Pleth NICU: Resp CCU: Pleth

C.2.6 Record

Item Name		Configurable		Default
		In Config Mode	In Monitor Mode	
Paper Size		No	Yes	A4
Print On Both Sides		No	Yes	Off
ECG Reports	Amplitude	No	Yes	10 mm/mV
	Sweep	No	Yes	25 mm/s
	Auto Interval	No	Yes	Off
	12-Lead Format	No	Yes	12 x 1
Tabular Trends Reports	Set as End Case Report	No	Yes	Unselected
	Back	No	Yes	Auto
	Resolution	No	Yes	Auto
	Report Layout	No	Yes	Parameter Oriented
	Currently Displayed Trended Parameters	No	Yes	Selected
	Standard Parameter Group	No	Yes	Unselected
	Custom	No	Yes	Unselected
	Not Print Blank Pages	No	Yes	Selected
Graphic Trends Reports	Set as End Case Report	No	Yes	Unselected
	Back	No	Yes	Auto
	Paginal Time	No	Yes	Auto
Realtime Reports	Set as End Case Report	No	Yes	Unselected
	Sweep	No	Yes	Auto
	Select Wave	No	Yes	Current

C.3 User Maintenance Items

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
Changing Bed No.	No	Yes	Protected
Atmospheric Pressure	No	Yes	760 mmHg
Height Unit	No	Yes	cm
Weight Unit	No	Yes	kg
ST Unit	No	Yes	mV
Press. Unit	No	Yes	mmHg
CVP Unit	No	Yes	cmH_2O
CO_2 Unit	No	Yes	mmHg
Temp Unit	No	Yes	℃
Network Type	No	Yes	LAN
Address Type	No	Yes	Manual
Select CMS (for T5 only)	No	Yes	On
ADT Query	No	Yes	On
Latching Alarms	Yes	Yes	Off
Alarm Pause Time	Yes	Yes	2 min
Max. Alarm Pause 15min	Yes	Yes	Disabled

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
High Alarm Interval (s)	No	Yes	10
Med Alarm Interval (s)	No	Yes	20
Low Alarm Interval (s)	No	Yes	20
Alarm Light on Alarm Reset	No	Yes	On
Reset Other Bed's Alarms	No	Yes	Off
Alarm Reset By Other Bed	No	Yes	On
Minimum Alarm Volume	Yes	Yes	General: 2 OR: 1 ICU, NICU, CCU: 2
Alarm Sound	No	Yes	ISO
Reminder Tone	No	Yes	On
Reminder Interval	No	Yes	3 min
ECGLeadOff Lev.	No	Yes	Low
SpO_2SensorOff Lev.	No	Yes	Low
IBPSensorOff Lev.	No	Yes	Med
Lethal Arrh. OFF	No	Yes	Disable
Extended Arrh.	No	Yes	Disable
Alarm Delay	No	Yes	6 s
ST Alarm Delay	No	Yes	30 s
Other Bed Disconnection Alm	No	Yes	On
Wave Line	No	Yes	Mediate
Outdoor Mode	No	Yes	Manual
ECG Standard	No	Yes	AHA
Notch Freq.	No	Yes	50 Hz
Data Transfer Method	No	Yes	Off
Transferred Data Length	No	Yes	4 h
Para Switch Authority	No	Yes	Unprotected
Parameter Switch	Yes	Yes	■ When [**Para Switch Authority**] is set to [**Protected**]: Unselected ■ When [**Para Switch Authority**] is set to [**Unprotected**]: Selected
SpO_2 Tone	No	Yes	Mode 1

D Alarm Messages

This chapter lists only the most important physiological and technical alarm messages. Some messages appearing on your monitor may not be included.

In this chapter:

- The "I" column indicates how indications of technical alarms perform after the alarm system is reset: "A" means that some technical alarms are cleared; "B" indicates that some technical alarms are changed to the prompt messages; and "C" indicates that a " √ " appears before the alarm message, appears in the alarm symbol area, and the indication of the alarm lamp depends on the alarm light setting. Refer to ***section 7.8 Resetting Alarms*** for details.
- The "L" field indicates the alarm level: H means high, M means medium and L means low. "*" means the alarm level is user-adjustable.
- XX represents a measurement or parameter label, such as ECG, NIBP, HR, ST-I, PVCs, RR, SpO_2, PR, etc.

