iPM 12/iPM 10/iPM 8/iPM 7/iPM 6/iPM 5

Patient Monitor

Operator's Manual

CE 0123

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 obtained conveniently when needed.

Intended Audience

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

Illustrations

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

Conventions

- ***Italic text*** is used in this manual to quote the referenced chapters or sections.
- [ ] is used to enclose screen texts.
- → is used to indicate operational procedures.

Contents

1 Safety

1.1 Safety Information

⚠ WARNING

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

⚠ CAUTION

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

NOTE

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

1.1.1 Warnings

⚠ WARNING

- **This equipment is used for single patient at a time.**
- **Before putting the system into operation, the operator must verify that the equipment, connecting cables and accessories are in correct working order and operating condition.**
- **To avoid risk of electric shock, this equipment must only be connected to a supply mains with protective earth. If the installation does not provide for a protective earth conductor, disconnect it from the power line and operate it on battery power, if possible.**
- **To avoid explosion hazard, do not use the equipment in the presence of oxygen-rich atmospheres, flammable anesthetics, or other flammable agents (such as gasoline).**
- **Use and store the equipment in specified environmental condition. The monitor and accessesories may not meet the performance specification due to aging, stored or used outside the specified temperature and humidity range.**
- **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.**
- **Verify that the DC power supply meets the requirements specified in A.2 Power Source Specifications.**
- **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.**
- **When disposing of the package material, be sure to observe the applicable waste control regulations and keep it out of children's reach.**
- **Ensure that the patient monitor is supplied with continuous electric power during work. Sudden power failure may lead to data loss.**
- **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

⚠ CAUTION

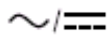
- **To ensure patient safety, use only parts and accessories specified in this manual.**
- **At the end of its service life, the equipment, as well as its accessories, must be disposed of in compliance with the guidelines regulating the disposal of such products. If you have any questions concerning disposal of the equipment, please contact us.**
- **Magnetic and electrical fields are capable of interfering with the proper performance of the equipment. For this reason make sure that all external devices operated in the vicinity of the equipment comply with the relevant EMC requirements. Mobile phone, X-ray equipment or MRI devices are a possible source of interference as they may emit higher levels of electromagnetic radiation.**
- **Before connecting the equipment to the power line, check that the voltage and frequency ratings of the power line are the same as those indicated on the equipment's label or in this manual.**
- **Always install or carry the equipment properly to avoid damage caused by drop, impact, strong vibration or other mechanical force.**
- **Dry the equipment immediately in case of rain or water spray.**

1.1.3 Notes

NOTES

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

1.2 Equipment Symbols

	General warning sign		Refer to instruction manual/booklet
	Power ON/OFF (for a part of the equipment)		Battery indicator
	Alternating current		ALARM PAUSED
	Alarm Reset		Graphical recorder
	Freeze/unfreeze waveforms		Main menu
	NIBP start/stop key		Inserted direction
	Alternating/Direct current		Direct current
	Equipotentiality		VGA output
	USB connector		Network connector
	Gas outlet		Input/output
IPX1	Protection against vertically falling water drops		Serial number
	Manufacturer		DATE OF MANUAFACTURE
	AUTHORISED REPRESENTATIVE IN THE EUROPEAN COMMUNITY		Non-ionizing electromagnetic radiation
	DEFIBRILLATION-PROOF TYPE CF APPLIED PART		DEFIBRILLATION-PROOF TYPE BF APPLIED PART
	The product bears CE mark indicating its conformity with the provisions of the Council Directive 93/42/EEC concerning medical devices and fulfils the essential requirements of Annex I of this directive. Note: The product complies with the Council Directive 2011/65/EU.		
	The following definition of the WEEE label applies to EU member states only. This symbol indicates that this product should not be treated as household waste. By ensuring that this product is disposed of correctly, you will help prevent bringing potential negative consequences to the environment and human health. For more detailed information with regard to returning and recycling this product, please consult the distributor from whom you purchased it. * For system products, this label may be attached to the main unit only.		

NOTE

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

2 The Basics

2.1 Monitor Description

2.1.1 Intended Use

This patient monitor is intended to be used for monitoring, displaying, reviewing, storing and transferring of multiple physiological parameters including ECG, heart rate (HR), respiration (Resp), temperature (Temp), SpO_2, pulse rate (PR), non-invasive blood pressure (NIBP), invasive blood pressure (IBP), cardiac output (C.O.), carbon dioxide (CO_2), oxygen (O_2), anesthetic gas (AG) and bispectral index (BIS).

The monitor can be used in pre-hospital and hospital environments, including but not limited to, ICU, general ward, outpatient department, emergency room, operating room, recovery room and preoperative observation ward.
iPM 8/iPM 5 can be used in an ambulance for patient transfer.

⚠ WARNING

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

2.1.2 Applied Parts

The applied parts of the iPM series patient monitors are:

- ECG electrodes and leadwires,
- SpO_2 sensor
- NIBP cuff
- Temp probes
- IBP/ICP transducer,
- C.O. sensor
- CO_2 sampling line/Nasal sampling cannula, water trap, airway adapter, mainstream sensor, and mask
- AG sampling line, water trap, and airway adapter
- BIS sensor

2.1.3 Connecting BeneView T1 Patient Monitor

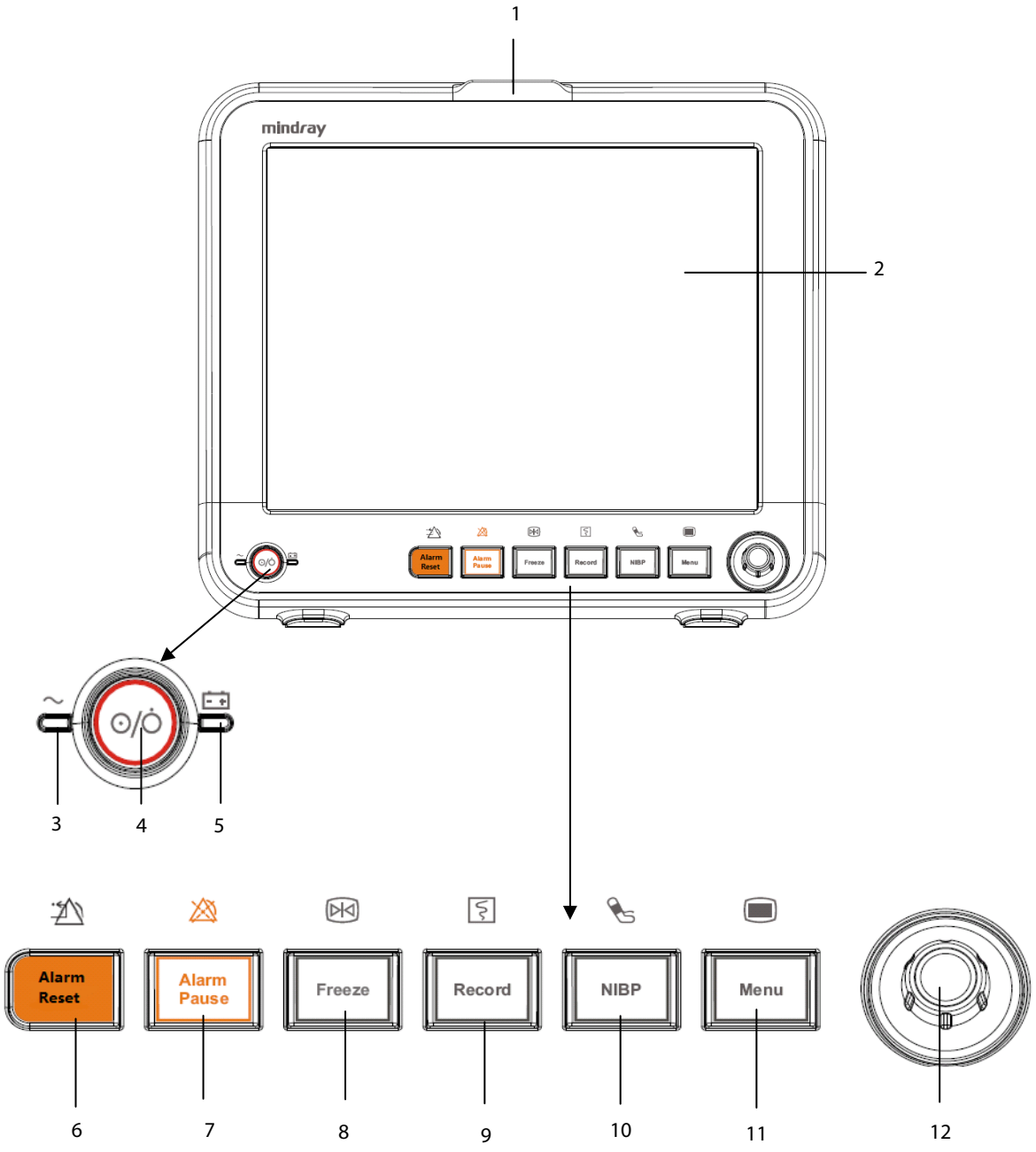
This patient monitor can connect a BeneView T1 patient monitor through its multifunctional connector for patient transfer. When BeneView T1 is connected, parameter modules of BeneView T1 is used if parameters modules of the two monitors conflict.

