T1 Patient Monitor

Operator's Manual

For this Operator's Manual, the issue date is November 2014.

⚠ WARNING

- **Federal Law (USA) restricts this device to sale by or on the order of a physician.**

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

⚠ WARNING

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

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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 conveniently referenced 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 to quote the referenced chapters or sections.
- [ ] is used to enclose screen text.
- → is used to indicate operational procedures.

Contents

1 Safety

1.1 Safety Information

⚠ WARNING

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

⚠ CAUTION

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

NOTE

- **Provides application tips or other useful information to ensure that you get the most from your product.**

1.1.1 Warnings

⚠ WARNINGS

- **This equipment is used for single patient at a time.**
- **The equipment is not intended to be used within the Magnetic Resonance (MR) environment.**
- **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.**
- **The equipment must be connected to a properly installed power outlet with protective earth contacts only. 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).**
- **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.**
- **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.**
- **Dispose of the package material, observing the applicable waste control regulations and keeping 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

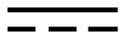
- **Use only parts and accessories specified in this manual.**
- **At the end of its service life, the equipment, as well as its accessories, must be disposed of in compliance with the guidelines regulating the disposal of such products. If you have any questions concerning disposal of the equipment, 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 see the screen and access the operating controls.**
- **Keep this manual in the vicinity of the equipment so that it can be conveniently referenced 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
	Lock; tighten		Alternating current
	Date of Manufacture		Symbol for "MANUFACTURER"
	Input/output	IPX1	Protected against vertically falling water drops per IEC 60529
	Defibrillation-proof Type CF applied part		Direction and angle of rotation
	USB connector		
	Caution, consult accompanying documents		
	Dispose of in accordance to your country's requirements		
ETL CLASSIFIED C ETL US Intertek 3191955	Conforms to UL Std.60601-1, IEC Std.60601-2-25, IEC Std.60601-2-27, IEC Std.60601-2-30, IEC Std.60601-2-34, IEC Std.60601-2-49 Certified to CSA Std.C22.2 No 601.1, IEC Std.60601-2-25, CSA Std. C22.2 No 60601-2-27, CSA Std.C22.2 No 60601-2-30, CSA Std.22.2 No 60601-2-34, CSA Std.C22.2 No 60601-2-49		

NOTE

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

2 The Basics

2.1 Intended Use

T1 patient monitor, hereafter referred to as "the monitor" or "the equipment", is intended 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), and carbon dioxide (CO_2).

All the parameters can be applied to a single adult, pediatric or neonatal patient with the exception of the following: arrhythmia detection and ST Segment analysis of Mortara ECG algorithm are intended for adult and pediatric patients; arrhythmia detection of Mindray ECG algorithm is intended for adult and pediatric patients; ST Segment analysis of Mindray ECG algorithm is intended for adult patients only.

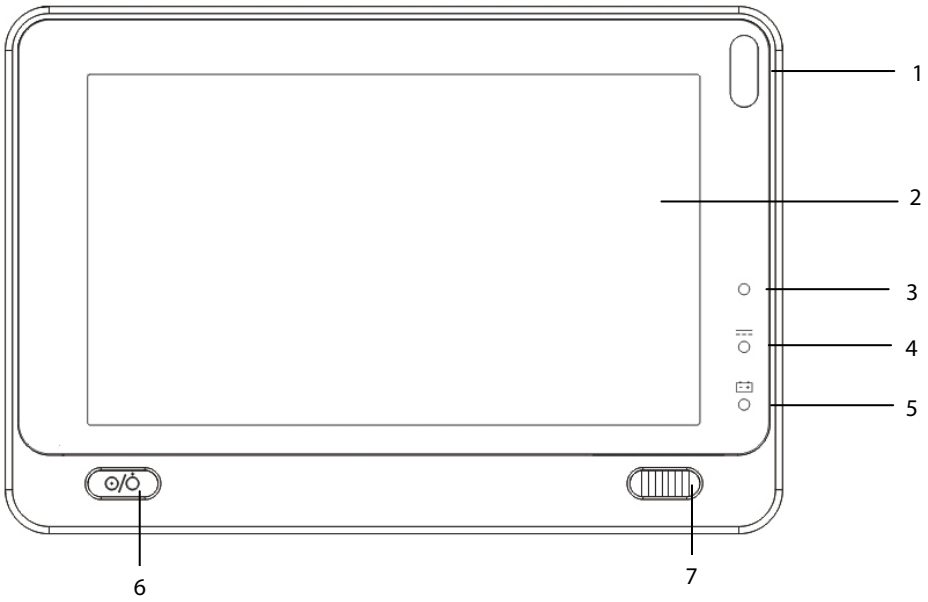
The monitor is intended to be used in a hospital environment including, but not limited to, ICU, CCU, PICU, NICU, RICU, emergency room, operating room, postoperative observation ward, etc. It can also be used during patient transport both inside the hospital and with an ambulance. For patient transport monitoring 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 is intended for use only by clinical professionals or under their guidance. It must only be used by those who have received adequate training in its use. Anyone unauthorized or untrained must not perform any operation on it.

The monitor can be used as a stand-alone patient monitor.

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 level.

2. Display Screen

3. Ambient light sensor

   When [**Brightness**] is set to [**Auto**], the system automatically adjusts screen 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 malfunctioning, or no external DC power supply is connected when the patient monitor is power off.
   - Flashing: when the patient monitor operates on battery power.

6. Power On/Off Switch

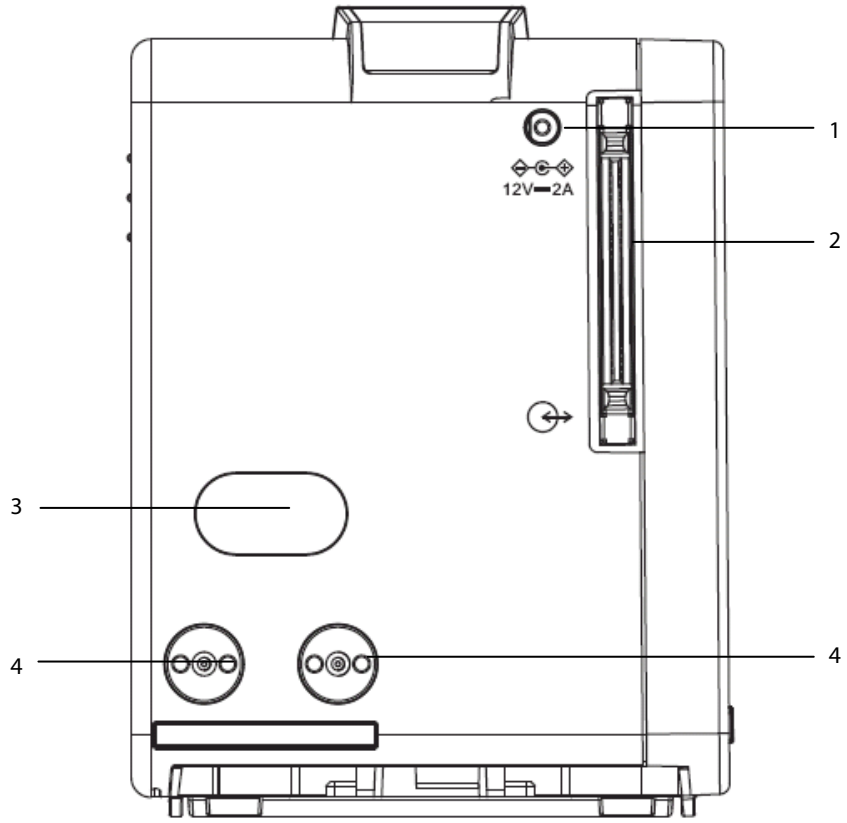
   - Pressing this switch turns the patient monitor on.
   - When the monitor is on, pressing and holding this switch turns the monitor off.

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

7. Lock/unlock switch:

   Sliding this switch to the right locks/unlocks the touch screen.

2.2.2 Left View

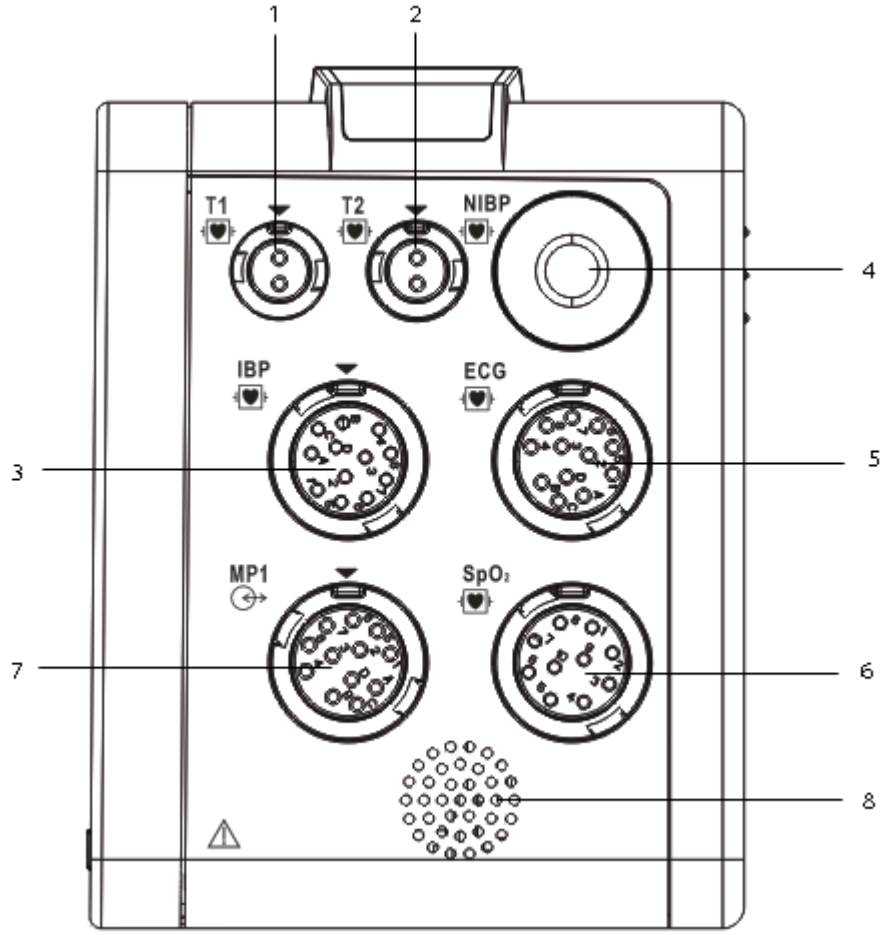


1. External DC power supply connector
2. Main unit multi-pin connector: connects T1 to the T1 handle or T1 docking station.
3. Infrared filter: is for future use.
4. Contact: is for future use.

NOTE

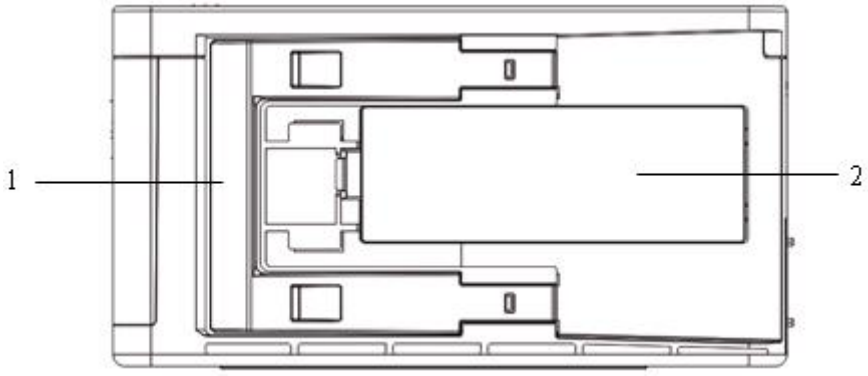
- **To ensure good contact, clean the contacts regularly, as dust and dirt may collect on them. When cleaning the contacts, wipe them with cotton, dampened with alcohol. Using forceps is recommended.**

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 defibrillation synchronization signal.
8. Speaker

2.2.4 Bottom View

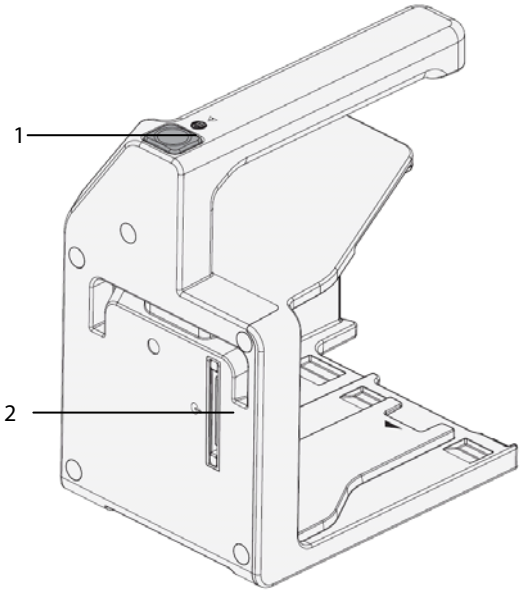


1. Latch: locks T1 when T1 is in use with T1 docking station, or T1 handle. Pressing here releases T1 so that you can remove it from T1 docking station, or T1 handle.
2. Battery door

2.3 T1 handle

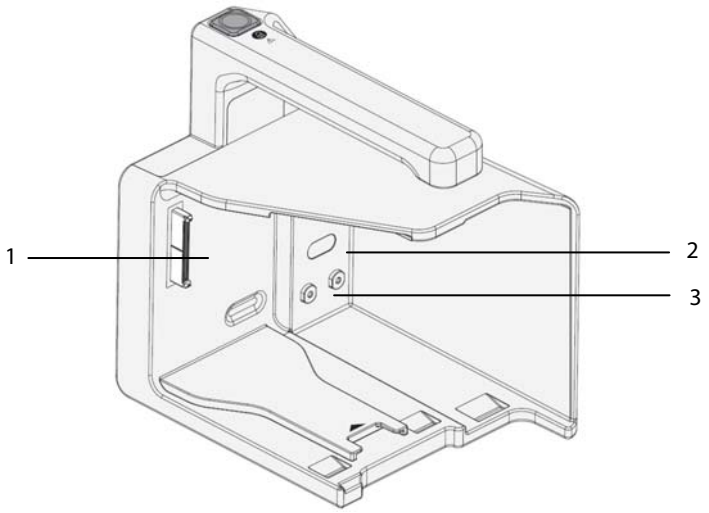
T1 handle is used for connecting a T1.

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

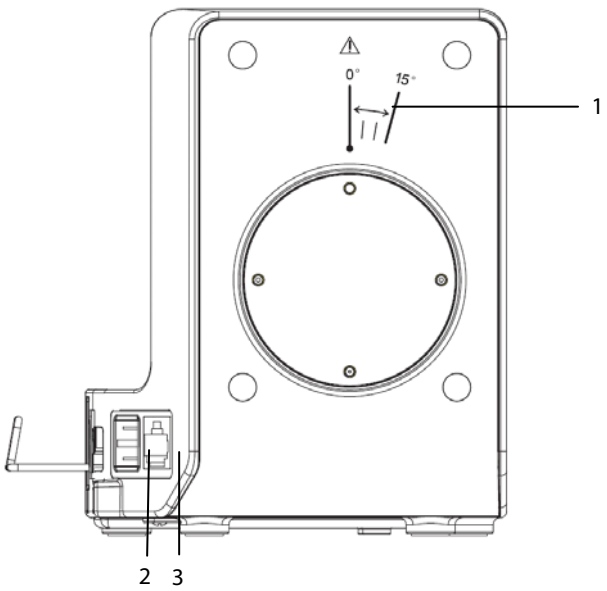


1. T1 handle multi-pin connector 2: connects the T1 handle and T1.
2. Infrared filter: is for future use.
3. Contact: is for future use.