In the "Cause and Solution" column, corresponding solutions are given instructing you to troubleshoot problems. If the problem persists, contact your service personnel.

D.1 Physiological Alarm Messages

Measurement	Alarm messages	L	Cause and solution
XX	XX Too High	M*	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 Too Low	M*	
ECG	ECG Weak Signal	H	The ECG signal is so weak that the monitor can't perform ECG analysis. Check the patient's condition and the ECG connections.
	Asystole	H	Arrhythmia has occurred to the patient. Check the patient's condition and the ECG connections.
	VFib/VTac	H	
	Vtac	H	
	Vent. Brady	H	
	Extreme Tachy	H	
	Extreme Brady	H	
	R on T	M*	
	Run PVCs	L*	
	Couplet	M*	
	PVC	M*	
	PVCs/min	M*	
	Bigeminy	M*	
	Trigeminy	M*	
	Tachy	M*	
	Brady	M*	

Measurement	Alarm messages	L	Cause and solution
	Missed Beats	M*	
	Irr. Rhythm	M*	
	Vent. Rhythm	M*	
	Multif. PVC	M*	
	Nonsus. Vtac	M*	
	Pause	L*	
	PNP	M*	The pacer appears abnormal. Check the pacer.
	PNC	M*	
Resp	Resp Apnea	H	The respiration signal was so weak that the monitor cannot perform respiration analysis. Check the patient's condition and the Resp connections.
	Resp Artifact	H	The patient's heartbeat has interfered with his respiration. Check the patient's condition and the Resp connections.
SpO_2	SpO_2 Desat	H	The SpO2 value has fallen below the desaturation alarm limit. Check the patient's condition and check if the alarm limit settings are correct.
	No Pulse	H	The pulse signal was so weak that the monitor cannot perform pulse analysis. Check the patient's condition, SpO_2 sensor and measurement site.
CO_2	CO_2 Apnea	H	The patient stops breathing, or the respiration signal was so weak that the monitor cannot perform respiration analysis. Check the patient's condition and the RM connections.

A.2 Technical Alarm Messages

Measurement	Alarm message	L	I	Cause and solution
XX	XX SelfTest Err	H	C	An error occurred to the XX module, or there is a problem with the communications between the module and the monitor. Re-plug the module and restart the monitor, or plug the module into another monitor.
	XX Init Err	H	A	
	XX Init Err N	H	A	
	N is within 1 to 8			
	XX Comm Err	H	A	
	XX Comm Stop	H	C	
	XX Comm Abnormal	H	A	
	XX Limit Err	L	C	XX parameter limit is accidentally changed. Contact your service personnel.
	XX Overrange	L	C	The measured XX value is not within the specified range for XX measurement. Contact your service personnel.
ECG	ECG Lead Off	L*	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 YY Lead Off	L*	B	
	Note: YY represents the leadwires V, LL, LA, RA, C, F, L, R, V1, V2, V3, V4, V5, V6, C1, C2, C3, C4, C5, or C6			
	ECG Noisy	L	A	The ECG signal is noisy. Check for any possible sources of signal noise around the cable and electrode, and check the patient for great motion.
	ECG Artifact (for Mortara algorithm only)	L	A	Artifacts are detected on the ECG analysis lead and as a result heart rate cannot be calculated and Asystole, Missed Beats and Vfib cannot be analyzed. Check the connections of the electrodes and leadwires and check for any possible source of interference around the cable and electrode. Check the patient's condition and check the patient for great motion.
	ECG Low Freq. Noise	L	A	Low frequency signals are detected on the ECG analysis lead. Check for any possible source of interference around the cable and electrode.
	ECG Amplitude Too Small	L	C	The ECG amplitude didn't reach the detected threshold. Check for any possible source of interference around the cable and electrode.
	ECG Config. Err	L	C	ECG configuration is wrongly downloaded. Check the downloaded configuration and re-download the correct configuration.
Temp	Temp Cal. Err	H	C	A calibration failed. Restart the monitor.
	YY Sensor Off	L	A	The temperature sensor has become detached from the patient or the module. Check the sensor connections.
	YY represents a temperature label.			
	Temp Cal. Err	H	C	
SpO_2	SpO_2 Sensor Off	L*	B	The SpO_2 sensor has become detached from the patient or the module, or there is a fault with the SpO_2
	SpO_2 Sensor Fault	L	C	