NOTE

- **BeneView T1's external PiCCO module or CO module, if connected, stops working when BeneView T1 is in use with this patient monitor.**

2.2 Main Unit

2.2.1 Front View



1. Alarm lamp

   When a physiological alarm or technical alarm occurs, this lamp will flash as defined below.

   - 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.

2. Display Screen
3. AC power LED（iPM 12/iPM 10/iPM 7/iPM 6）

   AC/DC power LED（iPM 8/iPM 5）

4. Power On/Off Switch

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

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

5. Battery LED

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

6.  Press to reset the alarm system.
7.  Press to pause or restore alarms.
8.  Press to freeze or unfreeze waveforms.
9.  Press to start or stop recordings.
10.  Press to start or stop NIBP measurements.
11. 

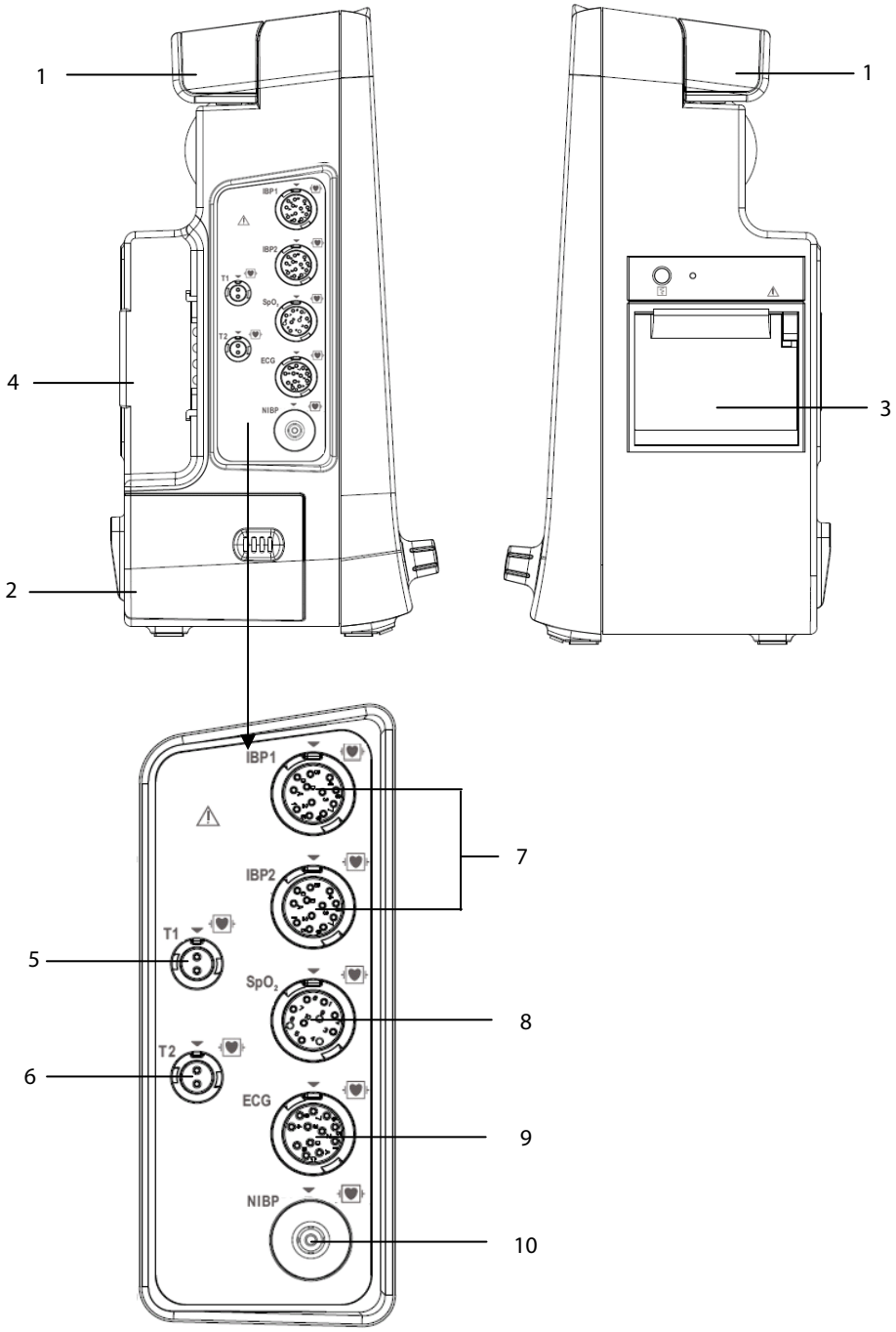
    If no menu is displayed on the screen, pressing it will enter the main menu. If there is a menu displayed on the screen, pressing it will close that menu.

12. Knob

    Rotate the Knob clockwise or anti-clockwise. With each click, the highlight jumps to the neighboring item. When you reach your desired item, press the Knob to select it.