2.4 T1 Docking Station

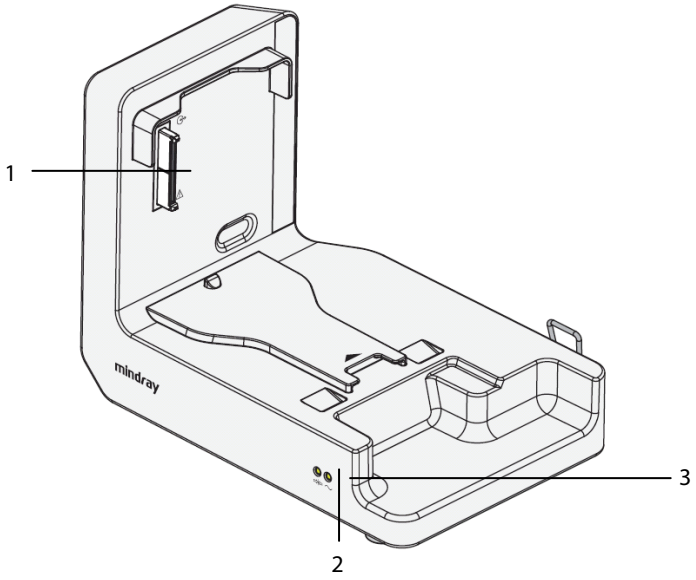
T1 docking station is used to connect the T1 or T1 handle.

2.4.1 Left View



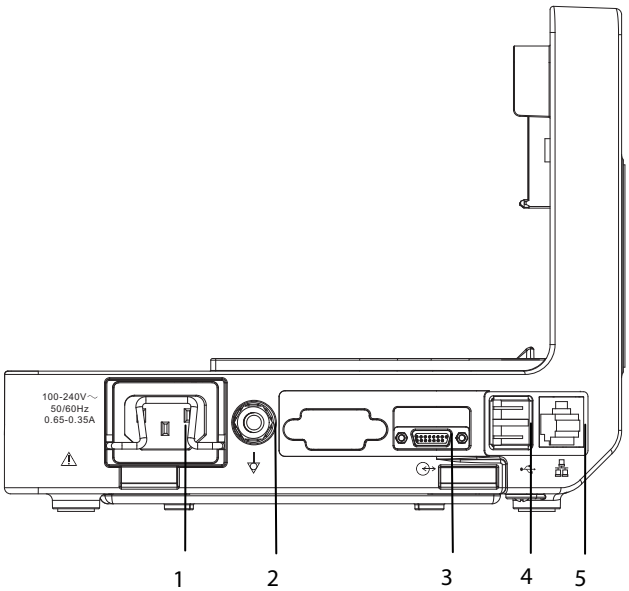
1. Symbol: indicates the direction and angle that T1 docking station can rotate when T1 docking station is fixed onto a transverse or a vertical rod.
2. USB connector: connects USB devices, including the USB drive, mouse and keyboard.
3. Network connector: a standard RJ45 connector that connects the 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 eliminate the potential differences between them.
3. External device connector: is for future use.
4. USB connector: connects USB devices, including the USB drive, mouse and keyboard.
5. Network connector: a standard RJ45 connector that connects the patient monitor to the CMS or CIS.

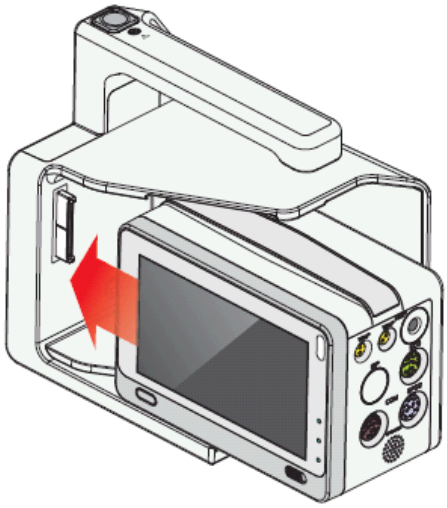
2.5 External Parameter Modules

The monitor can connect the external sidestream CO_2 module to perform CO_2 monitoring through the T1 handle.

2.6 Installation

T1 in Use with the T1 Handle

You can install the T1, if needed, to the T1 handle as indicated below:



You hear a click when T1 is pushed into place.

To remove the T1:

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

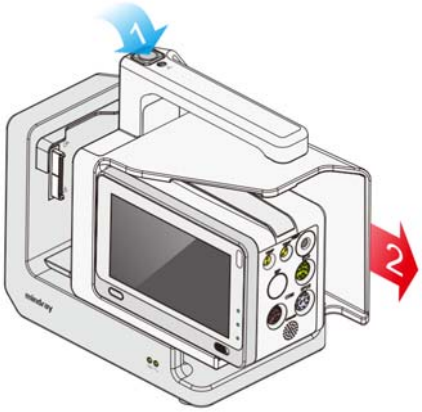
T1 Handle in Use with the T1 Docking Station

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.

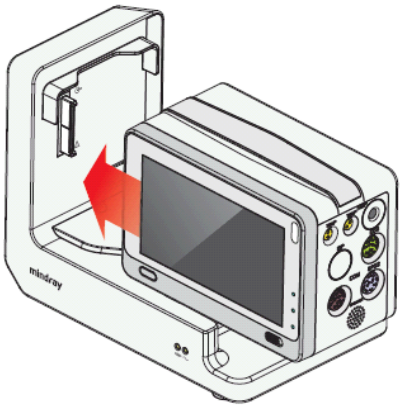


⚠ CAUTION

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

T1 in Use with the T1 Docking Station

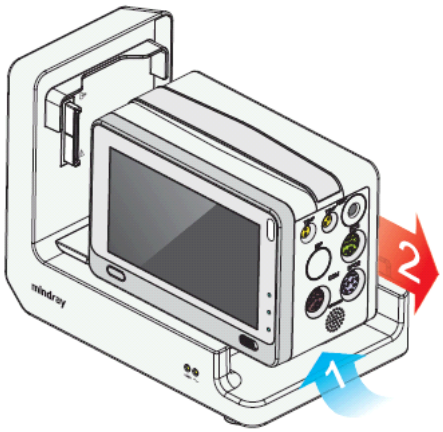
You can also install T1 directly to the T1 docking station as shown below:



You hear a click when T1 is pushed into place.

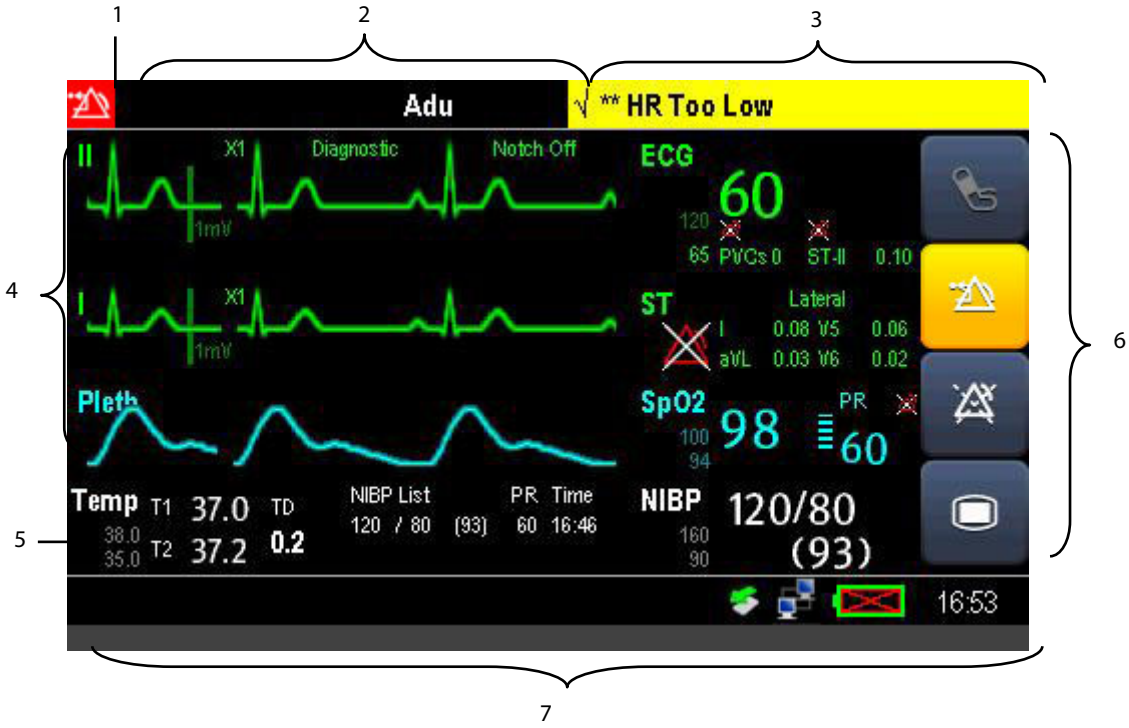
To remove T1 from the T1 docking station:

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, patient name, patient category and paced status. indicates that the patient has an implanted pacemaker. If no patient is admitted, selecting this area enters the [**Patient Setup**] menu. For admitted patients, selecting this area enters 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 scroll. Selecting this area shows the Technical Alarms list.
3. Physiological Alarm Area

   This area shows physiological alarm messages. When multiple alarms occur, the messages scroll. Selecting this area shows 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 parameter values displayed in this area, corresponding waveforms are not displayed.

6. QuickKeys Area

   This area contains QuickKeys that provides quick 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 prompt messages, network status icons, battery status icons, date and time, etc. For details about battery status symbols, refer to ***Chapter 18 Battery***.

   -  indicates patient monitor is connected to a wire network successfully.
   -  indicates the patient monitor has failed to connect a wire network.
   -  indicates a USB disk is inserted.

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 altering, 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 60601-1-1 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 60601-1-1. 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 equipment operating environment should 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 should be left for convenient operation, maintenance and repair. Moreover, to maintain good ventilation, the equipment should be at least 2 inches (5 cm) 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 being taking measurements, check the patient monitor for any mechanical damage, and make sure that all external cables, plug-ins and accessories are properly connected.
2. Connect the monitor with the DC adapter. 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 panel.

⚠ WARNING

- **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 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 10 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 patient data.**

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, the symbol  is shown in the Main Menu QuickKey area. Sliding the lock/unlock key to the right can unlock the screen.

3.5 Using the On-screen Keyboard

The on-screen keyboard enables you to enter information.

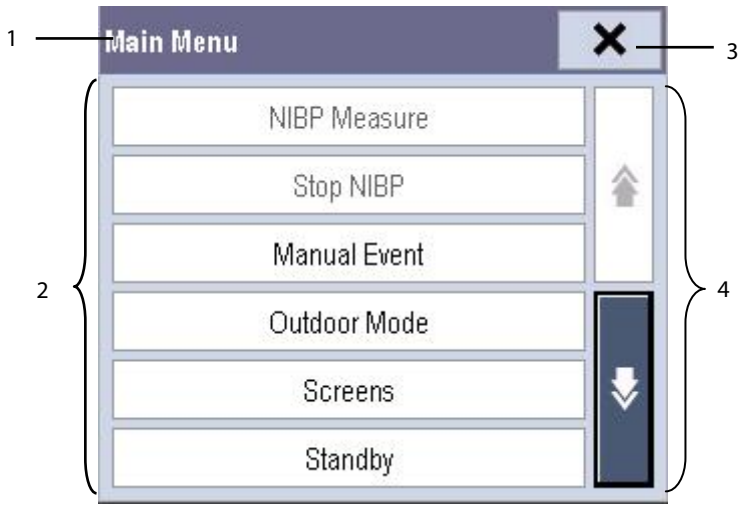
- Use the ← key to delete the previously entered character.
- Use the ⇪ key to toggle between uppercase and lowercase letters.
- Select ↵ to confirm what you have entered and close the on-screen keyboard.

- For some languages, press the switch button to display the special letters. For example, to enter the special letter 'â' in French, you should first press the character "^", and then select the target special letter 'â'. We call the character "^" as a "switch button". The following table defines the switch buttons and the special letters corresponding with the keyboards for each language:

Language	Switch Button	Special Letters
French	^	â, ê, û, î, ô
	¨	Ä, Ë , Ü, Ï , Ö

3.6 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 ">>" incorporate 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.

3.7 Changing General Settings

3.7.1 Setting up a Monitor

To install a monitor or change its location, set it as follows:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. In the [**User Maintenance**] menu, set in [**Monitor Name**], [**Department**] and [**Bed No.**].

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.

3.7.2 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.

NOTE

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

3.7.3 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 [**24 h**] and [**12 h**].

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 loss.**

3.8 Setting Parameters

3.8.1 Switching the Parameters On/Off

To switch the parameters on or off, select [**Main Menu**]→[**Screen Setup >>**]→[**Screen Layout >>**]→[**Parameters Switch**]. When you can access 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.**

3.8.2 Accessing the Parameters Menu

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

3.9 Operating Mode

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

3.9.1 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.

3.9.2 Privacy Mode

Privacy mode is only available when an admitted patient 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 doses the following after activating privacy mode:

- The screen turns blank and the message [**Under monitoring. Press any key to exit the privacy mode**] displays.
- 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 any of the following situations:

- The patient monitor disconnects from the 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.**

3.9.3 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 pop-up.

⚠ 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 too low.**

3.9.4 Outdoor Mode

The outdoor mode is intended for transferring patients outdoors. In this mode, the parameter color is white and unchangeable, and the screen brightness automatically changes 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 [**Outdoor Mode**] is set to [**Auto**] and the strength of ambient light is lower than the threshold for more than 5 seconds.

3.9.5 Configuration Mode

Refer to ***Chapter 6 Managing Configurations*** for the details.

3.9.6 Demo Mode

In Demo mode, the monitor can demonstrate its major functions when a 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,

1. Select [**Main Menu**]→[**Maintenance >>**].
2. Select [**Exit Demo**] →[**Ok**].

⚠ WARNING

- **The Demo mode is for demonstration purpose only. To avoid the potential risk of the simulated data being mistaken for the monitored patient's data, do not enter the Demo mode while monitoring a patient. Otherwise, improper patient monitoring and delayed treatment could occur.**

3.9.7 Standby Mode

In Standby mode, you can temperately stop 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 dimmest.
   - 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 automatically changes to the dimmest setting.

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 ***section 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 Configuring Your Screens

You can configure 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 settings are password-protected and can be modified by authorized personnel only. Once the change is made, notify those who use the monitor.

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 parameter, and then select a color from the pop-up menu.

4.3.3 Choosing a Screen

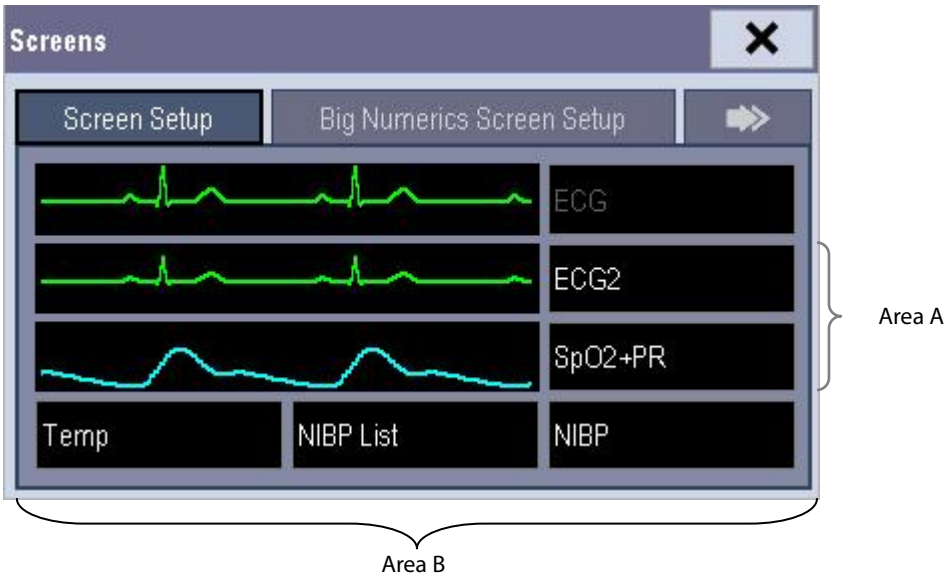
By selecting [**Main Menu**]→[**Screens >>**]→[**Choose Screen**], you can choose either:

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

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 ***section 4.3 Configuring Your Screens***.
- You can select the parameters you want to view on the 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

- **Unallocated parameters in the [Screen Setup] window do not display. However, the monitor can still sound alarms for 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.