Measurement	Alarm message	L	I	Cause and solution
	SpO_2 No Sensor	L	B	sensor, or an unspecified SpO_2 sensor has been used. Check the sensor application site and the sensor type, and make sure if the sensor is damaged. Reconnect the sensor or use a new sensor.
	SpO_2 Unknown Sensor	L	C	
	SpO_2 Sensor Incompatible	L	C	
	SpO_2 Too Much Light	L	C	There is too much light on the SpO_2 sensor. Move the sensor to a place with lower level of ambient light or cover the sensor to minimize the ambient light.
	SpO_2 Low Signal	L	C	The SpO_2 signal is too low or too weak. Check the patient's condition and change the sensor application site. If the error persists, replace the sensor.
	SpO_2 Weak Pulse	L	C	
	SpO_2 Interference	L	C	The SpO2 signal has been interfered. Check for any possible sources of signal noise around the sensor and check the patient for great motion.
	SpO_2 Board Fault	L	C	There is a problem with the SpO_2 measurement board. Do not use the module and contact your service personnel.
NIBP	NIBP Loose Cuff	L	A	The NIBP cuff is not properly connected, or there is a leak in the airway.
	NIBP Air Leak	L	A	
	NIBP Pneumatic Leak	L	A	Check the NIBP cuff and pump for leakages.
	NIBP Cuff Type Wrong	L	A	The cuff type applied mismatches the patient category. Verify the patient category and replace the cuff.
	NIBP Air Pressure Err	L	A	An error occurred to the air pressure. Verify that the monitor application site meets the environmental requirements and check if there is any source that affects the air pressure.
	NIBP Weak Signal	L	A	The patient's pulse is weak or the cuff is loose. Check the patient's condition and change the cuff application site. If the error persists, replace the cuff.
	NIBP Signal Saturated	L	A	The NIBP signal is saturated due to excess motion or other sources.
	NIBP Overrange	L	A	The measured NIBP value is not within the specified range.
	NIBP-XX Over Upper Limit	L	A	The measured pressure is greater than the specified NIBP measurement upper limit.
	NIBP-XX Over Lower Limit	L	A	The measured pressure is lower than the specified NIBP measurement lower limit.
	XX represents diastolic pressure, mean pressure, or systolic pressure.			
	NIBP Excessive Motion	L	A	Check the patient's condition and reduce the patient motion.
	NIBP Cuff Overpress.	L	A	The NIBP airway may be occluded. Check the airway and measure again.
	NIBP Equip Err	H	A	An error occurred during NIBP measurement and therefore the monitor cannot perform analysis correctly. Check the patient's condition and NIBP connections, or replace the cuff.
	NIBP Timeout	L	A	
	NIBP Measure Failed	L	A	

Measurement	Alarm message	L	I	Cause and solution
	NIBP Illegally Reset	L	A	An illegal reset occurred during NIBP measurement. Check if the airway is occluded.
IBP	YY Sensor Off	M*	A	Check the sensor connection and reconnect the sensor.
	YY Disconnected	H	C	The liquid way is disconneted 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 problem remains, contact the Customer Services Dept. for help.
	YY Sensor Fault	M	C	Replace the sensor.
	YY Non-Pulsatile	L	A	The catheter may be occluded. Please flush the catheter.
	YY represents an IBP label.			
CCO	Invalid/Faulty PiCCO catheter	L	C	Erroneous or invalid catheter is used. Please use the proper catheter.
	TB Sensor Off	L	A	Check the sensor connections.
	PiCCO Comm Abnormal	H	A	Abnormal communication occurred between the PiCCO module and the system. Remove/connect the module again or restart the machine. If the problem remains, contact the Customer Services Dept. for help.
	PiCCO Comm Err	H	A	Erroneous communication occurred between the PiCCO module and the system. Remove/connect the module again or restart the machine. If the problem remains, contact the Customer Services Dept. for help.
	PiCCO Init Err	H	A	An error occurred to the module during the power-on self-test. Remove/connect the module again or restart the machine. If the problem remains, contact the Customer Services Dept. for help.
	Inject Temp. Sensor Err	L	C	An error occurred to the injectate temperature sensor or the sensor cable. Check/replace the sensor or the sensor cable.
	PiCCO Comm Stop	H	A	Remove/connect the module again or restart the machine. If the problem remains, contact the Customer Services Dept. for help.
CO_2	CO_2 Sensor High Temp	L	C	Check, stop using or replace the sensor.
	CO_2 Sensor Low Temp	L	C	Check, stop using or replace the sensor.
	CO_2 Temp Overrange	L	C	The operating temperature of the CO2 module goes beyond the specified range. After it restores within the specified range, the module will restart automatically.
	CO_2 Airway High Press.	L	C	An error occurred in the airway pressure. Check the patient connection and patient circuit, and then restart the monitor.
	CO_2 Airway Low Press.	L	C	
	CO_2 High Barometric Press.	L	C	Check the CO2 connections, make sure that the monitor application site meets the requirements, and check for special sources that affect the ambient pressure. Restart the monitor.
	CO_2 Low Barometric Press.	L	C	