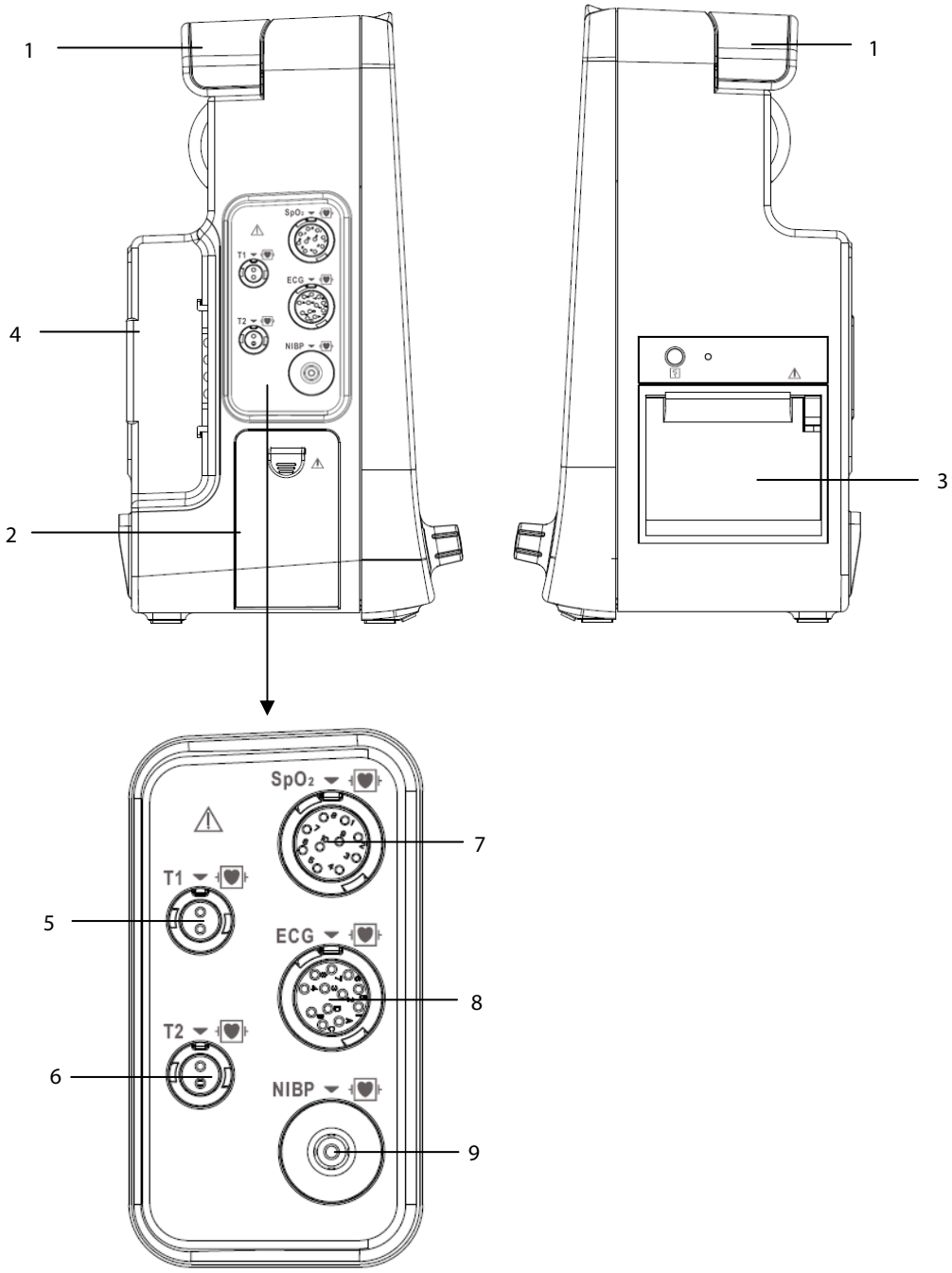
2.2.2 Side View

2.2.2.1 iPM 12/iPM 7



1. Handle
2. Battery compartment
3. Recorder
4. Parameter module slot
5. Connector for Temp probe 1
6. Connector for Temp probe 2
7. Connector for IBP cable
8. Connector for SpO_2 cable
9. Connector for ECG cable
10. Connector for NIBP cuff

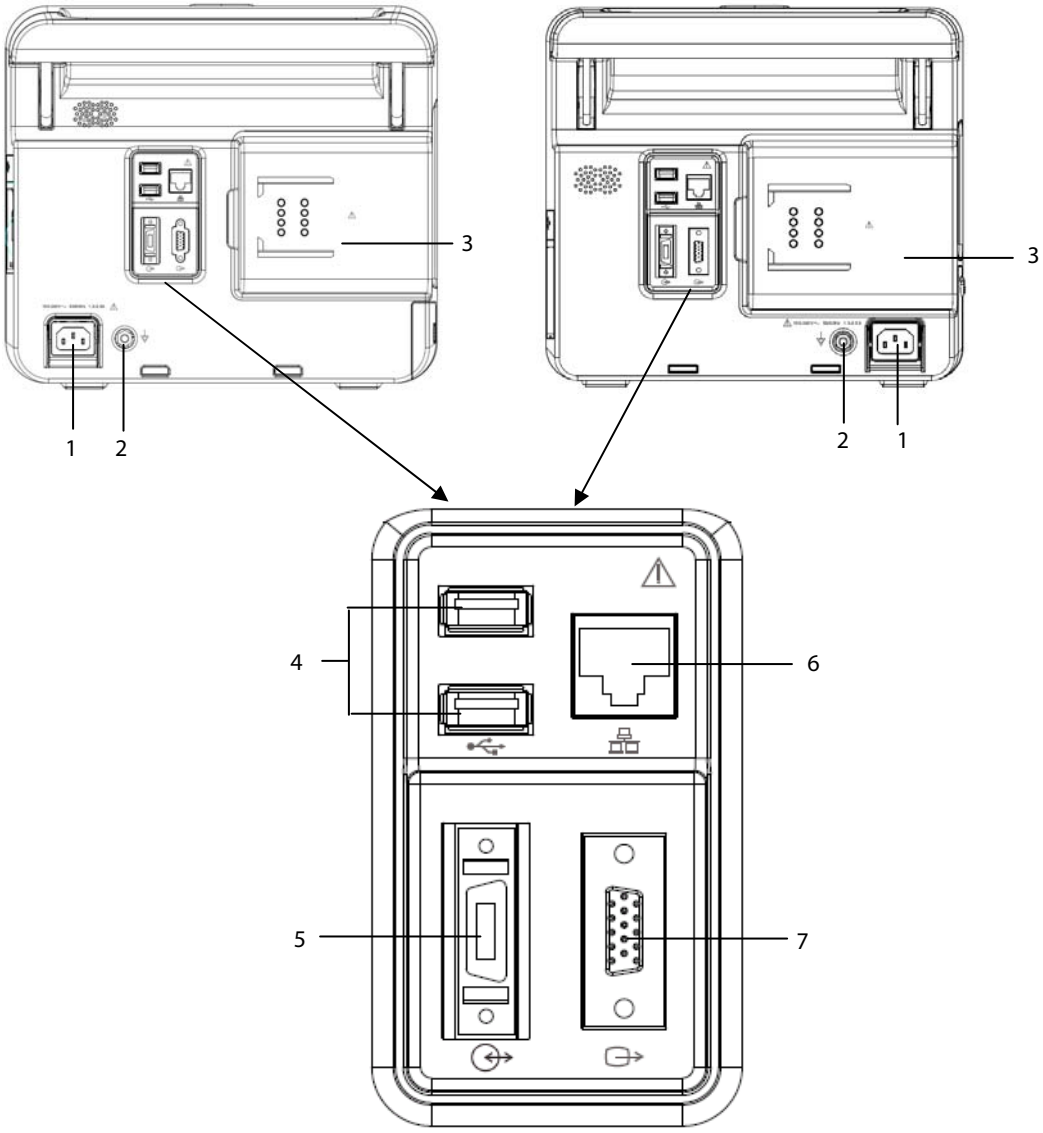
2.2.2.2 iPM 10/iPM 8/iPM 6/iPM 5



1. Handle
2. Battery compartment
3. Recorder
4. Parameter module slot
5. Connector for Temp probe 1
6. Connector for Temp probe 2
7. Connector for SpO_2 cable
8. Connector for ECG cable
9. Connector for NIBP cuff

2.2.3 Rear View

2.2.3.1 iPM 12/iPM 10/iPM 7/iPM 6



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. Parameter Module Slot

   Used for connecting the parameter modules.
4. USB Connectors

   They connect the USB devices, such as a barcode scanner.
5. Multifunctional Connector
   - ◆ It outputs defibrillator synchronization signals, nurse call signals and analogy output signals.
   - ◆ It connects BeneView T1 patient monitor.