5 Managing Patients

5.1 Admitting a Patient

The patient monitor displays physiological data and stores it in 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 is combined with the previous patient's data. 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 remaining patient demographic details later.

1. Select [**Main Menu**]→[**Patient Setup >>**].
2. Select [**Quick Admit**]. If a patient has been admitted, 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 Querying and Obtaining Patient Information

The monitor can obtain patient information from Hospital Information System (HIS) through the eGateway. To query or obtain patient information from the HIS:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Gateway Comm Setting >>**], and set [**IP Address**] and [**Port**]. Set [**ADT Query**] to [**On**].
2. Select the patient information area to enter the [**Patient Demographics**] menu.
3. Select [**Obtain Patient Info. >>**] to enter the [**Obtain Patient Information**] menu.
4. Input a query condition and then select [**Query**]. The monitor will display the obtained patient information.
5. Select a patient and then click [**Import**] to update the corresponding patient information.
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 the HIS, the monitor only updates patient information. The patient's monitoring data is not changed and the patient is not discharged.**

5.4 Associating Patient Information

After associating patient information with the HIS, the monitor will automatically update patient information if corresponding HIS information changes. The monitor can associate patient's MRN, 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 entered.**

5.5 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**].

5.6 Discharging a Patient

To discharge a patient:

1. Select [**Main Menu**]→[**Patient Setup >>**].
2. Select [**Discharge Patient**]. In the pop-up menu, you can either:
   - 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 stored in the monitor.**

5.7 Transferring Patient Data

You can transfer patient data between monitors without re-entering the patient demographic information. Transferring of patient data enables you to review the patient's history. 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. Refer to the operator manual of the host monitor.

⚠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.**

5.7.1 Transferring Patient Data via a USB Drive

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

5.7.1.1 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 pop-up 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.

5.7.1.2 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 pop-up menu, you can:
   - Select [**Transfer**] to transfer the patient data to the monitor, or
   - Select [**Cancel Transfer**] to cancel the transfer operation.
   - Select [**Unload USB Drive**] to not transfer the patient data and to unload the USB drive.

3. After you select [**Transfer**], in the pop-up 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 manages 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 pop-up 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.**

5.8 Auto Deleting History Data from SD Card

When the free space of the SD card is smaller than 370 M, the monitor automatically deletes all patients' history data, except the data of the current monitored patient and the latest patient data, from the SD card.
If the free space of the SD card is still smaller than 370 M after the auto deleting, the monitor will trigger a technical alarm to prompt: "Storage Card Space Low". For details about the technical alarm, refer to ***section D.2 Technical Alarm Messages***.

5.9 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 Hypervisor Central Monitoring System with a system software version 01.01.00 or greater supports T1.**

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

FOR YOUR NOTES

6 Managing Configurations

6.1 Introduction

When continuously monitoring a patient, the clinical professional often needs to adjust the monitor's settings according to the patient's condition. The collection of all these settings is called a configuration. Allowing you to configure the monitor more efficiently, the monitor provides different sets of configurations to accommodate the varying patient categories and departments. You can change the settings from a default configuration and then save it 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 relate 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.

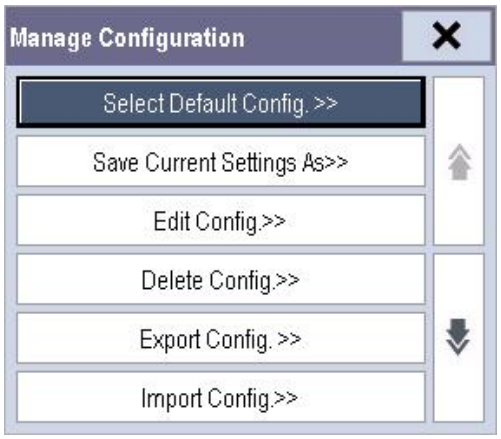
- User maintenance items

  These items relate 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 ***Appendix C Default Configurations***.

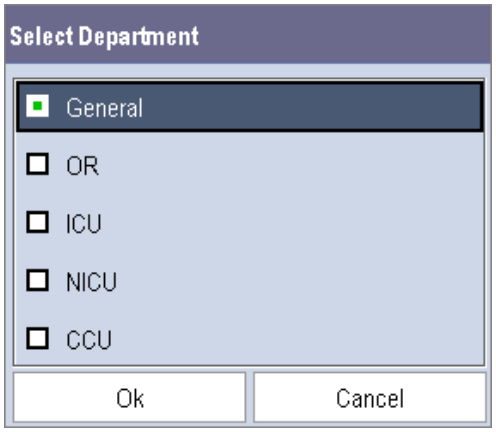
6.2 Entering the Manage Configuration Menu

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

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

6.4 Setting Default Configuration

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

- The patient monitor restarts after being switched off for more than 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 restored configuration is subject to the patient category (adult, pediatric or neonate). 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

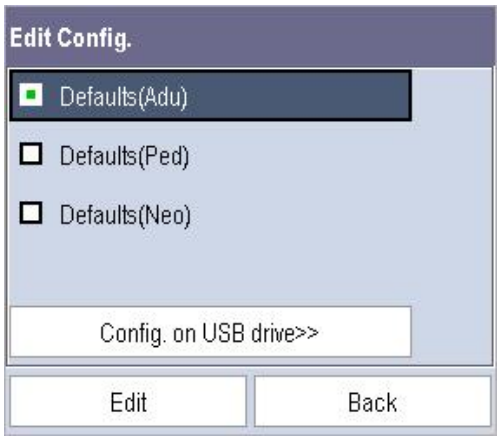
Current settings can be saved as a user configuration. Up to 3 user configurations can be saved.

To save current settings:

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

6.6 Editing Configurations

1. Select [**Edit Config. >>**] in the [**Manage Configuration**] menu. The pop-up 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 with another name.

6.7 Deleting a Configuration

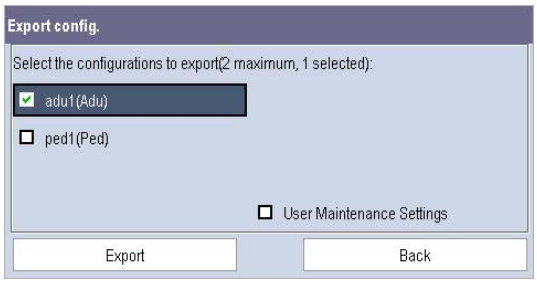
1. To delete a configuration, select [**Delete Config. >>**] in the [**Manage Configuration**] menu. The pop-up menu shows the existing user configurations on the monitor. Selecting [**Config. on USB drive >>**] will show the existing user configurations on the USB drive.
2. Select the user configurations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

6.8 Transferring a Configuration

When installing several monitors with identical user configuration it is not necessary to set each unit separately. A 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 monitor's external device 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 the monitor's external device 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 to ensure that all the settings are appropriate for your patient.

To load a configuration,

1. Select [**Load Configuration >>**] from the main menu. The pop-up 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**].

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 restores the latest configuration if it restarts within 60 seconds after the power failure. And it will restore the default configuration rather than the latest configuration if it restarts 120 seconds after the power failure. The monitor loads either the latest configuration or the default configuration if it 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 pop-up menu.
3. Select [**Ok**].

7 Alarms

Alarms, triggered by an abnormal vital sign or technical issue with the patient monitor, are visually and audibly indicated to the user.

⚠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 a CMS, remote suspension, inhibition, and reset of monitor alarms via the CMS may cause a potential hazard. For details, refer to the operator's manual of the CMS.**

7.1 Alarm Categories

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

1. 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.

2. 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 your 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 numerics

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 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 and give visual and audible alarm indications accordingly.**

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.

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**].

NOTE

- **User or factory default configurations have 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 tone is silenced or turned off, the patient monitor issues a periodical reminder tone.

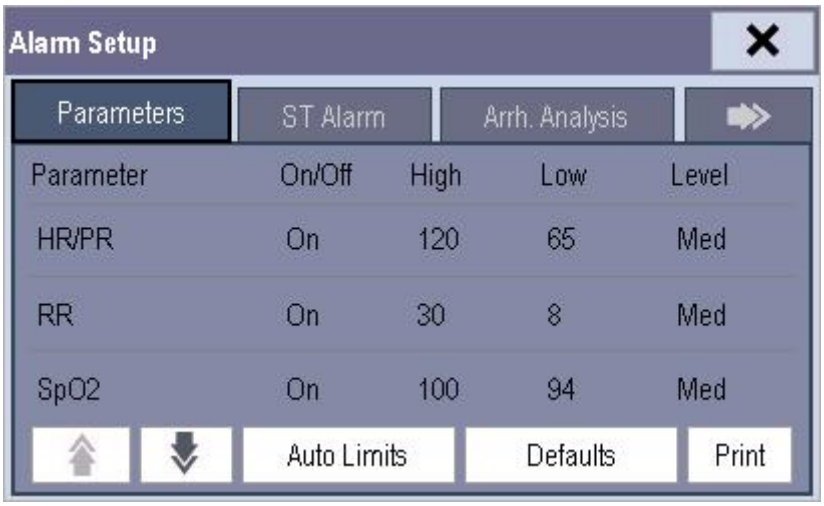
1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Alarm Setup >>**] to enter the [**Alarm Setup**] menu.
   - ◆ To switch the reminder tones on or off, select [**Reminder Tones**] and toggle between [**On**] and [**Off**].
   - ◆ To set 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**] menu, 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.



Refer to ***Chapter 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.**
- **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. 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 40 bpm (whichever is greater)	(HR – 30) or 90 bpm (whichever is greater)	HR × 1.25 or 240 bpm (whichever is smaller)	(HR + 40) or 200 bpm (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
NIBP	NIBP-S	(SYS × 0.68 + 10) mmHg	(SYS – 15) or 45 mmHg (whichever is greater)	(SYS × 0.86 + 38) mmHg	(SYS + 15) or 105 mmHg (whichever is smaller)	Adult: 45 to 270 Pediatric: 45 to 185 Neonate: 35 to 115

Module	Parameter	Low alarm limit		High alarm limit		Auto alarm limits range
		Adult/ pediatric	Neonate	Adult/ pediatric	Neonate	
	NIBP-D	(Dia × 0.68 + 6) mmHg	(Dia – 15) or 20 mmHg (whichever is greater)	(Dia × 0.86 + 32) mmHg	(Dia + 15) or 80 mmHg (whichever is smaller)	Adult: 25 to 225 Pediatric: 25 to 150 Neonate: 20 to 90
	NIBP-M	(Mean × 0.68 + 8) mmHg	(Mean – 15) or 35 mmHg (whichever is greater)	(Mean × 0.86 + 35) mmHg	(Mean + 15 or 95) mmHg (whichever is smaller)	Adult: 30 to 245 Pediatric: 30 to 180 Neonate: 25 to 105
Temp	T1	(T1 – 0.5) °C	(T1 – 0.5) °C	(T1 + 0.5) °C	(T1 + 0.5) °C	1 to 49 °C
	T2	(T2 – 0.5) °C	(T2 – 0.5) °C	(T2 + 0.5) °C	(T2 + 0.5) °C	1 to 49 °C
	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 45 mmHg (whichever is greater)	(SYS × 0.86＋ 38) mmHg	(SYS + 15) or 105 mmHg (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 20 mmHg (whichever is greater)	(Dia × 0.86＋32) mmHg	(Diav15) or 80 mmHg (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 35 mmHg (whichever is greater)	(Mean × 0.86 + 35) mmHg	(Mean + 15) or 95 mmHg (whichever is smaller)	Adult: 30 to 245 Pediatric: 30 to 180 Neonate: 25 to 105
PA	IBP-S	SYS × 0.75	SYS × 0.75	SYS × 1.25	SYS × 1.25	3 to 120 mmHg
	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: 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 40 mmHg

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. You can set the [**Alarm Delay**], in the [**Others**] window of [**Alarm Setup**] menu.

Alarm delay is not applied to the following physiological alarms:

- Apnea
- ST alarms
- Arrhythmia alarms
- ECG weak signal
- Resp artifact
- SpO_2 Desat
- No pulse
- Nellcor SpO_2 over alarm limits
- HR over alarm limits
- Measurements of noncontinuous parameters over alarm limits

You can set [**Apnea Delay**] and [**ST Alarm Delay**] separately in the [**Others**] window of [**Alarm Setup**] menu.

7.5.4 Setting SpO_2 Technical Alarm Delay

You can set the [**Tech. Alarm Delay**] in in the [**Others**] tab of the [**Alarm Setup**] menu. The options are [**Off**], [**5 s**], [**10 s**] and [**15 s**]. 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 are switched off. In CPB mode, [**CPB Mode**] is displayed in the physiological alarm area with a red background color.

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

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 alarms 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 sound 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 pop-up list.

7.7 Switching 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 sound 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.

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**].

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 ***section D.2 Technical Alarm Messages***.

7.9 Latching Alarms

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

- If an alarm is latched, alarm indications remain presented even though alarm conditions end, except that:
  - The parameter reading and violated alarm limit stop flashing.
  - The time when the alarm was last triggered is displayed behind the alarm message.
- If an alarm is not latched, the alarm indications disappear as soon as the alarm conditions end.

When the alarm system is reset, the latched physiological alarms are cleared.

To latch a physiological alarm,

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Alarm Setup** >>].
3. Select [**Latching Alarms**] and toggle between [**High only**], [**Hi&Med**], [**All**] and [**Off**]. If you select [**High only**]: only high priority alarms are latched; if you select [**Hi&Med**]: both high priority alarms and mediate priority alarms are latched; if you select [**All**]: all alarms are latched; if you select [**Off**]: the alarm latching is turned off.

NOTE

- **Changing of alarm priority may affect the latching status of corresponding alarm. Determine if you need to reset the latching status for the specific alarm after changing its alarm priority.**

7.10 Testing Alarms

When the monitor starts up, a self-test is performed. In this case the alarm lamp is lit in yellow and red respectively, and the system gives a beep. This indicates that the visible and audible alarm indicators are functioning correctly.

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

7.11 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 ***Appendix 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 two algorithms:

- Mindray ECG algorithm
- Mortara ECG algorithm

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

8.2 Safety

⚠ WARNING

- **Use only ECG electrodes and cables specified by the manufacturer.**
- **When connecting electrodes and/or patient cables, make sure that the connectors never come into contact with other conductive parts, or with earth. In particular, make sure that all of the ECG electrodes are attached to the patient, to prevent them from contacting conductive parts or 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 defibrillator-proof ECG cables during defibrillation.**
- **Keep distance with the patient or metal devices connected to the patient during defibrillation.**

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

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 site, 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.

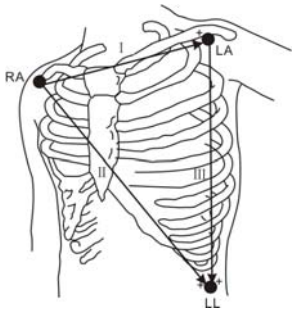
8.3.3 ECG Lead Placements

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

3-Leadwire Electrode Placement

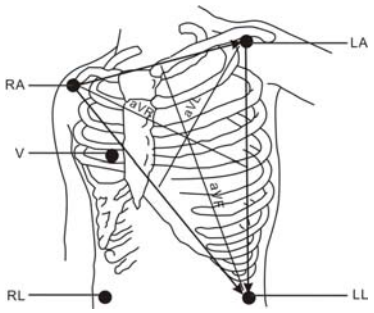
Following is an electrode configuration when using 3 leadwires:

- ■ 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.