Measurement	Alarm message	L	I	Cause and solution
	CO_2 FilterLine Occluded	L	C	The airway or watertrap was occluded. Check the airway and remove the occlusion.
	CO_2 No Watertrap	L	B	Check the watertrap connections.
	CO_2 Check Adapter	L	A	There is a problem with the airway adapter. Check, clean or replace the adapter.
	CO_2 FilterLine Err	L	C	Check if there is a leak in the CO_2 sample line or the CO_2 sample line has been occluded.
	CO_2 Zero Failed	L	A	Check the CO_2 connections. After the sensor's temperature becomes stabilized, perform a zero calibration again.
	CO_2 System Err	L	A	Re-plug the module or restart the monitor.
	CO_2 Check Cal.	L	C	Perform a calibration.
	CO_2 Check Airway	L	C	An error occurred to the airway.
	CO_2 No Filterline	L	A	Make sure that the filterline is connected.
	CO_2 No Sensor	L	A	Make sure that the sensor is connected.
	CO_2 Main Board Err	H	C	There is a problem with the CO_2 module. Re-plug the module or restart the monitor.
	CO_2 Checking Sensor	L	C	
	CO_2 Replace Scrubber&Pump	L	C	
	CO_2 15V Overrange	H	C	
	CO_2 Hardware Err	H	C	
Power	12V Too High	H	C	There is a problem with the system power supply. Restart the monitor.
	12V Too Low	H	C	
	5V Too High	H	C	
	5V Too Low	H	C	
	3.3V Too High	H	C	
	3.3V Too Low	H	C	
	No Battery	H	C	1. Battery is not installed or poor contact: properly install the battery. 2. Battery circuit failure or battery failed: contact your service personnel.
	Low Battery	M	C	Connect the monitor to external power source, or charge the battery using a battery charger.
	Battery Depleted	H	C	Connect the monitor to external power source, or charge the battery using a battery charger.
	T1 battery to be protected and not work.	H	C	T1 battery will be soon protected and will not supply power. If you are going to use T1 for patient transport, please replace the battery.
	T1 battery aged. Replace the battery	L	C	T1 battery lifetime is expired. Replace the battery with a new one.
	Power Board Comm Err	H	C	Restart the monitor. If the problem persists, contact your service personnel.
	RT Clock Need Reset	L	C	Internal backup battery cell fails. Contact your service personnel.