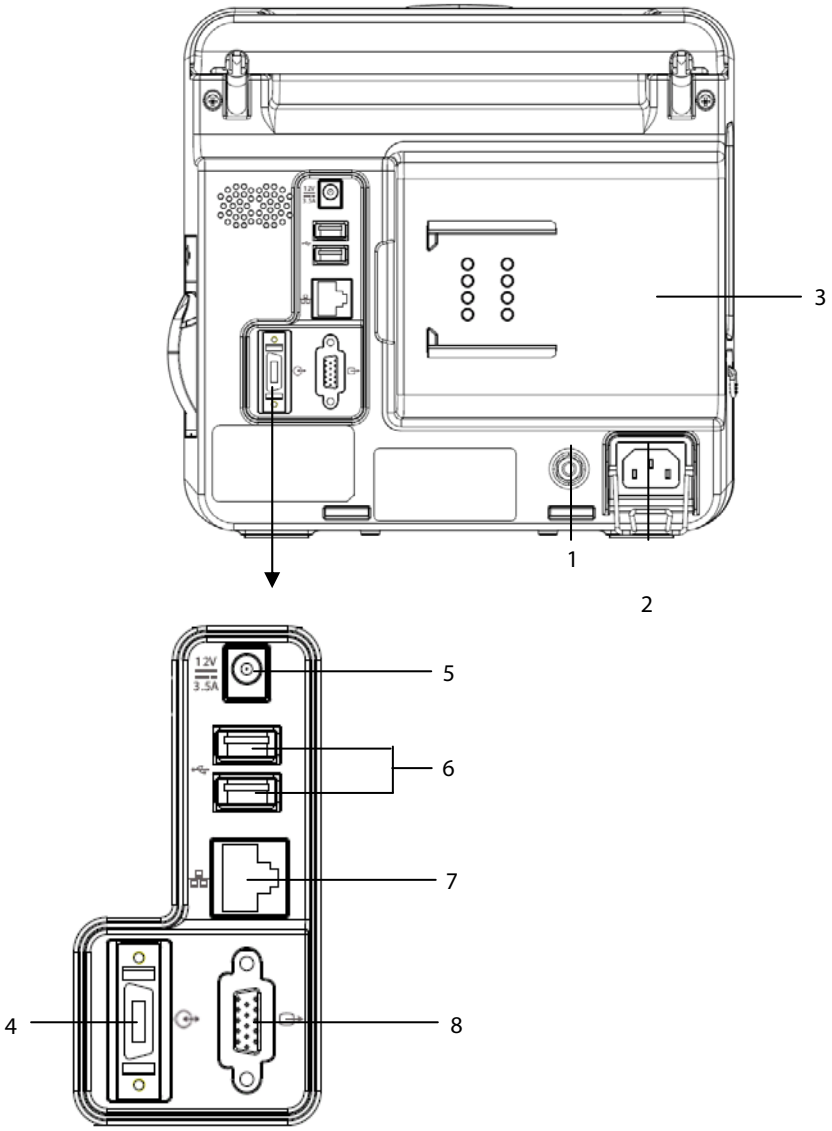
6. Network Connector

   It is a standard RJ45 connector which connects the patient monitor to CMS or other patient monitor for remote view. It also connects the patient monitor to PC for system upgrade.

7. VGA Connector

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

2.2.3.2 iPM 8/iPM 5



1. Equipotential Grounding Terminal

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

2. AC Power Input

3. Parameter Module Slot

   Used for connecting the parameter modules.

4. Multifunctional Connector

   - It outputs defibrillator synchronization signals, nurse call signals and analogy output signals.
   - It connects BeneView T1 patient monitor.

5. DC Power Input

   It is a standard DC power input connector with positive inside and negative outside. It can be connected to vehicle DC power supply through a DC power cord we supply (***PN: M03-010089-00***).

6. USB Connectors

   They connect the USB devices, such as a barcode scanner.

7. Network Connector

   It is a standard RJ45 connector which connects the patient monitor to CMS or other patient monitor for remote view. It also connects the patient monitor to PC for system upgrade.

8. VGA Connector

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

2.3 Modules

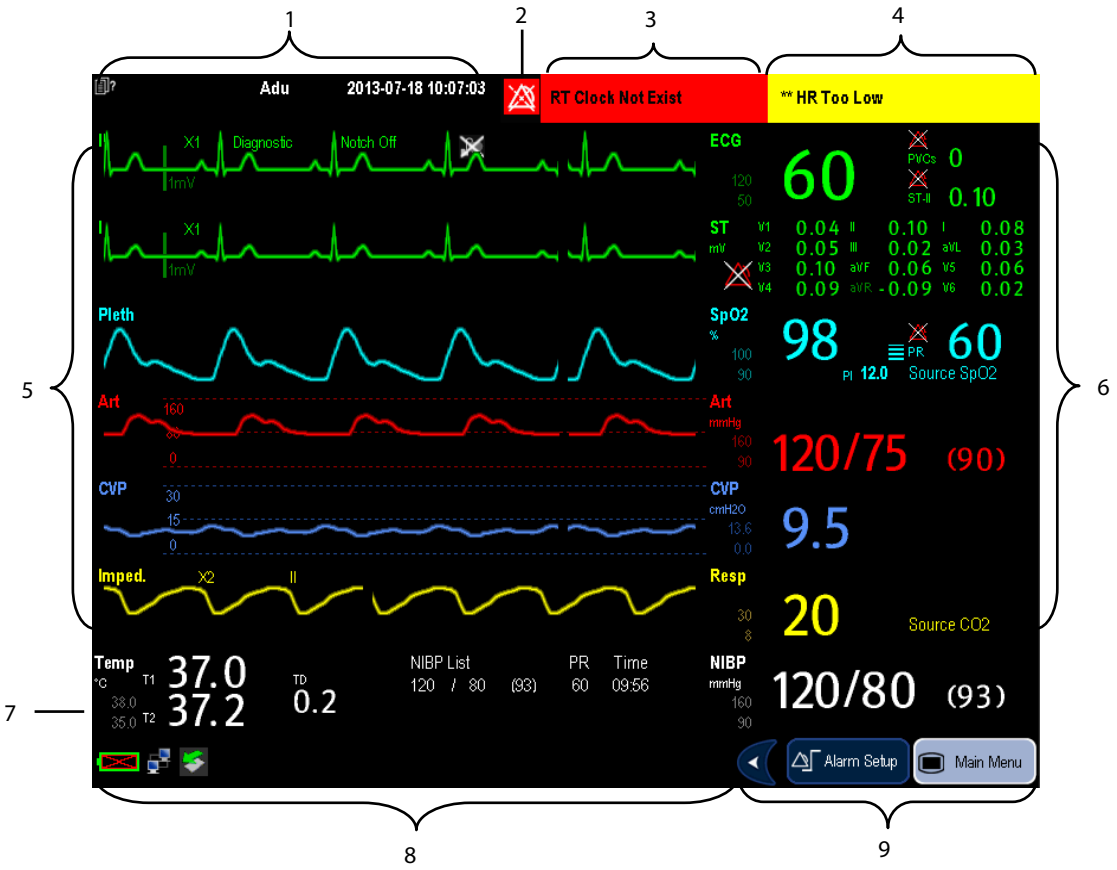
Module	Description
IBP module:	Contains IBP cable connector
Sidestream CO2 module:	Contains CO_2 watertrap connector, and CO_2 gas outlet.
Microstream CO2 module:	Contains CO_2 sampling line connector, and CO_2 gas outlet.
Mainstream CO2 module:	Contains CO_2 transducer connector.
IBP+C.O. module:	Contains IBP cable connector and C.O. cable connector.
IBP+C.O. + sidestream CO_2 module:	Contains IBP cable connector, C.O. cable connector, CO_2 watertrap connector, and CO_2 gas outlet.
IBP+C.O. + microstream CO_2 module:	Contains IBP cable connector, C.O. cable connector, CO_2 sampling line connector, and CO_2 gas outlet.
IBP+C.O.+ mainstream CO_2 module:	Contains IBP cable connector, C.O. cable connector, and CO_2 transducer connector.
IBP+C.O.+AG module (with or without O_2):	Contains IBP cable connector, C.O. cable connector, AG watertrap slot, and AG gas outlet.
IBP + sidestream CO_2 module:	Contains IBP cable connector, CO_2 watertrap connector, and CO_2 gas outlet.
IBP + microstream CO_2 module:	Contains IBP cable connector, CO_2 sampling line connector, and CO_2 gas outlet.
IBP + mainstream CO_2 module:	Contains IBP cable connector and CO_2 transducer connector.
IBP + AG module (with or without O_2):	Contains IBP cable connector, AG watertrap slot, and AG gas outlet.
BIS module	Contains BIS cable connector.
BIS + AG module (with O_2):	Contains BIS cable connector, AG watertrap slot, and AG gas outlet.