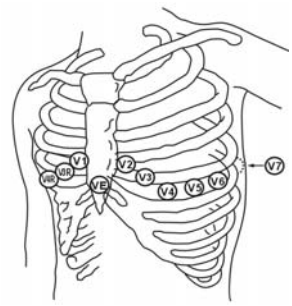
5-Leadwire Electrode Placement

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.

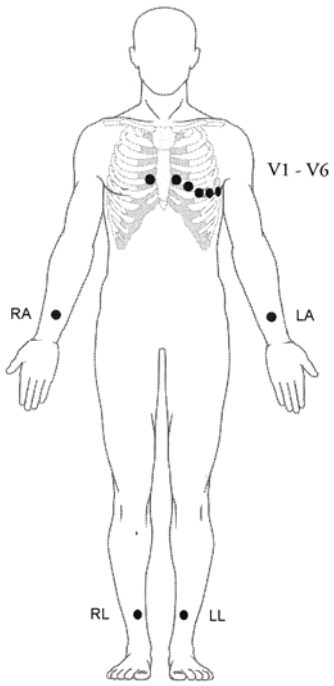
The chest (V) electrode can be placed on one of the following positions:



- 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 electrosurgical units (ESU), patient leads should be placed in a position that is equal distance from the Electrosurgery electrotome and the grounding plate to avoid burns to the patient. Never entangle the ESU cable and the ECG cable together.**
- **When using electrosurgical units (ESU), never place ECG electrodes near to the grounding plate 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 when the [**Paced**] status 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 patient information 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 pop-up menu and toggle between [**Yes**] and [**No**].

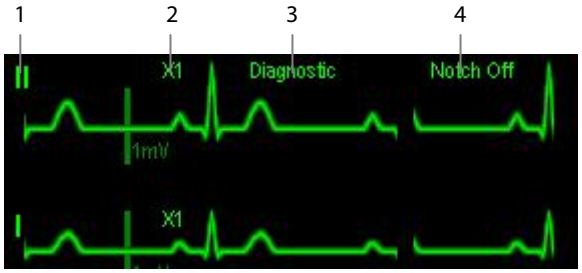
If you do not set the paced status, the patient monitor issues a prompt tone when pace pulse is detected. At the same time, the paced symbol flashes and the message [**Please confirm the pace of patient**] appears in the ECG waveform area. Then, please check and set the paced status of the patient.

Warning

- **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.**
- **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].**
- **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

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

For 12-lead ECG display screen, refer to ***section 8.9 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 waveform interference is strong (such as spikes).
   - [**Weak**]: when waveform interference is weak.
   - [**Off**]: to turn the notch filter off.

Set notch frequency according to the electric power frequency of your country. To set notch filter frequency:

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

- When [**Pacer Reject**] is switched on, the pace pulses are not counted as extra QRS complexes.
- The pace pulse marks "|" are shown on the ECG wave when pace pulses are detected.

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 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 pop-up 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.

8.5.10 Setting the Alarm Level for ECG Lead Off Alarms

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

8.5.11 Adjusting QRS Volume

QRS sounds are produced based on the alarm source.

To adjust the QRS volume,

1. Select [**Others >>**] from the [**ECG Setup**] menu.
2. Select [**QRS Volume**] from the pop-up menu and select the appropriate setting.
   When a valid SpO2 measured value is available, the system adjusts the pitch tone of QRS sound based on the SpO2 value.

8.5.12 About the Defibrillator Synchronization

If a defibrillator is connected, a defibrillator synchronization pulse (100 ms, +5 V) 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.**
- **Before defibrillation, make sure that the [Filter] is set to [Diagnostic].**
- **After defibrillation is finished, select the filter mode as required.**

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. If you change [**Monitor**] or [**Surgery**] to [**Diagnostic**] or [**ST**], ST-segment analysis remains 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.

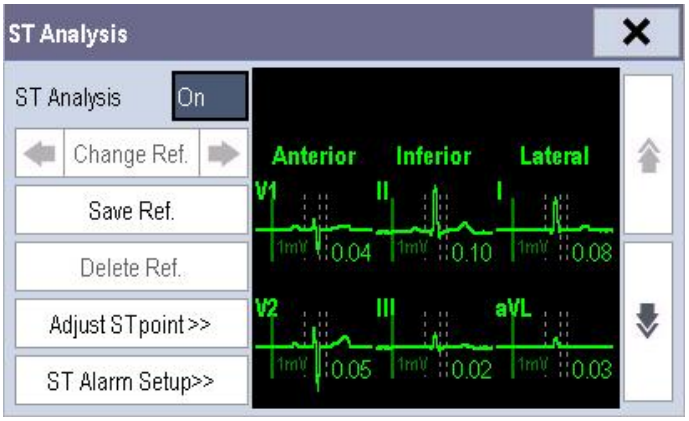
8.6.3.2 ST Segment

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 from the [**Screens**] menu. Set [**ST Segment**] to be displayed.

Select the ST parameter window or ST segment area to 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 a reference. Up to 20 references 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 pop-up.

8.6.7 Changing the ST Alarm Limits

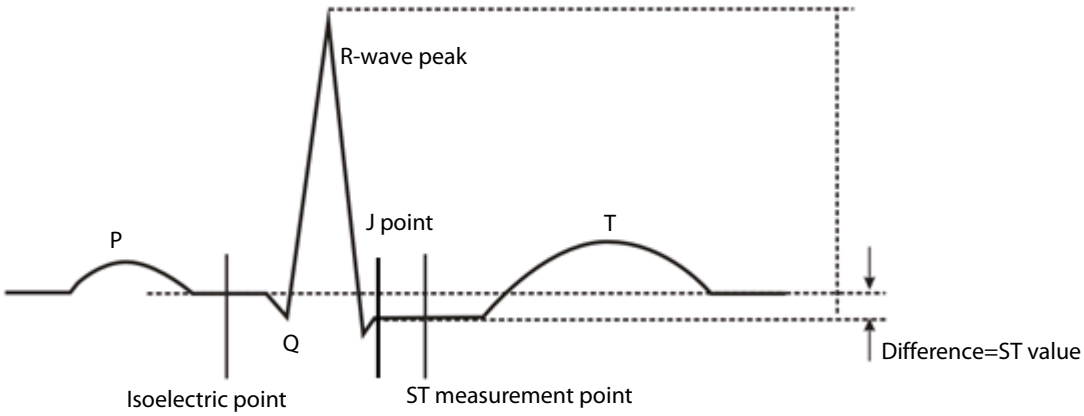
High and low ST alarm limits can be set individually for each ECG lead. Alarm limits can also be set separately for single-lead and multi-lead ST monitoring. You can select [**ST Alarm Setup >>**] from [**ST Analysis**] menu and then change ST alarm settings for each lead.

8.6.8 Setting the ST Alarm Delay Time

You can set the ST alarm delay time from the [**Others**] window of [**Alarm Setup**] menu.

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 ST measurement points are appropriate for your patient.**

To adjust the ST measurement points, select [**Adjust ST Point >>**] from the [**ST Analysis**] menu. In the [**Adjust ST Point**] window, you can:

- Select [**Auto**] to automatically adjust the ISO point and set ST point, or

- Manually adjust ST measurement points.

In the [**Adjust ST Point**] window, three vertical lines represent the ISO, J and ST point positions respectively. To manually adjust the ST measurement points:

1. Use the arrows ◀ and ▶ besides the [**View Leads**] button to select an ECG lead with obvious J point and R wave.
2. 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+60/80 ms**], [**J+40 ms**], [**J+60 ms**] or [**J+80 ms**]. When [**J+60/80 ms**] 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 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 arrhythmias. It is not designed to detect 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.**
- **Mortara arrhythmia algorithm is not intended for neonatal patients.**

8.7.1 Understanding the Arrhythmia Events

Mindray ECG 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 message	Description	Category
Pacer not paced	No pace pulse detected for 1.75 x average R-to-R intervals following a QRS complex (for paced patients only).	arrhythmia
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.	
VT > 2	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.	
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.	

Mortara ECG 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.	
VT > 2	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.	

Arrhythmia Message	Description	Category
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.	

8.7.2 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 arrythmia alarms is always high. It is unchangeable.**

8.7.3 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. When 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 ECG 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 ECG 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

8.7.4 Setting the Extended Arrh. (For Mindray ECG Algorithm Only)

The following arrhythmia events are defined as extended arrhythmia:

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

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.

8.7.5 Reviewing Arrhythmia Events

Please refer to ***Chapter 16 Review***.

8.8 ECG Relearning

8.8.1 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

- **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.**

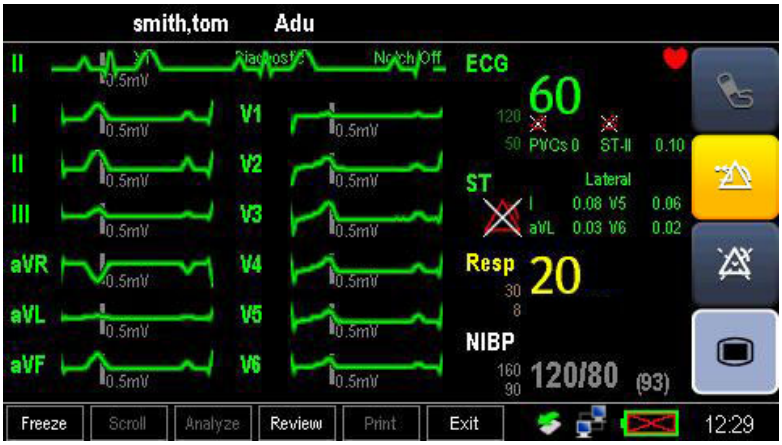
8.8.2 Automatic ECG Relearning

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 ECG calibration is completed and [**Stop Calibrating ECG**] is selected.
- Switch between normal screen and 12-lead full screen for 12-lead ECG monitoring.
- The paced status of the patient is changed.

8.9 12-Lead ECG Monitoring

1. Refer to ***section 8.3.3 ECG Lead Placements*** for placing the electrodes.
2. In the [**ECG Setup**] menu, select [**Lead Set**]→[**12-Lead**].
3. Select [**Main Menu**]→[**Screens**]→[**Choose Screen**]→[**ECG 12-Lead Full-Screen**].



There are a total of 12 ECG waves and 1 rhythm wave displayed on the screen. The rhythm lead is ECG Ⅰ before entering the 12-lead ECG monitoring screen. The ST numerics are displayed in three groups:

- ST Ant (anterior): V1, V2, V3, V4
- ST Inf (inferior): II, III, aVF, (aVR)
- ST Lat (lateral): I, aVL, V5, V6

Although aVR is displayed in the ST Inf group, it is not an inferior lead.

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 exits the 12-lead full screen.

FOR YOUR NOTES

9 Monitoring Respiration (Resp)

9.1 Introduction

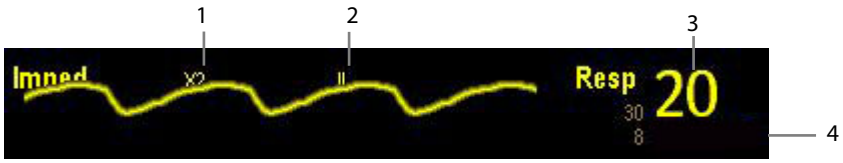
Impedance respiration is measured across the thorax. When the patient is breathing or ventilated, the volume of air changes in the lungs, resulting in impedance changes between the electrodes. Respiration rate (RR) is calculated from these impedance changes, and a respiration waveform appears on the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

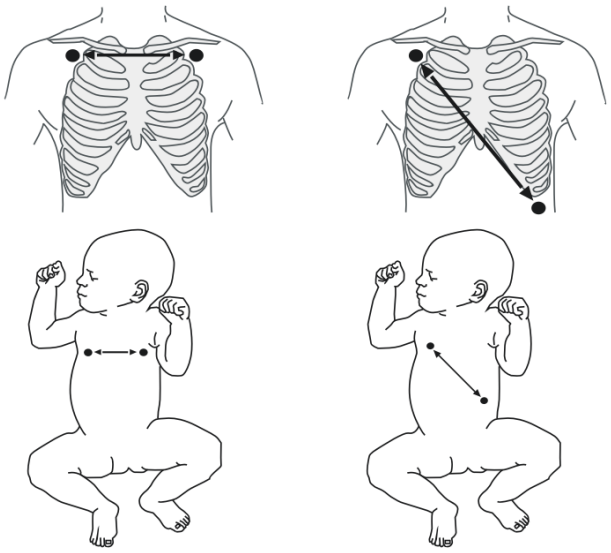
9.4 Placing Resp Electrodes

As the skin is a poor conductor of electricity, preparing the skin is necessary for a good respiration signal. You can refer to ***section 8.3.1 Preparing the Patient and Placing the Electrodes*** 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.

1. In the [**Resp Setup**] menu, select [**Apnea Delay**].
2. Select the appropriate setting. The [**Apnea Delay**] of Resp 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 ***section 9.4.4 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 Respiration Rate (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  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.
ECG	RR source is from impedance respiration measurement.

9.10 Setting Alarm Properties

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

FOR YOUR NOTES

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 ***Chapter 14 Monitoring IBP***). The displayed pulse numeric is color-coded to match its source.

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 [**SpO_2 Setup]** menu.
2. Select [**PR Source**] and then select a label or [**Auto**] from the pop-up menu.

The pop-up 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 pop-up 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 pop-up 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 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**] or [**SpO_2 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

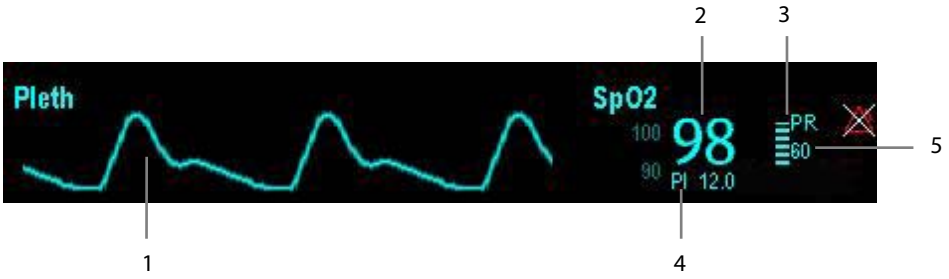
When PR is used as the alarm source, the PR source will be used as a source for the QRS tone. You can change the QRS volume by adjusting [**Beat Vol**] in the [**SpO2 Setup**] menu. When a valid SpO_2 value exists, the system will adjust the pitch tone of QRS volume according to the SpO_2 value.

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 photo detector in the probe. The SpO_2 module processes the electrical signal and displays a waveform and digital values for SpO_2 and pulse rate.

This device is calibrated to display functional oxygen saturation. It provides five measurements:



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

   PI is available for Mindray SpO_2 module and Masimo SpO_2 module.
5. Pulse rate (derived from the pleth wave): detected pulsations per minute.

11.2 Safety

⚠ WARNING

- **Use only SpO_2 sensors specified in this manual. Follow the SpO_2 sensor's instructions for use and adhere to all warnings and cautions.**
- **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 SpO_2 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.**

11.3 Identifying SpO_2 Modules

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 connectors for these three SpO_2 sensors 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.

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 [**SpO2 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 alarms can be distracting. Nellcor's Sat-Seconds alarm management technique is used to reduce these nuisance alarms.

The Sat-Seconds feature is available with the Nellcor SpO_2 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.