Measurement	Alarm message	L	I	Cause and solution
	RT Clock Not Exist	H	C	Contact your service personnel.
System	IP Address Conflict	L	A	Set a new IP address.
	Restoring Last Config. Failed	L	A	Restart the monitor. If the problem persists, E2PROM may fail. Contact your service personnel.
	Loading Default Config. Failed.	L	A	Restart the monitor. If the problem persists, E2PROM may fail. Contact your service personnel.
	USB Drive Err	M	A	1. Disconnect the USB memory and reconnect it properly. 2. If the problem persists, format the USB memory. 3. If the problem still persists, replace the USB drive.
	Storage Card Err	M	C	Restart the monitor. If the problem persists, format the storage card.
	Storage Card Space Low	L	A	Delete unnecessary data from the storage card.
	USB Drive Space Low	L	A	Delete unnecessary data from the USB memory, or replace the USB memory.
	Read Dock E2PROM Error	H	C	Disconnect T1 from the docking station and reconnect it, or replace the external display.
	Unknown Device	L	A	The external device fails, or is not supported by T1, or is not connected properly. Reconnect the external device properly. If the problem persists, replace the external device.
	Read dock E2PROM error!	H	C	T1does not properly connect with the T1 dock, or unspecified external display is connected. Reconnect T1 with T1 the docking station or replace the external display.
	Other Bed Disconnected	L	A	Check network connection.
	No CMS	L	A	The monitor is disconnected from the CMS. Check network connection.
	PWR interrupted. Check meas. State.	L	A	Power supply failed accidently. Check the measurements when the monitor restarts.

FOR YOUR NOTES

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 by 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 Labelling

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

- 10μA in Normal Condition
- 50μA in Single Fault Condition

For BF applied parts

- 100μA in Normal Condition
- 500μA 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,

- 10μA in Normal Condition
- 50μA in Single Fault Condition

For BF applied parts,

- 100μA in Normal Condition
- 500μA 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.**

F Symbols and Abbreviations

F.1 Symbols

µA	microampere
µV	microvolt
µs	Microsecond
A	ampere
Ah	ampere hour
bpm	beat per minute
bps	bit per second
ºC	centigrade
cc	cubic centimeter
cm	centimeter
dB	decibel
DS	dyne second
ºF	fahrenheit
g	gram
GHz	gigahertz
GTT	gutta
h	hour
Hz	hertz
in	inch
kg	kilogram
kPa	kilopascal
L	litre
lb	pound
m	meter
mAh	milliampere hour
Mb	mega byte
mg	milligram
min	minute
ml	milliliter
mm	millimeter
mmHg	millimeters of mercury
cmH2O	centimeters of water
ms	millisecond
mV	millivolt
mW	milliwatt
MΩ	megaohm
nm	nanometer
rpm	breath per minute
s	second

V	volt
VA	volt ampere
Ω	ohm
W	watt
–	minus, negative
%	percent
/	per; divide; or
+	plus
=	equal to
<	less than
>	greater than
≤	less than or equal to
≥	greater than or equal to
±	plus or minus
×	multiply

F.2 Abbreviations

AAMI	Association for Advancement of Medical Instrumentation
AC	alternating current
Adu	adult
AHA	American Heart Association
Air Flow	air flow
ANSI	American National Standard Institute
Ao	aortic pressure
Art	arterial
aVF	left foot augmented lead
aVL	left arm augmented lead
aVR	right arm augmented lead
awRR	airway respiratory rate
BAP	brachial arterial pressure
Base Flow	base flow
BC	burst count
BP	blood pressure
BSA	body surface area
BT	blood temperature
BTPS	body temperature and pressure, saturated
C.I.	cardiac index
CCI	Continuous Cardiac Index
CCO	continuous cardiac output
CCU	cardiac (coronary) care unit
CE	Conformité Européenne
CFI	cardiac function index
CIS	Clinical Information System

CISPR	International Special Committee on Radio Interference
CMOS	complementary metal oxide semiconductor
CMS	central monitoring system
C.O.	cardiac output
CO_2	carbon dioxide
COHb	carboxyhemoglobin
CompI	compliance
CP	cardiopulmonary
CPI	cardiac power index
CPO	Cardiac Power Output
Cstat	static compliance
CVP	central venous pressure
DC	direct current
Des	desflurane
Dia	diastolic
DPI	dot per inch
dPmx	left ventricular contractility
DVI	digital video interface
ECG	electrocardiograph
EDV	end-diastolic volume
EEC	European Economic Community
EEG	electroencephalogram
EMC	electromagnetic compatibility
EMG	electromyography
EMI	electromagnetic interference
ESU	electrosurgical unit
Et	end-tidal
$EtCO_2$	end-tidal carbon dioxide
EtN_2O	end-tidal nitrous oxide
EtO	ethylene oxide
EtO_2	end-tidal oxygen
ELWI	extravascular lung water index
EVLW	extravascular lung water
Exp. Flow	expiratory flow
Exp%	inspiration termination level
FAP	femoral arterial pressure
FCC	Federal Communication Commission
FDA	Food and Drug Administration
FEV1.0%	first second forced expiratory volume ratio
Fi	fraction of inspired
FPGA	field programmable gate array
GEDI	global end diastolic volume index
GEF	global ejection fraction
Hb	hemoglobin
Hb-CO	carbon mono-oxide hemoglobin
HbO_2	oxyhemoglobin