NOTE

- **The above modules support 2 invasive blood pressures through a dual-receptacle extended cable (PN: 040-001029-00).**

2.4 Display Screen

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



1. Patient Information Area

   This area shows the patient information such as department, bed number, room number, patient name and patient category. indicates that no patient is admitted or the patient information is incomplete. If no patient is admitted, selecting this area will enter the [**Patient Setup**] menu. If a patient has been admitted, selecting this area will enter the [**Patient Demographics**] menu.

2. Alarm Symbols

   - ◆ indicates alarms are paused.
   - ◆ indicates alarms are reset.
   - ◆ indicates alarm sounds are turned off.
   - ◆ indicates the system is in alarm off status.

3. Technical Alarm Area

   This area shows technical alarm messages and prompt messages. When multiple messages come, they will be displayed circularly. Select this area and the technical alarm list will be displayed.

4. Physiological Alarm Area

   This area shows physiological alarm messages. When multiple alarms occur, they will be displayed circularly. Select this area and the physiological alarm list will be displayed.

5. Waveform Area

   This area shows measurement waveforms. The waveform name is displayed at the left upper corner of the waveform. Select this area and the corresponding measurement setup menu will be displayed.

6. Parameter Area A

   This area shows measurement parameters. Each monitored parameter has a parameter window and the parameter name is displayed at the upper left corner. The corresponding waveform of each parameter is displayed in the same row in the waveform area. Select this area and the corresponding measurement setup menu will be displayed.

7. Parameter Area B

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

8. Prompt Message Area

   This area shows the current configuration name, prompt messages, network status icons, battery status icons, etc. For details about battery status symbols, refer to the chapter ***26 Batteries.***

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

9. QuickKeys Area

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

2.5 QuickKeys

A QuickKey is a configurable graphical key, located at the bottom of the main screen. They give you fast access to functions. Their availability and the order in which they appear on your screen, depend on how your patient monitor is configured.

The following QuickKeys can be displayed on the screen:


Display more QuickKeys.


Hide the QuickKeys.


Enter the main menu


Enter standby mode


Change alarm settings


Review the patient's data


Enter the NIBP measurement menu


Stop all NIBP measurement


Zero IBP


Start the realtime print


Print Setup


Reset the alarm system


Pause or restore alarms


Change screen


Enter the patient setup menu


Trigger a manual event


Have a split-screen view of minitrends


Enter the volume setup menu


Default configurations

 Start cardiac output procedure

 Perform calculations

 Have a split-screen view of another patient's conditions

 Have a split-screen view of OxyCRG trends

 Enter the interpretation of resting 12-lead ECG screen

 Enter the full-screen 7-lead ECG screen

 Enter the [**Parameters**] menu

 Start NIBP STAT measurement

Enter the [**Unit Setup**] menu

 Enter the PAWP measurement screen

 Enter the CPB mode

 Enter the privacy mode

 Enter the night mode

 View respiratory loops

 Intubation mode

You can also select your desired QuickKeys to display on the screen.

1. Select [**Main Menu**]→[**Maintenance >>**]→[**Manage Configuration >>**]→enter the required password→[**Ok**].
2. In the [**Manage Configuration**] menu, select [**Edit Config.>>**].
3. In the pop-up menu, select the desired configuration and then select [**Edit**].
4. In the pop-up menu, select [**Screen Setup >>**].
5. In the [**Select QuickKeys**] screen, select your desired QuickKeys and the order of them.

3 Basic Operations

3.1 Installation

⚠ WARNING

- **The equipment shall be installed by personnel authorized by us.**
- **The software copyright of the equipment is solely owned by us. No organization or individual shall resort to juggling, copying, or exchanging it or to any other infringement on it in any form or by any means without due permission.**
- **Devices connected to the equipment must meet the requirements of the applicable IEC standards (e.g. IEC 60950 safety standards for information technology equipment and IEC 60601-1 safety standards for medical electrical equipment). The system configuration must meet the requirements of the IEC 60601-1 medical electrical systems standard. Any personnel who connect devices to the equipment's signal input/output port is responsible for providing evidence that the safety certification of the devices has been performed in accordance to the IEC 60601-1. If you have any question, please contact us.**
- **If it is not evident from the equipment specifications whether a particular combination with other devices is hazardous, for example, due to summation of leakage currents, please consult the manufacturers or else an expert in the field, to ensure the necessary safety of patients and all devices concerned will not be impaired by the proposed combination.**

3.1.1 Unpacking and Checking

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

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

NOTE

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

⚠ 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.**

3.1.2 Environmental Requirements

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

The environment where the equipment is used shall be reasonably free from noises, vibration, dust, corrosive, flammable and explosive substances. If the equipment is installed in a cabinet, sufficient space in front and behind shall be left for convenient operation, maintenance and repair. Moreover, to maintain good ventilation, the equipment shall be at least 2 inches (5cm) away from around the cabinet.

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

⚠ WARNING

- **Make sure that the operating environment of the equipment meets the specific requirements. Otherwise unexpected consequences, e.g. damage to the equipment, could result.**
- **The equipment use a mains plug as isolation means to the mains power supply. Do not locate the equipment in a place difficult to operate the mains plug.**

3.2 Getting Started

3.2.1 Connecting to Power Source

Using AC Power Source

To use AC power source, connect one end of the power cord with the AC power input on the equipment's back and the other end with a wall AC mains outlet.

⚠ WARNING

- **Use only AC power cord we supplied.**
- **Where the integrity of the external protective conductor in the installation or its arrangement is in doubt, the equipment shall be operated from the battery. Otherwise the patient or operator might be shocked.**

Using Vehicle DC Power Source (for iPM 8/iPM 5 only)

When using in an ambulance, you can use the vehicle DC power source to run iPM 8/iPM 5. To use the DC power, connect the equipment's DC power input with the vehicle's DC outlet through the DC power cord we supply (***PN: M03-010089-00***).

⚠ WARNING

- **Use only DC power cord we supplied to connect the vehicle DC power source. Using an AC/DC adapter is fobidden.**
- **Where the integrity of the external protective conductor in the installation or its arrangement is in doubt, the equipment shall be operated from the battery. Otherwise the patient or operator might be shocked.**
- **If DC power cord is damaged, NEVER try to repair it. Replace it with a new one.**
- **Ensure that the equipotential grounding terminal is properly connected.**
- **Do not touch the patient and the monitor's metal parts or connectors at the same time when DC power source is used.**
- **Ensure that the DC power source meets the specification.**
- **Remove the DC power line immedaitely from use in case of any damage.**

Using a Battery

You can run the patient monitor on a rechargeable lithium battery. When a battery is installed, the equipment will automatically run power from the battery in the case that external power fails.