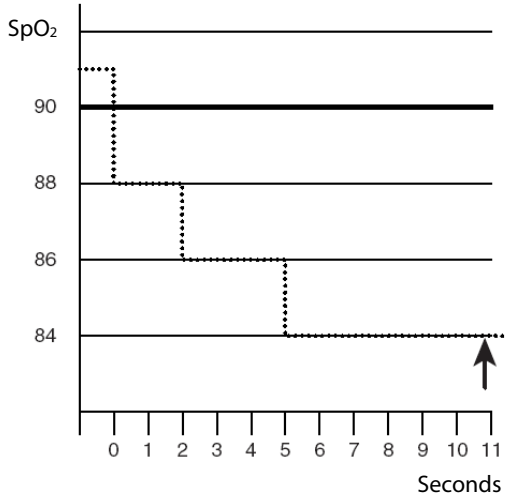
With Sat-Seconds alarm management, high and low alarm limits are set in the same way as traditional alarm management. A Sat-Seconds limit is also set. The Sat-Seconds limit controls the amount of time that SpO_2 saturation may be outside the set limits before an alarm sounds. The method of calculation 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 pop-up menu.

11.5.8 Setting the SpO_2 Tone Mode

Select [**Others >>**] from the [**User Maintenance**] menu. In the pop-up 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 pop-up 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 SpO_2, measurement, check the patient's 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 SpO_2 sensor, or use of incorrect SpO_2 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.

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 60601-2-30/EN60601-2-30, 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 patients with sickle-cell disease or any condition where skin damage has occurred or is expected.**
- **Use clinical judgment to determine whether to perform frequent unattended blood pressure measurements on patients with severe blood clotting disorders because of the risk of hematoma in the limb fitted with the cuff.**
- **Do not use the NIBP cuff on a limb with an intravenous infusion or arterial catheter in place. This could cause tissue damage around the catheter when the infusion is slowed or blocked during cuff inflation.**
- **If you doubt the NIBP measurements, determine 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 40 bpm or greater than 240 bpm, 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 three 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.

12.5 Setting Up the NIBP Measurement

12.5.1 Preparing to Measure NIBP

1. Power on the monitor.
2. Verify that the patient category is correct. Change it if necessary. Refer to ***section 6.4 Setting Default Configuration*** for more details.
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 the patient's upper arm or thigh 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 folded and twisted.

NOTE

- **Equipment use is restricted to single patient use.**

12.5.2 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.

12.5.3 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.

12.5.4 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.

12.5.5 Starting a STAT Measurement

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

12.6 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

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

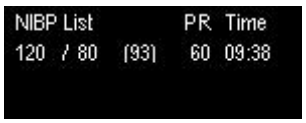
You can set the initial cuff inflation pressure manually. In the [**NIBP Setup**] menu, select [**Initial Pressure**] and then select the appropriate setting.

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 pop-up 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, where the most recent NIBP measurements display. The displayed PR 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 pop-up 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 pop-up 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. Remove 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.
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 Setting the Temperature Unit

Select [**Unit Setup >>**] from the [**User Maintenance**] menu. In the pop-up menu, select [**Temp Unit**] and toggle between [**°C**] and [**°F**].

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.**
- **When using accessories, their operating temperature should be taken into consideration. For details, refer to instructions for use of accessories.**

14.3 Zeroing the Transducer

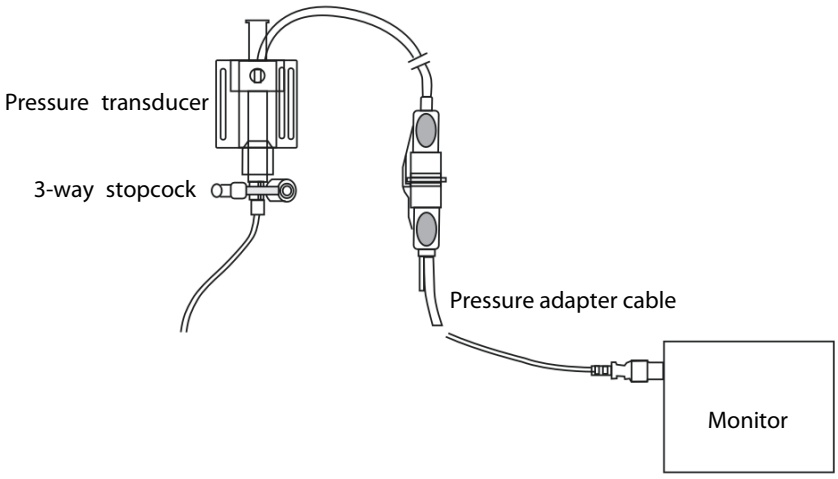
To avoid inaccurate pressure readings, the monitor requires a valid zero. Zero the transducer in accordance with your hospital policy (at least once per day).

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.

To zero the transducer:

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.

NOTE

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

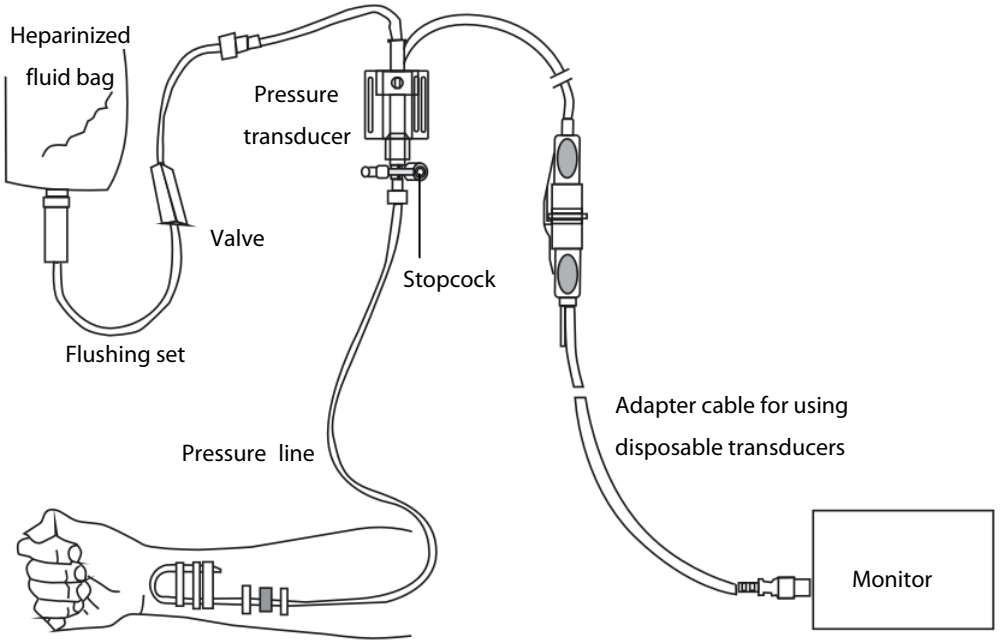
14.4 Setting Up the Pressure Measurement

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 air turn on the stopcock to the patient.

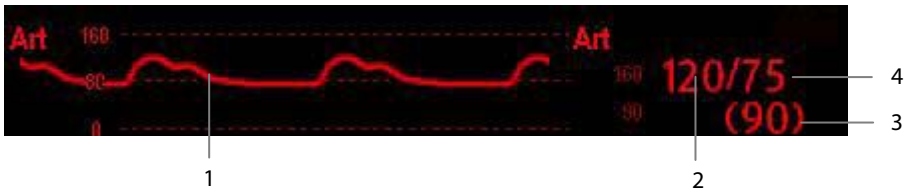


⚠ WARNING

- **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.**

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.



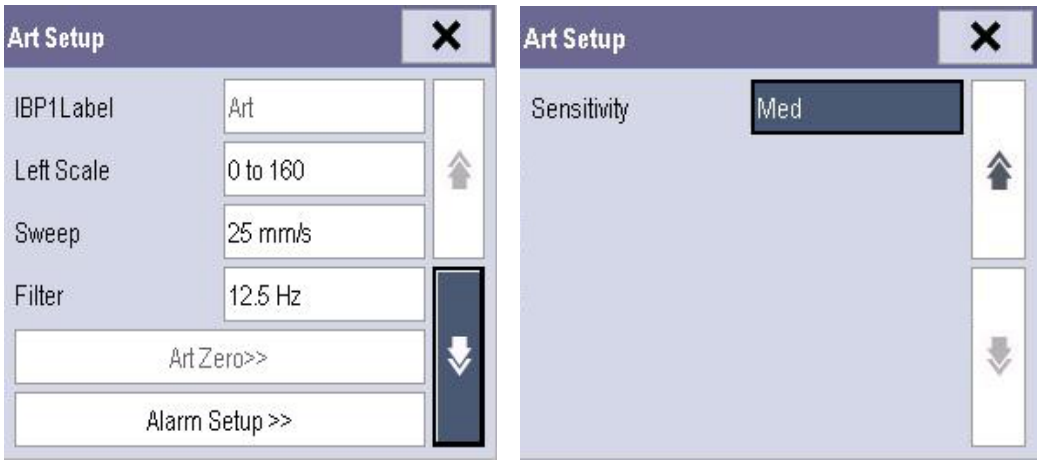
1. Waveform
2. Systolic pressure
3. Mean pressure
4. Diastolic pressure

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. In the menu, there is a figure showing the current IBP measurement connector.



2. Select [**Label**] and then select your desired label from the list. Labels already used 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
P1 to P4	Non-specific pressure label		

NOTE

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

14.6.2 Setting Alarm Properties

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

14.6.3 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.

14.6.4 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.

14.6.5 Setting the Pressure Unit

Select [**Unit Setup >>**] from the [**User Maintenance**] menu. In the pop-up menu, select [**Press. Unit**] and toggle between [**mmHg**] and [**kPa**]. Select [**CVP Unit**] and toggle between [**mmHg**], [**cmH_2O**] and [**kPa**].

15 Monitoring CO_2

15.1 Introduction

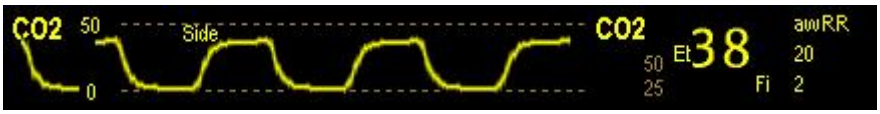
CO_2 monitoring is a continuous, non-invasive technique for determining the concentration of CO_2 in the patient's airway by measuring the absorption of infrared (IR) light of specific wavelengths. The CO_2 has its own absorption characteristic and the amount of light passing the gas probe depends on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

Sidestream is used for measuring CO_2 in the patient's airway. Sidestream 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 sidestream 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.

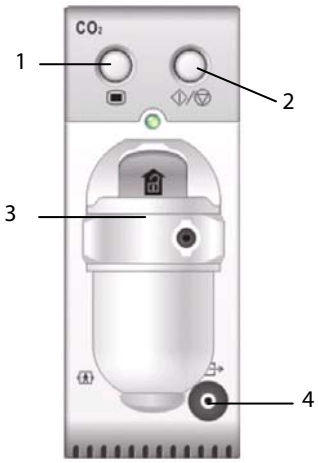
The measurement provides:

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 CO_2 Module

This monitor uses an external module to perform CO_2 monitoring.



1. Setup key to enter the CO_2 setup menu
2. Measure/standby
3. CO_2 watertrap seat
4. Gas outlet

15.3 Preparing to Measure CO_2

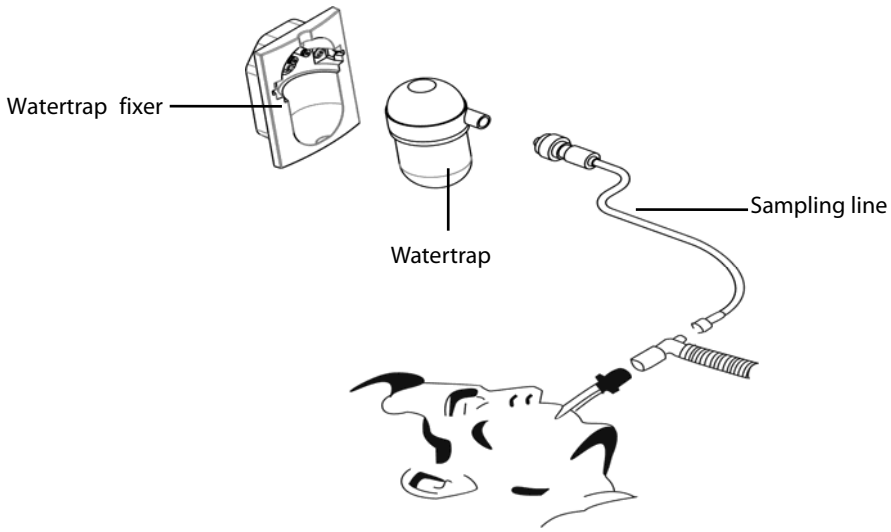
⚠WARNING

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

NOTE

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

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



⚠CAUTION

- **Do not apply adult watertrap to the neonate patient. Otherwise, patient injury could result.**
- **The watertrap collects water drops condensed in the sampling line and therefore prevents them from entering the module. To avoid blocking the airway, empty the watertrap container whenever half full. Dispose of accumulated fluids in accordance with hospital policy or your local regulations.**
- **The watertrap has a filter preventing bacterium, water and secretions from entering the module. After 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.**
- **Performing CO_2 measurements during warm-up may compromise the measurement accuracy.**

NOTE

- **To extend the life of the watertrap and module, disconnect the watertrap and set the CO_2 operating mode to standby when CO_2 monitoring is not required. *Refer to 15.4.9 Entering the Standby Mode*.**

15.4 Changing CO_2 Settings

15.4.1 Setting the CO_2 Unit

Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→ [**Unit Setup >>**]. In the [**Unit Setup**] menu, select [**CO_2 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 [**CO_2 Setup**] menu.

15.4.3 Setting up Gas Compensations

⚠WARNING

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

1. Select the CO_2 parameter window to access the [**CO2 Setup**] menu.
2. According to the actual condition, set the concentration required for the following compensations:
   - [**O_2 Compen**]
   - [**N_2O Compen**]
   - [**Des Compen**]

15.4.4 Setting up Humidity Compensation

The CO_2 modules is 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.

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

1. Select the CO_2 parameter window to access the [**CO2 Setup**] menu.
2. Select [**Apnea Delay**] and then select the appropriate setting.

The monitor will alarm if the patient has stopped breathing for longer than the selected apnea time. The [**Apnea Delay**] setting of Resp and CO_2 are synchronized.

⚠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 Setting the Flow Rate

You can change the sampling rate of respiratory gas in the patient's airway by setting the flow rate.

To set the flow rate:

1. Select the CO_2 parameter window to access the [**CO2 Setup**] menu.
2. 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.**

15.4.7 Setting up the CO_2 Waveform

Select the CO_2 parameter window to access the [**CO2 Setup**] menu, in which 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**].

15.4.8 Setting RR Source

To set RR source:

1. Select the CO_2 parameter window to access 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 synchronized. For details, please refer to *section **9.9 Setting RR Source***.

13.4.9 Entering the Standby Mode

By default, the CO_2 module is in measure mode. To enter or exit the Standby mode manually:

1. Select [**Operating Mode**] in the [**CO2 Setup**] menu
2. Select [**Standby**] or [**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 CO_2 module will also enter the standby mode.
- If the monitor exits the standby mode, the CO_2 module will also exit the standby mode.
- If the CO_2 module enters or exits the standby mode, it will not affect the monitor.

When you set the CO_2 module to the standby 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 previously set sample flow rate.

You can set a delay time, after which the CO_2 module will enter the standby mode if no breath is detected.

13.5 Measurement Limitations

Some adverse effects can influence CO_2 performance.

⚠CAUTION

- **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 cmH_2O)
  - Other sources of interference, if any
- **Measurement accuracy 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 is unspecified for breath rate larger than 60 bpm.**

13.6 Leakage test

When the modules need maintenance, the monitor displays this message in the CO_2 waveform window: [**Need maintenance. Enter CO2 setup menu.**] Then:

1. Select [**Main Menu**] →[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→ **[Maintain CO2 >>**]
2. Perform leakage test according to the prompt messages on the menu.