HR	heart rate
I:E	inspiratory-expiratory ratio
IBP	invasive brood pressure
IBW	ideal body weight
ICP	intracranial pressure
ICT/B	intracranial catheter tip pressure transducer
ICU	intensive care unit
ID	identification
I:E	inspiratory time: Expiratory time ratio
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
IP	internet protocol
IT	injectate temperature
ITBI	Intrathoracic Blood Volume Index
ITBV	Intrathoracic Blood Volume
LA	left arm
LAP	left atrial pressure
Lat	lateral
LCD	liquid crystal display
LCW	left cardiac work
LCWI	left cardiac work index
Leak Comp	leak compensation
LED	light emitting diode
LL	left leg
LVD	low voltage directive
LVDS	low voltage differential signal
LVET	left ventricular ejection time
LVSW	left ventricular stroke work
LVSWI	left ventricular stroke work index
MAC	minimum alveolar concentration
Art mean	mean arterial pressure
MDD	Medical Device Directive
MetHb	methemoglobin
MRI	magnetic resonance imaging
N/A	not applied
N_2	nitrogen
N_2O	nitrous oxide
Neo	neonate
NIBP	noninvasive blood pressure
O_2	oxygen
O_2%	oxygen concentration
OR	operating room
oxyCRG	oxygen cardio-respirogram
PA	pulmonary artery
Papnea	apnea pressure
pArt-D	diastolic artery pressure

pArt-M	mean artery pressure
pArt-S	systolic artery pressure
PD	photodetector
Ped	pediatric
Pleth	plethysmogram
PPV	Pulse Pressure Variation
PR	pulse rate
PVC	premature ventricular contraction
PVR	pulmonary vascular resistance
PVRI	pulmonary vascular resistance index
PVPI	pulmonary vascular permeability index
pArt	artery pressure
pCVP	central venous pressure
R	right
RA	right arm
RAM	random access memory
RAP	right atrial pressure
Rec	record, recording
Resp	respiration
RHb	reduced hemoglobin
Rise Time%	rise time
RL	right leg
RR	respiration rate
SFM	self-maintenance
SI	stroke index
SpO_2	arterial oxygen saturation from pulse oximetry
SQI	signal quality index
SR	suppression ratio
STR	systolic time ratio
SV	stroke volume
SVI	Stroke Volume Index
SVR	systemic vascular resistance
SVRI	systemic vascular resistance index
SVV	stroke volume variation
Sync	synchronization
Sys	systolic pressure
Taxil	axillary temperature
TB	Blood Temperature
TD	temperature difference
Temp	temperature
TFC	thoracic fluid content
TFI	thoracic fluid index
TFT	thin-film technology
Thigh	time for the upper pressure level
Toral	oral temperature
Tplat	plateau time

Trect	rectal temperature
Trise	rise time
Tslope	time for the pressure to rise to target pressure
Tube ID	tube ID
UAP	umbilical arterial pressure
UPS	uninterruptible power supply
USB	universal serial bus
UVP	umbilical venous pressure
VAC	volts alternating current
WLAN	wireless local area network
WOB	work of breathing
WOBimp	imposed work of breathing

G Declaration of Conformity

Declaration of Conformity V2.0

Declaration of Conformity

CE

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:	Patient Monitor (Including Accessories)
Model:	BeneView T1/T1

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	☒ EN 50385:2002
☒ ETSI EN 301 489-1 V2.2.0	☒ ETSI EN 301 489-17 V3.1.1
☒ EN 300 328 V2.1.1	☒ ESTI EN 301 893 V2.1.1

Start of CE-Marking:	**2017-6-13**
Place, Date of Issue:	Shenzhen, 2018.12.9
Signature:	
Name of Authorized Signatory:	Mr. Wang Xinbing
Position Held in Company:	Manager, Technical Regulation

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