Refer to ***26 Batteries*** for detail.

3.2.2 Turning Power On

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

1. Before you start to make measurements, check the patient monitor and plug-in modules for any mechanical damage and make sure that all external cables, plug-ins and accessories are properly connected.
2. Plug the power cord into the AC or DC power source. 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.

⚠ 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.**

NOTE

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

3.2.3 Starting Monitoring

1. Decide which measurements you want to make.
2. Connect the required modules, patient cables and sensors.
3. Check that the patient cables and sensors are correctly connected.
4. 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

To disconnect the patient monitor from the power, follow this procedure:

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

NOTE

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

3.4 Using Keys

The monitor has three types of keys:

- Softkey: A softkey is a graphic key on the screen, giving you fast access to certain menus or functions. The monitor has two types of softkeys:
  - Parameter keys: Each parameter area can be seen as a softkey. You can enter a parameter setup menu by selecting its corresponding parameter area.
  - QuickKeys: QuickKeys are configurable graphical keys, located at the bottom of the main screen. For details, refer to the section ***QuickKeys.***
- Hardkeys: A hardkey is a physical key on a monitoring device, such as the main menu hardkey on the monitor's front.
- Pop-Up Keys: Pop-up keys are task-related keys that appear automatically on the monitor screen when required. For example, the Confirm pop-up key appears only when you need to confirm a change.

3.5 Using the Touchscreen

Select screen items by pressing them directly on the patient monitor's screen. You can enable or disable touchscreen operation by pressing and holding the [**Main Menu**] QuickKey for 3 seconds. A padlock symbol is displayed if touchscreen operation is disabled.

3.6 Using the On-screen Keyboard

The onscreen keyboard enables you to enter information.

- Use the key to delete the previously entered character.
- Use the key to toggle between uppercase and lowercase letters.
- Select the key to confirm what you have entered and close the onscreen keyboard.
- Select the @!# to access the symbol keyboard.
- Select the to exit the symbol keyboard.

3.7 Setting the Screen

You can enter the [**Screen Setup**] window as shown below by selecting [**Main Menu**] → [**Screen Setup**] → [**Screen Layout >>**]. In this window, you can allocate the positions of the parameters and waveforms. The parameters or waveforms whose positions are not allocated will not be displayed.

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

- 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 the parameters and their waveforms. When there is no parameter displayed in area C, both the parameters and their waveforms will be displayed in area B. Otherwise, only the parameters will be displayed.
- In Area C, you can choose to display Timer and all the parameters whose associated waveforms will not be displayed.

The screen can automatically adjust to ensure the best view based on your screen setup.

If no corresponding parameter or waveform is displayed after the module is inserted, you should perform the following inspections:

- Check the connection between the module and lead, cable, sensor, or external device.
- Enter the [**Screen Setup**] window for the desired display configuration.
- Check that the parameter is switched on in [**Parameters Switch**] window.

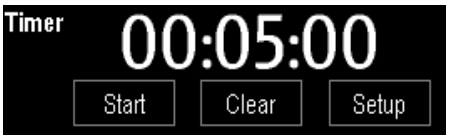
⚠ WARNING

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

3.8 Using Timer

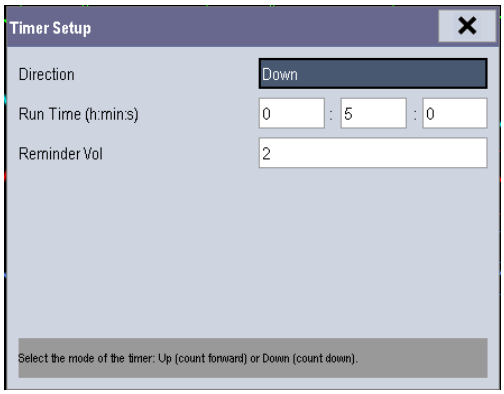
To display the timer in the main screen, follow this procedure:

1. Select [**Main Menu**]→[**Screen Setup>>**]→[**Screen Layout >>**] to access the [**Screens**] window.
2. Select [**Screen Setup**] tab.
3. In the Area C, select [**Timer**] from the drop-down list of the desired parameter area. Refer to ***3.7 Setting the Screen*** for Area C.
4. Select ✕ to exit the window. The main screen will display the timer.



- Select [**Start**] or [**Pause**] to start or pause the timing.
- Select [**Clear**] to clear current timing result.
- Select [**Setup**] to access the [**Timer Setup**] window, in which you can set the [**Direction**] to [**Up**] or [**Down**]. If you select [**Down**], you should set:
  - [**Run Time(h:min:s)**]: The available time range is 0 to 100 hours, and the default time is 5 minutes.

◆ [**Reminder Vol**]: During the last 10 seconds of the countdown, the system issues reminder tone. The available volume range is 0 to 10. 0 means off, and 10 the maximum volume.

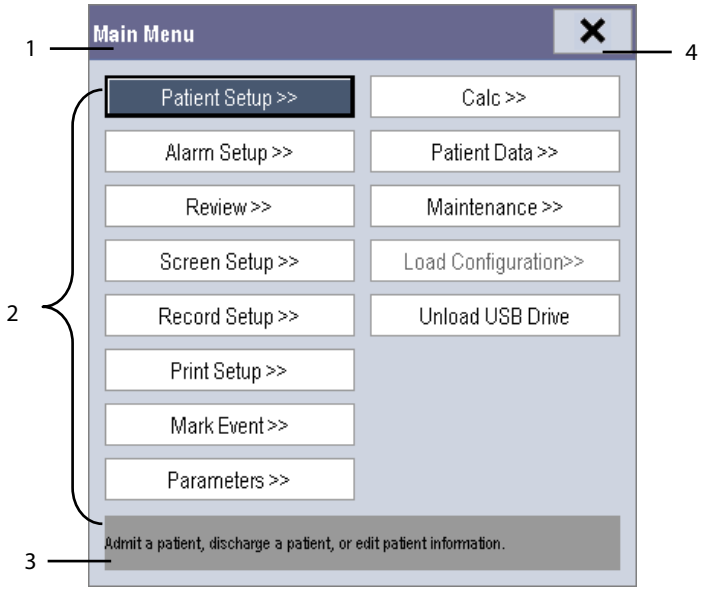


Note

- **Corresponding events are created when the timer is started, paused or stopped. You can review these events in the [Events] page of the [Review] window.**

3.9 Using the Main Menu

To enter the main menu, select the ▣ on-screen QuickKey or the ▣ hardkey on the monitor's front. Most of monitor operations and settings can be performed through the main menu.



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

1. Heading: gives a sum-up for the current menu.
2. Main body: displays options, buttons, prompt messages, etc. The menu button with ">>" enlarges a secondary window to reveal more options or information.
3. Online help area: displays help information for the highlighted menu item.
4. ✕: select to exit the current menu.

3.10 Changing General Settings

This chapter covers only general settings such as language, brightness, date and time, etc. Measurement settings and other settings can be referred to in respective sections.

3.10.1 Setting up a Monitor

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

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

3.10.2 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.**

3.10.3 Adjusting the Screen Brightness

1. Select the [**Main Menu**]→[**Screen Setup >>**]→[**Brightness**].
2. Select the appropriate setting for the screen brightness. 10 is the brightest, and 1 is the least bright.

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

3.10.4 Showing/Hiding the Help

The patient monitor provides online help information. The user can display or hide the help as required.