15.7 Troubleshooting the CO_2 Sampling System

When the sampling system of the CO_2 module does not works correctly, check to see if the sampling line is kinked. If the sampling line is not kinked, remove it from the watertrap. If the monitor gives a message indicating the sample line still does not work correctly, it indicates that the watertrap is blocked, and it should be replaced with a new one. Otherwise, the sampling line is blocked and should be replaced with a new one.

15.8 Removing Exhaust Gases from the System

⚠WARNING

- **Anesthetics: When using the CO_2 measurement on patients who are receiving or have recently received anesthetics, connect the outlet to a scavenging system, or to the anesthesia machine/ventilator, 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

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.

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:

1. Select [**Main Menu**] →[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→ [**Maintain CO2 >>**]
2. Select [**Calibrate CO2 >>**]→[**Start Zero Cal.**].

Disconnecting the patient airway is not required when performing a zero calibration.

⚠WARNING

- **When performing a zero calibration during the measurement, disconnect the transducer from the patient's airway first.**
- **Do not rely on the readings during zeroing.**

FOR YOUR NOTES

16 Review

16.1 Accessing Respective Review Windows

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

16.2 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:

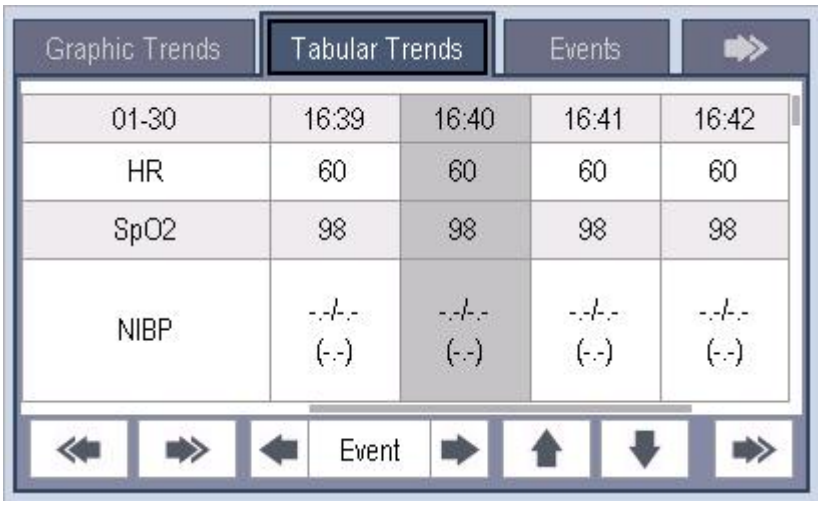
- Select [**Trend Group**] and you can select a trend group for viewing in the pop-up menu. If [**Custom 1**] or [**Custom 2**] is selected, you can also select [**Define Trend Group**], then you can select the parameters for viewing in the popup menu.
- Select [**Zoom**] to set the time length of review window.
- Select [**Waves**] to set the number of waves to display on one page.
- 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 a high level alarm has a red background. The one that triggered a medium/low level alarm has a yellow background.
- By selecting or beside [**Event**], you can position the cursor to a different event time.

- By selecting the [**Print**] button, you can set and print the graphic trends report with the printer. For how to configure the graphic trends report, refer to ***Chapter 17 Printing***.

16.3 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 pop-up 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 pop-up menu.
- Select [**Interval**] to change the resolution of the trend data and then select the appropriate setting:
  - [**5 s**] or [**30 s**]: select to view up to 4 hours of tabular trends at 5- or 30-seconds 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 a different event time.
- By selecting the [**Print**] button, you can set and print the tabular trends report with the printer. For how to configure the tabular trends report, refer to ***Chapter 16 Printing***.

16.4 Reviewing Events

16.4.1 Marking Events

During patient monitoring, some events may affect the patient and change the displayed waveforms or numerics displayed on the monitor. To help analyze these waveforms or numeric changes, you can mark these events.

Select [**Main Menu**]→[**Mark Event >>**]. In the pop-up menu, you can select the waves to store after triggering a manual event. 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.

16.4.2 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. You can review the parameter alarm events, arrhythmia alarm events and manual events. When an event occurs, the system stores all the measurement numerics at the event triggering time and related waveforms 4 seconds, 8 seconds or 16 seconds before and after the event triggering time, as per the setting of recording length.

In this window:

- Select [**Event**] to view the desired events.
- Select [**Level**] to view the desired events according to the alarm priority.

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

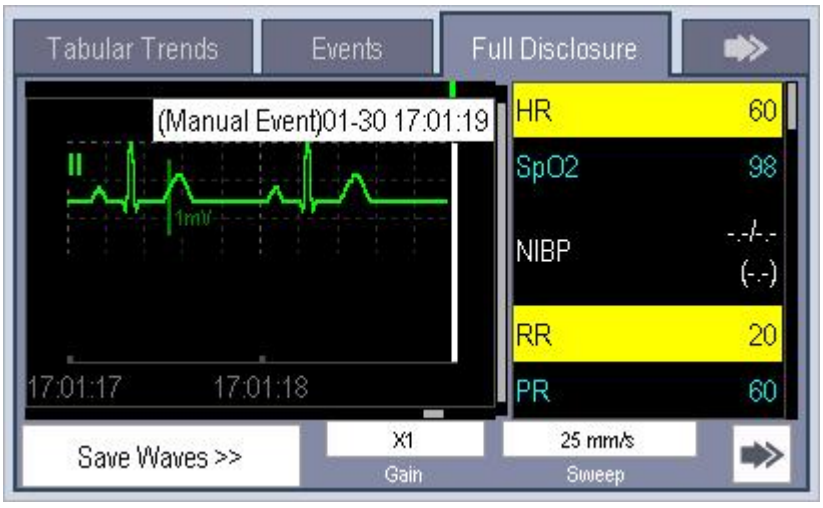
- **A total loss of power has no impact on the saved events.**

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**].
- Select the [**Events List**] button to view the events list.
- Select the [**Print**] button to print the displayed alarm events.

16.5 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 waveforms, your monitor must have an SD storage card.

17 Printing

17.1 Printer

The monitor can output patient reports via a connected printer. The monitor supports the following printers:

- HP LaserJet 1505n
- HP LaserJet P2035n
- HP LaserJet P4015n
- HP LaserJet 401dn
- HP LaserJet 602n

The reports specifications are:

- Paper: A4, Letter
- Resolution: 300 dpi

For more details about the printer, see the document accompanying the printer. With product upgrades, the monitor may support more printers without prior notice. If you have any questions or doubt about your printer, contact our company.

17.2 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 with a network cable, and then start printing what you want.

17.3 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**].

17.4 Starting Report Printouts

Reports	Contents	Procedures
ECG reports	ECG waveforms and relevant parameter values	Select [**Main Menu**]→[**Print Setup >>**]→[**ECG Reports >>**]→[**Print**]
Tabular trends	Depends 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	Depends 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	Depends on the selected alarms	Select [**Main Menu**]→[**Alarm Setup >>**]→[**Parameters**] →[**Print**]
Realtime waves	Depends on the selected waveforms	Select [**Main Menu**]→[**Print Setup >>**]→[**Realtime Reports >>**]→[**Print**]

17.5 Stopping Report Printouts

To stop report printouts, select [**Main Menu**]→[**Print Setup >>**]→[**Stop All Reports**].

17.6 Setting Up Reports

17.6.1 Setting Up ECG Reports

You can print ECG reports only from the 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.

17.6.2 Setting Up Tabular Trends Reports

To set up tabular trends reports, select [**Main Menu**]→[**Print Setup >>**]→[**Tabular Trends Reports >>**].

- [**Start time**]: set a time period whose trend data will be printed out by setting [**From**] and [**Back**]. For example, if you set [**From**] as 2013-4-2 10:00:00 and [**Back**] as [**2 h**], the outputted data will be from 2013-4-2 08:00:00 to 2013-4-2 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 parameter.
  - [**All**]: if you select [**All**], all trend data will be printed out. In this case, there 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 parameter.
- [**Select Parameter >>**]: from the pop-up 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**]: define a parameter group for printing from the parameters displayed in the lower part of the menu.

17.6.3 Setting Up Graphic Trends Reports

To set up graphic trends reports, select [**Main Menu**]→[**Print Setup >>**]→[**Graphic Trends Reports >>**]. Setting up graphic trends reports is similar with tabular trends reports. Refer to ***section 16.6.2 Setting Up Tabular Trends Reports*** for details.

17.6.4 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 pop-up menu, you can:
  - [**Current**]: print the currently displayed waves.
  - [**Select Wave**]: select the desired waves for printing.

17.7 End Case Reports

ECG reports, tabular trends reports, graphic trends reports, NIBP review reports and real time reports can be set as end case reports. When you discharge a patient, the system will automatically print all contents that are set as end case reports.

For example, to set the ECG report as an 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 pop-up dialog box.
3. Set as described in ***section 17.6.1 Setting Up ECG Reports***.

17.8 Printer Statuses

17.8.1 Printer Out of Paper

When the printer runs out of paper, the printer will not print until the paper is replaced. If there are too many print jobs that are not printed, a printer error may occur. In this case, you need to install paper and then re-send the print request. Restart the printer if necessary.

To avoid this, ensure that there is enough paper in the printer before sending a print request.

17.8.2 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.

18 Other Functions

18.1 Analog Output

The monitor is configured with a multifunction connector for analog output. You can contact your service personnel for more details.

18.2 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.

18.2.1 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.

18.2.2 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 pop-up 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.

NOTE

- **If no setting is selected from [Alm Lev] or [Alarm Cat.], no nurse call signal will be triggered whatever alarms occur.**

18.3 Network Connection

The equipment can be connected to the central monitoring system or viewed by other monitors through the network.

- When connected to the central monitoring system, T1 can transfer the patient information, parameter numeric and waveforms, physiological and technical alarms, alarm settings and module settings to the central monitoring system. The user can also admit and discharge patient, modify patient information, set alarm switch, alarm limits, and module settings of T1 from the central monitoring system.
- When viewed by other monitors, T1 transfers patient information, parameter numerics and waveforms, physiological and technical alarms ,and alarm settings to the other monitors.

18.3.1 Setting the Network Type

To set the network type, you can select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Network Setup >>**].

18.3.2 Setting the IP Address, Subnet Mask and eGateway

In the [**Network Setup**] menu, you can set IP address, subnet mask and eGateway with a system software version 5.0. 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.

19 Battery

19.1 Overview

The equipment is designed to operate from 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:

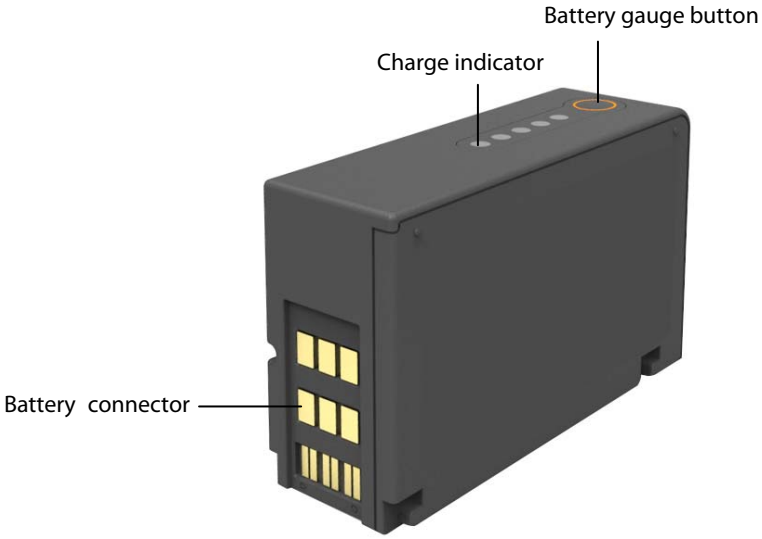

Indicates that battery works correctly. The solid portion represents the current charge level.


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.



The capacity of the battery is limited. When the battery is low, the technical alarm area displays [**Low Battery**], the alarm lamp flashes, and the monitor produces an alarm sound.

If the battery is depleted, the battery symbol on the screen flashes, the technical alarm area displays [**Battery Depleted**], the alarm lamp flashes, and the monitor produces alarm sound. Change the battery or connect the external power to the monitor. Otherwise, the monitor will shut down.

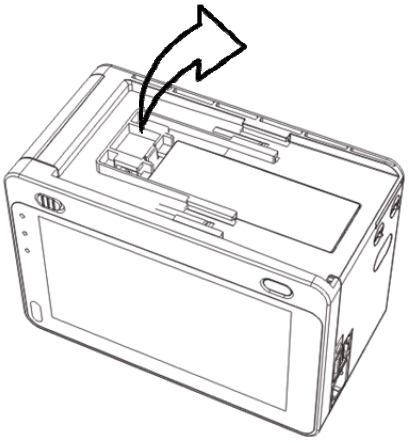
19.2 Safety

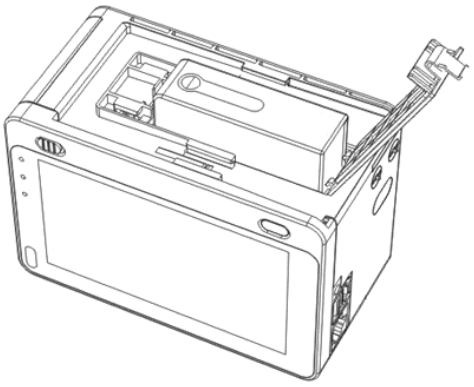
⚠ CAUTION

- **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, resulting the monitor power off.**
- **Take out the battery before the monitor is transported or will not be used for a long time.**
- **The Lithium-ion battery has a service life of two years. 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.**

19.3 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.

19.4 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. Use the battery charger specified by the equipment manufacturer.

For method 1, 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.

19.5 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.

19.6 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.**

19.7 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 ***19.5 Conditioning the Battery*** for details.

NOTE

- **Remove the battery from the equipment if the equipment is not used for a prolonged time (for example, several weeks). Otherwise the battery may be over discharged and damaged.**
- **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 ℃.**

19.8 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

20 Care and Cleaning

Use only the substances approved by us and methods listed in this chapter to clean or disinfect your equipment. Our 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. To clean or disinfect reusable accessories, refer to the instructions delivered with the accessories.

20.1 General Points

Keep your 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 any 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.**

⚠ 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.**

20.2 Cleaning

Clean your equipment on a regular basis. If there is heavy pollution or lots of dust and sand in your place, clean the equipment more frequently. Before cleaning the equipment, consult your hospital's regulations for cleaning the equipment.

Recommended cleaning agents are:

- Water
- 70% isopropyl alcohol
- 10% sodium hypochlorite (bleach) 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 the cleaning agent.
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.

20.3 Disinfecting

Disinfection may cause damage to the equipment and is therefore not recommended for this patient monitor unless otherwise indicated in your hospital's servicing schedule. Cleaning equipment before disinfecting is recommended.

The recommended disinfectants include: ethanol 70%, isopropanol 70%, perform® classic concentrate OXY.

NOTE

- **Sterilization is not recommended for this monitor, related products, accessories or supplies unless otherwise indicated in the Operator's manual that accompany the accessories or supplies.**

21 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.**
- **If you discover a problem with any of the equipment, contact your service personnel or us.**

21.1 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.

21.2 Maintenance and Testing Schedule

The following maintenance and tests, except for visual inspection, power on test, touchscreen calibration, battery check, ECG verification, NIBP Leakage test, and CO2 Leakage test, 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**
Performance Tests		
Visual inspection		1. When first installed or reinstalled.
ECG test	Performance test	1. If the user suspects that the measurement is incorrect. 2. Following any repairs or replacement of relevant module. 3. Once a year for NIBP and CO_2 tests. 4. Once every two years for other parameter module performance tests.
	Verification	
Resp performance test		
SpO2 test		
NIBP test	Pressure check	
	Leakage test	
Temp test		
IBP test	Performance test	
CO_2 tests and calibration	Leakage test	
	Pressure check	
	Calibration	
Analog output performance test		If the user suspects that the analog output does not work well.
Electrical Safety Tests		
Electrical safety tests		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	Once a year or if the battery run time reduced significantly.

21.3 Checking Monitor and Module Information

To view the information about system start time, self-test, 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 >>**].

21.4 ECG Verification

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 >>**]→[**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 completing the calibration, select [**Stop Calibrating ECG**].

You can print the square wave and wave scale and then measure the difference between them if necessary. If the difference exceeds 5%, contact your service personnel.

21.5 NIBP Leakage Test

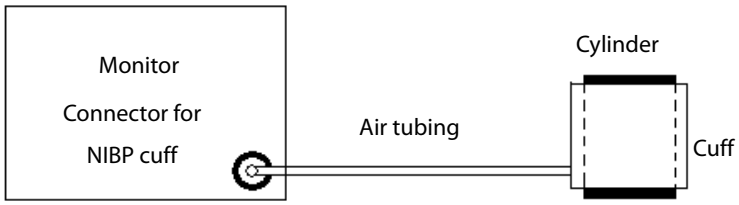
The NIBP leakage test checks the integrity of the system and of the valve. It is required at least once a year or when you doubt the measured NIBP. If the test failed, corresponding prompt messages will be given. If no message is displayed, it means no leakage is detected.

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 >>**]→[**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.

NOTE

- **The leakage test is intended for use to simply determine whether there are leakages in the NIBP airway. It is not the same as that specified in the EN 1060-3 standard.**

21.6 CO_2 Leakage Test

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:

   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.

21.7 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 middle 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.

NOTE

- **You cannot calibrate the touchscreen if it is locked.**

FOR YOUR NOTES

22 Accessories

The accessories listed in this chapter comply with the requirements of IEC 60601-1-2 when in use with the patient monitor.

⚠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.**

22.1 ECG Accessories

ECG Electrodes

Model	Quantity	Patient Category	Part No.
31499224	10 pieces	Adult	0010-10-12304
2245	50 pieces	Pediatric	9000-10-07469
2258-3	3 pieces	Neonate	900E-10-04880
31115796	60 pieces	Neonate	0681-00-0100-02
31115796	600 pieces	Neonate	0681-00-0100-01
A-10011	200 pieces	Adult, pediatric	0683-00-0449-01

12-Pin Trunk Cables

Leadwire supported	Compatible with	Type	Patient Category	Model	Part No.
5-leadwire	AHA	Snap, Defibrillator-proof	Adult, pediatric	EA6251B	040-000961-00
3-leadwire	AHA			EA6231B	040-000965-00
5-leadwire	AHA	Clip, Defibrillator-proof		EA6251A	040-000960-00
3-leadwire	AHA			EA6231A	040-000964-00

12-Pin Separable Trunk Cables

Leadwire supported	Compatible with	Type	Patient Category	Model	Part No.
3-leadwire	AHA/IEC	Defibrillator-proof	Infant, neonate	EV 6202	0010-30-42720
3-leadwire	AHA/IEC	ESU-proof		EV 6212	0010-30-42724
3-leadwire	/	Defibrillator-proof, DIN	Infant, neonate	EV 6222	040-000754-00
3/5-leadwire	AHA/IEC	Defibrillator-proof	Adult, pediatric	EV 6201	0010-30-42719
3/5-leadwire	AHA/IEC	ESU-proof		EV 6211	0010-30-42723
3/5-leadwire	DS	Defibrillator-proof		/	040-001416-00
3/5-leadwire	DS	ESU-proof		/	009-003652-00
12-leadwire	AHA	Defibrillator-proof	Adult	EV 6203	0010-30-42721

Cable Sets

3-Electrode Cable Sets						
Type	**Compatible with**	**Model**	**Patient Category**	**Part No.**	**Length**	**Remark**
Clip	AHA	EL6303A	Adult, pediatric	0010-30-42731	1 m	Long
		EL6301A		0010-30-42726	0.6 m	/
		EL6307A	Pediatric	0010-30-42898	0.6 m	/
		EL6305A	Infant, neonate	0010-30-42896	1 m	/
		EL6311A		040-000148-00	1 m	/
	AAMI	/	Adult, pediatric	0012-00-1514-04	45.7 cm	/
				0012-00-1514-05	61.0 cm	
				0012-00-1514-06	101.6 cm	
Snap	AHA	EL6301B	Adult, pediatric	0010-30-42734	1 m	/
		EL6307B	Pediatric	0010-30-42900	0.6 m	/
		EL6311B	Infant, neonate	040-000146-00	1 m	/
	AAMI	/	Adult, pediatric	0012-00-1503-04	45.7 cm	/
				0012-00-1503-05	61.0 cm	
				0012-00-1503-06	101.6 cm	

5-Electrode Cable Sets						
Type	**Compatible with**	**Model**	**Patient Category**	**Part No.**	**Length**	**Remark**
Clip	AHA	EL6501A	Adult, pediatric	0010-30-42727	0.6 m	/
		EL6503A		0010-30-42729	1 m to 1.4 m	Long
	AAMI	/		0012-00-1514-01	45.7 cm	/
				0012-00-1514-02	61.0 cm	
				0012-00-1514-03	101.6 cm	
Snap	AHA	EL6501B		0010-30-42735	1.4 m for RL and LL; 1 m for others	/
	AAMI	/		0012-00-1503-01	45.7 cm	/
				0012-00-1503-02	61.0 cm	
				0012-00-1503-03	101.6 cm	

12-Electrode Cable Sets						
Type	**Compatible with**	**Model**	**Patient Category**	**Part No.**	**Length**	**Remark**
Clip	AHA	EL 6801A	Adult	0010-30-42902	0.8 m	Limb
		EL 6803A		0010-30-42904	0.6 m	Chest
Snap	AHA	EL 6801B		0010-30-42906	0.8 m	Limb
		EL 6803B		0010-30-42908	0.6 m	Chest

22.2 SpO_2 Accessories

SpO_2 Sensors

The SpO_2 sensor material that contacts patients or other staff has undertaken the bio-compatibility test and is verified to be in compliance with ISO 10993-1.

Mindray SpO_2 Module			
Type	**Model**	**Patient Category**	**Part No.**
Disposable	MAXAI	Adult (>30 Kg)	0010-10-12202
	MAXPI	Pediatric (10 to 50 Kg)	0010-10-12203
	MAXII	Infant (3 to 20 Kg)	0010-10-12204
	MAXNI	Neonate, adult (<3 Kg or >40 Kg)	0010-10-12205
	DS-100A	Adult	9000-10-05161
	OXI-P/I	Pediatric, infant	9000-10-07308
	ES-3212-9	Adult	0010-10-12392
	OXI-A/N	Adult, neonate	9000-10-07336
Single patient use	520A	Adult	520A-30-64101
	520P	Pediatric	520P-30-64201
	520I	Infant	520I-30-64301
	520N	Neonate, adult	520N-30-64401
Reusable	518B	Neonate (Multi-sites)	518B-30-72107
	512E	Adult (Finger type)	512E-30-90390
	512F		512F-30-28263
	512G	Pediatric (Finger type)	512G-30-90607
	512H		512H-30-79061

Masimo SpO_2 Module			
Type	**Model**	**Patient Category**	**Part No.**
Disposable	LNCS NeoPt-L	Neonate (<1 Kg)	0010-10-42626
	LNCS Neo-L	Neonate, adult (<3 Kg or > 40 Kg)	0010-10-42627
	LNCS Inf-L	Infant (3 to 20 Kg)	0010-10-42628
	LNCS Pdtx	Pediatric (10 to 50 Kg)	0010-10-42629
	LNCS Adtx	Adult (> 30 Kg)	0010-10-42630
Reusable	LNCS DCI	Adult	0010-10-42600
	LNCS DCIP	Pediatric	0010-10-42634
	LNCS YI	Adult, pediatric, neonate	0010-10-43016

Nellcor SpO_2 Module			
Type	**Model**	**Patient Category**	**Part No.**
Disposable	MAXAI	Adult (>30 Kg)	0010-10-12202
	MAXPI	Pediatric (10 to 50 Kg)	0010-10-12203
	MAXII	Infant (3 to 20 Kg)	0010-10-12204
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 emited by the sensors:

- For 520A, 520P, 520I, 520N, 518B, 512E, 512F, 512G, 512H, and ES-3212-9: red light: 660 nm, infrared light: 905 nm.
- For LNCS NeoPt-L, LNCS Neo-L, LNCS Inf-L, LNCS Pdtx, LNCS Adtx, LNCS DCI, LNCS DCIP, and LNCS YI: red light: 660 nm, infrared light: 940 nm.
- For MAXAI, MAXPI, MAXII, MAXNI, DS-100A, OXI-P/I, and D-YS: red light: 660 nm, infrared light: 890 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, clinicians performing photodynamic therapy.

Extension Cable

Module type	Model	Remarks	Part No.
Mindray	562A	7 pins, 2.5 m	0010-20-42710
Masimo	/	8 pins, purple connector, 2.1 m	040-000332-00
Nellcor	572A	8 pins, 2.5 m	0010-20-42712

22.3 NIBP Accessories

Tubing

Type	Model	Patient Category	Part No.
Reusable	CM1903	Adult, large adult, pediatric, infant	6200-30-09688
	CM1901	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

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

22.4 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, neonate	Esophageal/Rectal	0011-30-37394
	MR404B		Skin	0011-30-37395
Disposable	MR411	Adult, pediatric, neonate	Esophageal/Rectal	0011-30-37398
				040-001261-00
	MR412		Skin	0011-30-37397

22.5 IBP/ICP Accessories

IBP			
Accessories Kit No.	**Model**	**Components**	**Part No.**
6800-30-50876 (Hospira)	IM2201	12-pin IBP Cable	001C-30-70759
	42584	Disposable Transducer	0010-10-42638
	42602	Steady Rest for IBP Transducer and Clamp	M90-000133---
	42394	Steady Rest for IBP Transducer and Clamp	M90-000134---
6800-30-50877 (BD)	IM2202	12-pin IBP Cable	001C-30-70757
	DT-4812	Disposable Pressure Transducer	6000-10-02107
	682275	Transducer/Manifold Mount	0010-10-12156
ICP			
Model		**Material**	**Part No.**
/		12-pin ICP cable, Gaeltec	0010-30-42742
ICT/B		Intracranial Pressure Transducer, Gaeltec	0010-10-12151
IBP adapter cable			
Model		**Description**	**Part No.**
/		12-pin to 6-pin	0010-30-43055
/		Double-end IBP Extension Cable	040-001029-00

22.6 CO_2 Accessories

Model	Description	Applicable patient	Part No.
4000	Nasal CO2 sample cannula	Adult	M02A-10-25937
4100	Nasal CO2 sample cannula	Pediatric	M02A-10-25938
4200	Nasal CO2 sample cannula	Neonate	M02B-10-64509
60-15200-00	Airway adapter	Adult, pediatric	9200-10-10533
60-15300-00	Airway adapter	Neonate	9200-10-10555
60-14100-00	Airway adapter, straight	Adult, pediatric	9000-10-07486
60-13100-00	Watertrap	Adult, pediatric	9200-10-10530
60-13200-00	Watertrap	Neonate	9200-10-10574
/	Airway adapter	Neonate	040-001187-00
/	Watertrap	Adult	100-000080-00
/	Watertrap	Neonate	100-000081-00

22.7 Others

Material	Part No.
Lithium battery , LI12I002A	022-000185-00
AC/DC adapter	022-000059-00
	022-000102-00
Patient Data Management and Review System	6800-30-51213
USB drive, 4G	023-000217-00
	023-000218-00
12-pin defibrillation sync cable	009-003249-00
Multi-functional analog output cable	009-002944-00
T1 docking station cable (1 m)	009-003591-00
T1 docking station cable (4 m)	009-003592-00
T1 charger material package	115-011223-00
Trolley bracket	045-000924-00
Wall mount accessories for dock	045-001228-00
Mount bracket	045-000931-00
Cross lock	045-001230-00
Material package for bedrail hook (folding)	115-021120-00
Monitor handle	115-021097-00
Material package for bedrail hook	115-021237-00
T1 docking station (without VGA)	115-018227-00
T1 handle	115-018221-00

FOR YOUR NOTES

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, and IBP.
Mode of operation	Continuous
Degree of protection against harmful ingress of water	IPX1
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

Main unit		
Item	**Operating conditions**	**Storage conditions**
Temperature (°C)	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

Battery charger, T1 handle, T1 docking station		
Item	**Operating conditions**	**Storage conditions**
Temperature (°C)	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	12 VDC, minimum 2 A
T1 docking station	
Input voltage	100 to 240 VAC (±10%)
Input current	0.65 A to 0.35 A
Frequency	50/60 Hz (±3 Hz)
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	4 h when powered by a new fully-charged battery at 25°C with ECG and SpO_2 cable connected, and auto NIBP measurements at an interval of 15 minutes. 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 (with battery)	143 mm×77 mm×102 mm	0.93 kg
Battery	74 mm×47 mm×24 mm	0.12 kg
Battery charger	159 mm×99 mm×44 mm	0.46 kg
T1 handle	164 mm×128 mm×164 mm	0.6 kg
T1 docking station	186 mm×121 mm×153 mm	0.89 kg

A.5 Hardware Specifications

A.5.1 Display

T1 display	
Screen type	Color TFT LCD
Screen Size	5 inch
Resolution	480×272 pixels

A.5.2 Equipment connector

Main unit

Main unit multi-pin connector	1
Multifunctional connector	1
DC input	1

T1 handle

T1 handle multi-pin connector 1	1
T1 handle multi-pin connector 2	1

T1 docking station

Network connector	1 (RJ45)
Equipotential grounding terminal	1
AC power input	1 (Standard 3-pin power connector)
External device connector	1
USB connector:	2 (Standard)
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: 0.05 to 150 Hz Monitor mode: 0.5 to 40 Hz Surgical mode: 1 to 20 Hz ST mode: 0.05 to 40 Hz
QRS delay	≤ 25 ms (in diagnostic mode, and with Paced off)
Sensitivity	1V/mV ±5%
PACE rejection/enhancement	Pace enhancement Signal amplitude: Voh≥2.5 V Pulse width: 10 ms±5% Signal rising and falling time: ≤100 μs
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	≤ 100 Ω
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 is equal to or smaller than 2 s, measured from the time of the patient monitor alarm signal generation to the time of the remote equipment alarm signal generation.

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 which types of waveforms are stored and the number of waveforms stored.

A.7 Measurement Specifications

The adjustable range of alarm limits is the same with the measurement range of signals unless otherwise specified.

A.7.1 ECG

ECG	
Standards	Meet standards of EC11, EC13, EN60601-2-27/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: 0.05 to 150 Hz Monitor mode: 0.5 to 40 Hz Surgical mode: 1 to 20 Hz ST mode: 0.05 to 40 Hz
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	<5 s (after defibrillation)
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 4.2.9.14 of ANSI/AAMI EC 13

ESU noise suppression	Based on the test method in clause 5.2.9.14 of EC 13, use ECG lead wires which are in compliance with AAMI. Compared with ECG baseline, the noise of peak to peak value ≤2 mV.