1. Select [**Main Menu**]→[**Screen Setup >>**].
2. Select [**Help**] and toggle between [**On**] and [**Off**].

3.10.5 Setting the Date and Time

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

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

⚠ CAUTION

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

3.10.6 Adjusting Volume

Alarm Volume

1. Select the [**Volume Setup**] QuickKey, or [**Main Menu**]→[**Alarm Setup >>**]→[**Others**].
2. Select [**Alm Volume**] and then select the appropriate volume: X-10, in which X is the minimum volume, depending on the set minimum alarm volume (refer to the chapter ***7 Alarms***), and 10 the maximum volume.

Key Volume

When you press the navigation knob or the touchscreen, or the hardkeys on the panel, the patient monitor prompts you by making a sound of the key volume you have set.

1. Select the [**Volume Setup**] QuickKey, or [**Main Menu**]→[**Screen Setu**p **>>**].
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 [**Volume Setup**] QuickKey, or 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.

3.11 Setting Parameters

3.11.1 Switching the Parameters On/Off

To switch the parameters on or off,

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

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

NOTE

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

3.11.2 Accessing the Parameters Menu

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

3.12 Operating Modes

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

3.12.1 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.

3.12.2 Night Mode

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

To activate the night mode:

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

⚠ WARNING

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

3.12.3 Privacy Mode

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

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

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

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

To cancel the privacy mode, press any key.

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

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

The touchscreen is locked automatically in the privacy mode.

⚠WARNING

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

3.12.4 Demo Mode

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

To enter the Demo mode:

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

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

⚠ WARNING

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

3.12.5 Standby Mode

In standby mode, you can temperately stops patient monitoring without turning off the monitor. To enter the standby mode, select the Standby QuickKey  .

4 Managing Patients

4.1 Admitting a Patient

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

To admit a patient:

1. Select the [**Patient Setup**] QuickKey, or [**Main Menu**]→[**Patient Setup >>**].
2. Select [**Discharge Patient**] to clear any previous patient data. If you do not erase data from the previous patient, the new patient's data will be saved into the data of the previous patient. The monitor makes no distinction between the old and the new patient data.
3. If [**Discharge Patient**] button appears dimmed, directly select [**Admit Patient**] and then select:
   - [**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.
4. 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.
5. 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].**

4.2 Quick Admitting a Patient

Use [**Quick Admit**] only if you do not have the time or information to fully admit a patient. Complete the rest of the patient demographic details later. Otherwise, the  symbol will always be displayed in the patient information area.

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

4.3 Setting the Monitor Location

To set the monitor location, follow this procedure:

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

4.4 Querying and Obtaining Patient Information

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

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

NOTE

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

4.5 Querying from Local Facility

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

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

4.6 Associating Patient Information

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

NOTE

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

4.7 Editing Patient Information

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

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

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

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

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

4.8 Discharging a Patient

To discharge a patient:

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

NOTE

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

4.9 Transferring a Patient

You can transfer patient data between monitors with a BeneView T1 patient monitor (referred to as T1 hereafter) or a USB drive without re-entering the patient demographic information. Transferring of patient data enables you to understand the patient's history condition. The patient data that can be transferred includes: patient demographics, trend data, alarm events and parameters alarm limits.

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

⚠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.**

4.9.1 Transferring Patient Data via T1

Familiarizing yourself with the data respectively stored in the patient monitor and T1 helps you understand the effects incurred by transferring patients with T1.

Contents stored		In the patient monitor	In the T1
Data	Patient demographics (Name, Bed No., Gender, etc.)	Yes	Yes
	Trend data	Yes	Yes
	Calculation data (Dose calculations, oxygenation calculations, etc.)	Yes	No
	Event data (Marked events, alarm events, etc.)	Yes	Yes
Settings	Monitor settings (Alarm pause, alarm volume, etc.)	Yes	No
	Parameter settings (Alarm limits, etc.)	Yes	Yes

Before transferring a patient with a T1, set the destination monitor as follows:

1. Select [**Main Menu**]→[**Maintenance**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Others >>**].
3. Set [**Data Transfer Method**] to [**Module**].
4. Set [**Apply Module Settings**] to [**On**]. If your patient monitor does not have this option, the system applies the T1's settings by default.

Then, follow this procedure to transfer the patient:

1. Disconnect T1 from the original monitor.
2. Connect T1 to the destination monitor.
3. If there is a mismatch between the T1 and monitor, the system will automatically display the [**Select Patient**] menu, from which you can choose the data set you want to continue using for this patient, either:
   - [**Continue Monitor**]: continue with the patient data and settings in the monitor, deleting all patient data and setting in T1 and copying all data in the monitor to T1.
   - [**Continue Module**]: continue with the patient data and settings in T1. Discharge the patient in the monitor. The monitor then automatically admits the patient and copies all data from T1.
   - [**New Patient**]: select this button if none of the information is correct. This deletes all data in the monitor and T1 and lets you admit a new patient on the monitor. In this case, you need to re-enter the patient demographics. The monitor will restore the settings according to the patient category.
   - [**Same Patient**]: select this button if the patient demographics are different, but it is the same patient. This merges the patient's trend data in the monitor and T1 and copies the settings in T1 to the monitor as well.
4. Select [**Yes**].

Operations	Examples of applications
Continue Monitor	1. Replace T1 during patient monitoring. 2. After the patient is admitted, connect the T1.

Continue Module	A patient is monitored using T1. You need to transfer the patient, e.g. from a ward (original monitor) to the operating room (destination monitor).
New Patient	Connect the T1 before admitting a new patient. However, the monitor and/or T1 store the previous patient's data and settings.
Same Patient	A patient is admitted by a monitor, to which T1 used in another monitor for monitoring this patient is connected.

4.9.2 Transferring Patient Data via a USB Drive

4.9.2.1 Transferring Data from the Monitor to a USB Drive

1. Select [**Main Menu**]→[**Patient Setup >>**].
2. Select [**Transfer to Storage Medium**]. In the popup menu, you can:
   - Select [**Ok**] to transfer the patient data, or
   - Select [**Cancel**] to exit the menu.
3. Wait until the following message appears: [**Transfer to storage medium successful. Please remove the USB drive.**].
4. Remove the USB drive from patient monitor.

4.9.2.2 Transferring Data from a USB Drive to the Monitor

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

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.**

4.10 Connecting to a Central Monitoring System

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

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

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

FOR YOUR NOTES

5 Managing Configurations

5.1 Introduction

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

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

- General
- OR
- ICU
- NICU
- CCU

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

⚠WARNING

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

The system configuration items can be classified as:

- Parameter configuration items

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

- Conventional configuration items

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

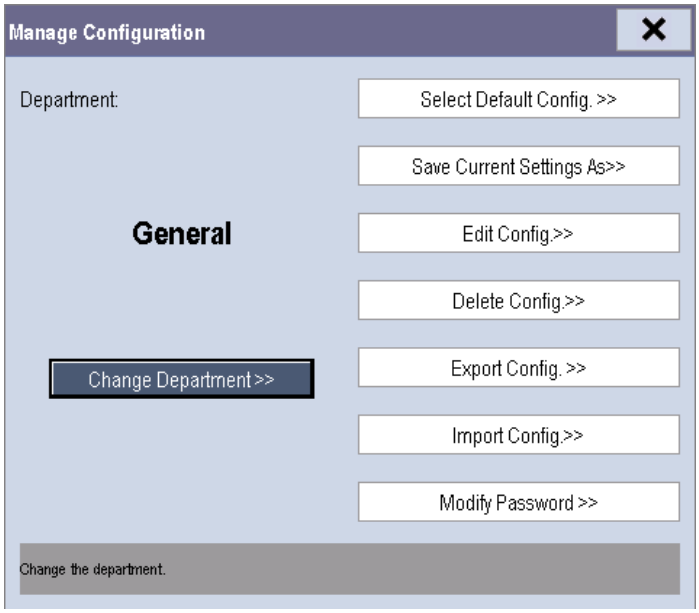
- User maintenance items

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

For the important configuration items and their default values and user maintenance items, see appendix ***Configuration Default Information***.