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 the ANSI/AAMI EC13: Sections 4.1.4.1 and 4.1.4.3, 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	
Pacer pulse detector rejection of fast ECG signals	10V/s RTI when measured in accordance with ANSI/AAMI EC13 Section 4.1.4.3.	
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)	
HR averaging method	Mindray ECG algorithm	Mortara ECG algorithm
	In compliance with the requirements in Clause 4.1.2.1 d) of ANSI/AAMI EC13, 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.	In compliance with the requirements in Clause 4.1.2.1 d) of ANSI/AAMI EC13, 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 equal to 48. The HR value displayed on the monitor screen is updated every second.
Response to irregular rhythm	In compliance with the requirements in Clause 4.1.2.1 e)of ANSI/AAMI EC13, 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	

Response time to heart rate change	Meets the requirements of ANSI/AAMI EC13: Section 4.1.2.1 f). From 80 to 120 bpm: less than 11 s From 80 to 40 bpm: less than 11 s	
Time to alarm for tachycardia (not available in USA)	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	
Tall T-wave rejection capability	When the test is performed based on part 4.1.2.1 c)of ANSI/AAMI EC 13, 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.	
Arrhythmia Analysis Classifications	Mindray ECG algorithm	Mortara ECG algorithm
	Asystole, VFib/VTac, Vtac, Vent. Brady, Extreme Tachy, Extreme Brady, PVC, Couplet, Bigeminy, Trigeminy, R on T, VT>2, PVCs, Tachy, Brady, Missed Beats, Vent. Rhythm, PNP, PNC, Multif. PVC, Nonsus. Vtac, Pause, Irr. Rhythm	Asystole, Vfib, Vtac, Vent. Rhythm, Couplet, VT>2, Bigeminy, Trigeminy, R on T, Multif. PVC, Irr. Rhythm, Tachy, Brady, Missed Beats, PNP, PNC
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 ECG algorithm), or per 16 heartbeats (Mortara ECG algorithm)	
Resolution	0.01 mV	
HR alarm limit	**Range (bpm)**	**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	

A.7.2 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 2500 Ω (using an ECG cable with 1kΩ resistance)	
Bandwidth	0.2 to 2.5 Hz (-3 dB)	
Sweep speed	3 mm/s, 6.25 mm/s, 12.5 mm/s, 25 mm/s, or 50 mm/s Accuracy: ±10%	
Respiration Rate		
Measurement range	Adult: 0 to 120 rpm Pediatric, neonate: 0 to 150 rpm	
Resolution	1 rpm	
Accuracy	7 to 150 rpm: ±2 rpm or ±2%, whichever is greater 0 to 6 rpm: Not specified	
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.7.3 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 ISO9919		
*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%		
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%
Accuracy	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	1 s
SpO_2 averaging time	2-4 s, 4-6 s, 8 s, 10 s, 12 s, 14 s, 16 s
Low perfusion conditions	Pulse amplitude: > 0.02% Light penetration: > 5%
Low perfusion SpO_2 accuracy	±2%

Nellcor SpO_2 Module

Standards	Meet standards of ISO9919
Measurement range	0 to 100%
Resolution	1%
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.	

A.7.4 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 254 bpm
Resolution	1 bpm
Accuracy	±3 bpm (measured without motion)
Refreshing rate	1 s

PR from Masimo SpO_2 Module

Measurement range	25 to 240 bpm
Resolution	1 bpm
Accuracy	±3 bpm (measured without motion) ±5 bpm (measured with motion)
Refreshing rate	1 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
Accuracy	20 to 250 bpm: ±3 bpm 251 to 300 bpm, not specified
Refreshing rate	1 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	40 to 240 bpm
Resolution	1 bpm
Accuracy	±3bpm or ±3%, whichever is greater

A.7.5 NIBP

Standards	Meet standards of EN60601-2-30/IEC60601-2-30, EN1060-1, EN1060-3,EN1060-4 and SP10			
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 h, 60, 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:	40 to 270	40 to 200	40 to 135
	Diastolic:	10 to 210	10 to 150	10 to 100
	Mean:	20 to 230	20 to 165	20 to 110
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: 240±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	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 American National Standard for Electronic or Automated Sphymomanometers (ANSI/AAMI SP10) in terms of mean error and standard deviation by comparing with intra-arterial or auscultatory measurements (depending on the configuration) in a typical patient population. For auscultatory reference, the 5th Korotkoff sound was used to determine the diastolic pressure.

In neonatal mode, the blood pressure measurements measured with this device are in compliance with the American National Standard for Electronic or Automated Sphymomanometers (ANSI/AAMI SP10) in terms of mean error and standard deviation by comparing with intra-arterial measurements (depending on the configuration) in a typical patient population.

A.7.6 Temp

Standards	Meet standard of EN12470-4
Technique	Thermal resistance
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

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.7.7 IBP

Standards	Meet standard of EN60601-2-34/IEC60601-2-34.
Technique	Direct invasive measurement
IBP	
Measurement range	-50 to 300 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
Impedance range	300 to 3000 Ω

Alarm limit	**Range (mmHg)**	**Step (mmHg)**
Sys High	(low limit + 2) to 300	1
Mean High		
Dia High		
Sys Low	-50 to (high limit – 2)	
Mean Low		
Dia Low		

A.8 CO_2

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
Accuracy drift	Meet the requirement for measurement accuracy within 6 hours
Resolution	1 mmHg
Sample flowrate	Adult: 70 ml/min, 100 ml/min, 120 ml/min, 150 ml/min Pediatric, neonate: 70 ml/min, 100 ml/min
Sample flowrate tolerance	15% or 15 ml/min, whichever is greater.
Warm-up time	60 s (maximum)
Rise time	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
Gas sampling delay time	Measured with a neonatal watertrap and a 2.5-meter neonatal sampling line:

	<4 s @ 100 ml/min <4.5 s @ 70 ml/min Measured with an adult watertrap and a 2.5-meter adult sampling line: <4.5 s @ 150 ml/min < 5 s @ 120 ml/min <5.5 s @ 100 ml/min <6.5 s @ 70 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
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	

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.		
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)	

FOR YOUR NOTES

B EMC

B.1 EMC

The device meets the requirements of IEC 60601-1-2. All the accessories listed in ***Chapter 22*** also meet the requirements of IEC 60601-1-2 when in use with this device.

Note

- **Using accessories, transducers and cables other than those specified may result in increased electromagnetic emission or decreased electromagnetic immunity of the device.**
- **The device or its components should not be used adjacent to or stacked with other equipment. If adjacent or stacked use is necessary, the device or its components should be observed to verify normal operation in the configuration in which it will be used.**
- **The device needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided below.**
- **Other devices may interfere with this device even though they meet the requirements of CISPR.**
- **When the inputted signal is below the minimum amplitude provided in technical specifications, erroneous measurements could result.**
- **Portable and mobile communication equipment may affect the performance of this device.**
- **Other devices that have RF transmitter or source may affect this device (e.g. cell phones, PDAs, and PCs with wireless function).**

Guidance and Declaration - Electromagnetic Emissions		
The device is intended for use in the electromagnetic environment specified below. The customer or the user of the device should assure that it is used in such an environment.		
Emission tests	**Compliance**	**Electromagnetic environment - guidance**
Radio frequency (RF) emissions CISPR 11	Group 1	The device uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class B	The equipment 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
RF emissions CISPR 11	Class A (when in use with T1 docking station)	The device is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes
Harmonic emissions IEC61000-3-2	Class A	
Voltage Fluctuations/Flicker Emissions IEC 61000-3-3	Complies	

⚠ WARNING

- **This equipment/system is intended for use by healthcare professionals only. This equipment/ system may cause radio interference or may disrupt the operation of nearby equipment. It may be necessary to take mitigation measures, such as re-orienting or relocating the [ME EQUIPMENT or ME SYSTEM] or shielding the location.**

Guidance and Declaration - Electromagnetic Immunity			
The device is intended for use in the electromagnetic environment specified below. The customer or the user of the device should assure that it is used in such an environment.			
Immunity test	**IEC60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	±6 kV contact ±8 kV air	±6 kV contact ±8 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	±2 kV for power supply lines ±1 kV for input/output lines	±2 kV for power supply lines ±1 kV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1 kV line(s) to line(s) ±2 kV line(s) to earth	±1 kV line(s) to line(s) ±2 kV line(s) to earth	
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5 % U_T (>95 % dip in U_T) for 0.5 cycle 40 % U_T (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) for 25 cycles <5 % U_T (>95 % dip in U_T) for 5 s	<5 % U_T (>95 % dip in U_T) for 0.5 cycle 40 % U_T (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) for 25 cycles <5 % U_T (>95 % dip in U_T) for 5 s	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.
Power frequency (50/60 HZ) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Note: U_T is the AC mains voltage prior to application of the test level.			

Guidance and Declaration - Electromagnetic Immunity			
The device is intended for use in the specified electromagnetic environment. The customer or the user of the device should assure that it is used in such an environment as described below.			
Immunity test	**IEC60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Conduced RF IEC61000-4-6	3 Vrms 150 kHz to 80 MHz	3Vrms	Portable and mobile RF communications equipment should be used no closer to any part of the system, including cables, than the recommended separation distance calculated from the equation appropriate for the frequency of the transmitter. Recommended separation distances: $d = 1.2\sqrt{P}$
Radiated RF IEC61000-4-3	3V/m 80MHz to 2.5GHz	3V/m (Resp: 1Vrms)	Recommended separation distances: 80 MHz～800 MHz $d = 1.2\sqrt{P}$ (Resp: $d = 3.5\sqrt{P}$) 800MHz-2.5GHz $d = 2.3\sqrt{P}$ (Resp: $d = 7\sqrt{P}$) Where, P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey [a], should be less than the compliance level in each frequency range [b]. Interference may occur in the vicinity of equipment marked with the following symbol: 
Note 1: At 80 MHz to 800 MHz, the separation distance for the higher frequency range applies. Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			
a Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the [ME EQUIPMENT or ME SYSTEM] is used exceeds the applicable RF compliance level above, the [ME EQUIPMENT or ME SYSTEM] should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the [ME EQUIPMENT or ME SYSTEM]. b Over the frequency range 150 kHz to 80 MHz, field strengths should be less than3V/m.			

Recommended separation distances between portable and mobile RF communications equipment and the device			
The device is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the device can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the device as recommended below, according to the maximum output power of the communications equipment.			
Rated maximum output power of transmitter (W)	**Separation distance in meters (m) according to frequency of the transmitter**		
	150 kHz ～ 80 MHz $d = 1.2\sqrt{P}$	80 MHz ～ 800 MHz $d = 1.2\sqrt{P}$ (Resp: $d = 3.5\sqrt{P}$)	800 MHz ～ 2.5 GHz $d = 2.3\sqrt{P}$ (Resp: $d = 7\sqrt{P}$)
0.01	0.12	0.12 (0.35)	0.23 (0.70)
0.1	0.38	0.38 (1.11)	0.73 (2.22)
1	1.20	1.20 (3.50)	2.30 (7.00)
10	3.80	3.80 (11.07)	7.30 (22.14)
100	12.00	12.00 (35.00)	23.00 (70.00)
For transmitters rated at a maximum output power not listed above, the recommended separation distance d in metres (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer. Note 1: At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies. Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			

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

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 Point	Yes	Yes	J + 60 ms

X represents I, II, III, aVR, aVL, aVF, or V1 to V6.

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
VT>2 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	Off	Med
Pause Alarm	Yes	Yes	Off	Low
Irr. Rhythm 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
VT>2 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	Adu:	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	

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
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	
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
Sensitivity	Yes	Yes	Med
Sweep	Yes	Yes	25 mm/s
Filter	Yes	Yes	12.5 Hz
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

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
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
Art, Ao, BAP, FAP, LV, P1-P2 Arterial Pressure Scale			
Scale (mmHg)	Yes	Yes	0-160
PA Waveform 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

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
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
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.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
Tech.Alarm Delay	Yes	Yes	Off

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	ECG
	2			SpO_2 + PR
	3			Resp
	4			NIBP
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 Waveform

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
	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
Temp Unit	No	Yes	°C
Network Type	No	Yes	LAN
Latching Alarms	Yes	Yes	Off
Alarm Pause Time	Yes	Yes	2 min
Minimum Alarm Volume	Yes	Yes	General: 2 OR: 1 ICU, NICU, CCU: 2
Alarm Sound	No	Yes	ISO
Reminder Tone	No	Yes	Off
Reminder Interval	No	Yes	1 min
ECGLeadOff Lev.	No	Yes	Low
SpO_2SensorOff Lev.	No	Yes	Low
IBP SensorOff Lev.	No	Yes	Low
Alarm Tone Interval	No	Yes	High Level Alarm: 10 s Med/Low Level Alarm: 20 s
Lethal Arrh. OFF	No	Yes	Disable
Extended Arrh.	No	Yes	Disable
Alarm Light on Alarm Reset	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
Parameter Switch	No	Yes	Selected
SpO_2 Tone	No	Yes	Mode 1

FOR YOUR NOTES

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 configurable.
- 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 make sure that 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*	
	VT>2	M*	
	Couplet	M*	
	PVC	M*	
	PVCs/min	M*	
	Bigeminy	M*	
	Trigeminy	M*	
	Tachy	M*	

Measurement	Alarm messages	L	Cause and solution
	Brady	M*	
	Missed Beats	M*	
	Irr. Rhythm	M*	
	Vent. Rhythm	M*	
	Multif. PVC	M*	
	Nonsus. Vtac	M*	
	Pause	M*	
	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.

D.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. Restart the monitor. If the problem persists, contact your service personnel.
	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 alarm limit was 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 ECG 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 excessive movement.
	ECG High Freq. Noise	L	A	High frequency signals are detected on the ECG analysis lead. Check for any possible source of interference around the cable and electrode.
	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 was incorrectly downloaded. Check the downloaded configuration and re-download the correct configuration.
Resp	Resp Disturbed	L	A	The respiration circuit is disturbed. Restart the monitor.
Temp	Temp Cal. Err	H	C	A calibration failed. Restart the monitor.
	T1 Sensor Off	L	A	The Temp sensor has become detached from the patient

Measurement	Alarm message	L	I	Cause and solution
	T2 Sensor Off	L	A	or the module. Check the sensor connections.
	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 sensor, or an unspecified SpO_2 sensor has been used. Check the sensor application site and the sensor type, and make sure the sensor is not damaged. Reconnect the sensor or use a new sensor.
	SpO_2 Sensor Fault	L	C	
	SpO_2 No Sensor	L	B	
	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 excessive movement.
	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 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	L*	A	Check the sensor connection and reconnect the sensor.
	YY Disconnected	H	C	The liquid way is disconnected from the patient, or the three-way valve is open to the air. Check the connection of the liquid way, or check the valve is open to the patient. If the problem remains, contact the Customer Services Dept. for help.
	YY Non-Pulsatile	L	A	The catheter may be occluded. Please flush the catheter.
	YY represents an IBP label.			
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 CO_2 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 CO_2 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	
	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.

Measurement	Alarm message	L	I	Cause and solution
	12V Too Low	H	C	■ When the monitor is charged by AC adapter, check the connection between the monitor and AC adapter. ■ When the monitor is charged by the batteries, check the batteries. ■ Restart the monitor. If the problem persists, contact your service personnel.
	5V Too High	H	C	There is a problem with the system power supply. Restart the monitor.
	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 an external power source, or charge the battery using a battery charger.
	Battery Depleted	H	C	Connect the monitor to an 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.
	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.
	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	B	The SD card has abnormal data. Format the SD 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.

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

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

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

NOTE

- **Make sure the safety analyzer is authorized to comply with requirement of IEC61010-1.**
- **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
°C	centigrade
cc	cubic centimeter
cm	centimeter
cmH2O	centimeters of water
dB	decibel
DS	dyne second
°F	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
ms	millisecond
mV	millivolt
mW	milliwatt
MΩ	megaohm
nm	nanometer

rpm	respirations per minute
s	second
V	volt
VA	volt ampere
Ω	ohm
W	watt

–	minus, negative
%	percent
/	per; divide; or; none; not applicable
+	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
e	blood temperature
e	body temperature and pressure, saturated
C.I.	cardiac index
CCI	Continuous Cardiac Index
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
COHb	carboxyhemoglobin
Compl	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
EMC	electromagnetic compatibility
EMG	electromyography
EMI	electromagnetic interference
ESU	electrosurgical unit
Et	end-tidal
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
HIS	hospital information system
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
MRN	medical record number
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
PR	pulse rate
PVC	premature ventricular contraction
PVR	pulmonary vascular resistance
PVRI	pulmonary vascular resistance index
PVPI	pulmonary vascular permeability index
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
WOB	work of breathing
WOBimp	imposed work of breathing