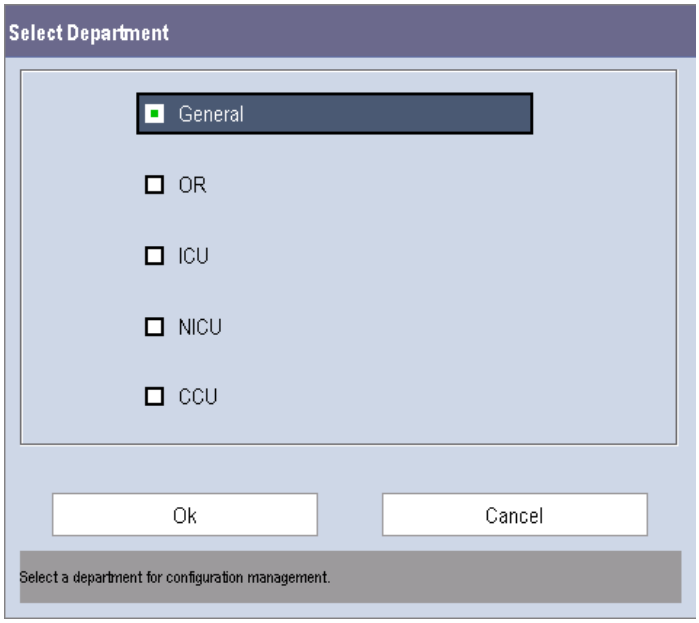
5.2 Entering the [Manage Configuration] Menu

1. Press the hardkey on the monitor's front to enter the main menu.
2. Select [**Maintenance >>**]→[**Manage Configuration >>**]. Enter the required password and then select [**Ok**].



5.3 Changing Department

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



NOTE

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

5.4 Setting Default Configuration

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

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

To set default configuration:

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

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

NOTE

- **To know what configuration is restored when the patient monitor starts, enter the main screen to check the prompt information at the lower part of the screen (displayed for about 10 seconds).**

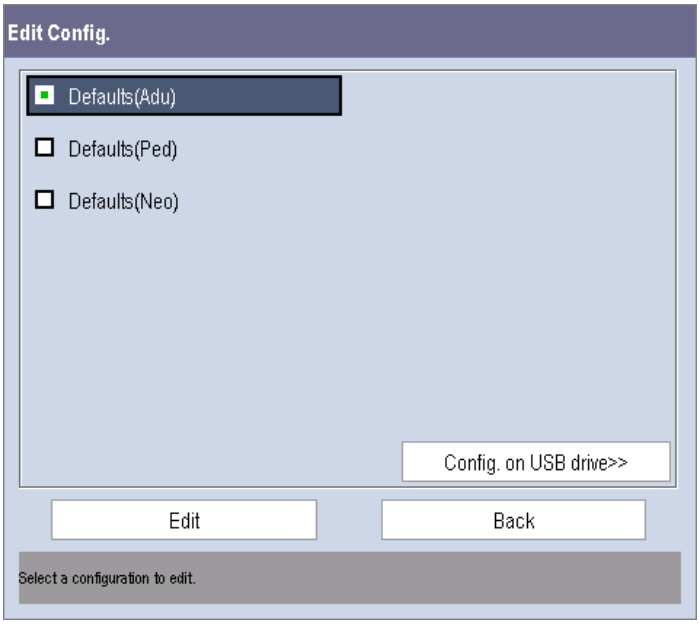
5.5 Saving Current Settings

Current settings can be saved as user configuration. Up to 5 user configurations can be saved. To save current settings:

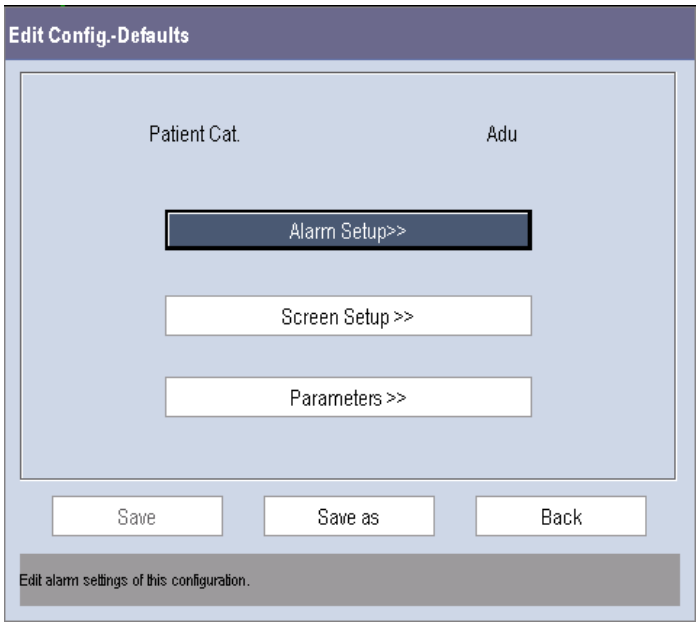
1. Select [**Save Current Settings As >>**] in the [**Manage Configuration**] menu.
2. In the popup dialog box, enter the configuration name and then select [**Ok**].

5.6 Editing Configuration

1. Select [**Edit Config. >>**] in the [**Manage Configuration**] menu. The following menu appears.



2. The popup menu shows the existing configurations on the monitor. Selecting [**Config. on USB drive >>**] will show the existing configurations on the USB drive. Select the desired configuration and then select the [**Edit**] button. The following menu appears.



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

5.7 Deleting a Configuration

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

5.8 Transferring a Configuration

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

To export the current monitor's configuration:

1. Connect the USB drive to the monitor's USB port.
2. Select [**Export Config. >>**] in the [**Manage Configuration**] menu.

   In the [**Export Config.**] menu, select the configurations and [**User Maintenance Settings**] to export. Then select the [**Export**] button. A status message will report completion of the transfer.

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

1. Connect the USB drive to the monitor's USB port.
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.

5.9 Loading a Configuration

You may make changes to some settings during operation. However, these changes or the pre-selected configuration may not be appropriate for the newly admitted patient. Therefore, the monitor allows you to load a desired configuration so as to ensure that all the settings are appropriate for your patient.

To load a configuration,

1. Select [**Load Configuration >>**] from the main menu.
2. The popup menu shows the existing configurations on the monitor. Selecting [**Config. on USB drive >>**] will show the existing configurations on the USB drive.
3. Select a desired configuration.
4. Select [**View**] to view the configuration details. In the popup menu, you can select [**Alarm Setup >>**], [**Screen Setup >>**] or [**Parameter >>**] to view the corresponding contents. The alarm setup items which are different than those currently used are marked in red.
5. Select [**Load**] to load this configuration.

5.10 Restoring the Latest Configuration Automatically

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

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

5.11 Modifying Password

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

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

6 User Screens

6.1 Tailoring Your Screens

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

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

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

6.1.1 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**].

6.1.2 Changing Measurement Colors

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

6.1.3 Changing Screen Layout

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

- You can choose the desired screen type in the [**Choose Screen**] window.
- You can select the parameters and waveforms you want to view in the [**Screen Setup**] window. For details, please refer to the section ***3.7 Setting the Screen***
- You can select the parameters you want to view on big numerics screen in the [**Big Numerics Screen Setup**] window
- You can switch on or off the connected parameter modules in the [**Parameters Switch**] window. If a parameter module is switched off, parameter values and waveforms will not display on the screen.

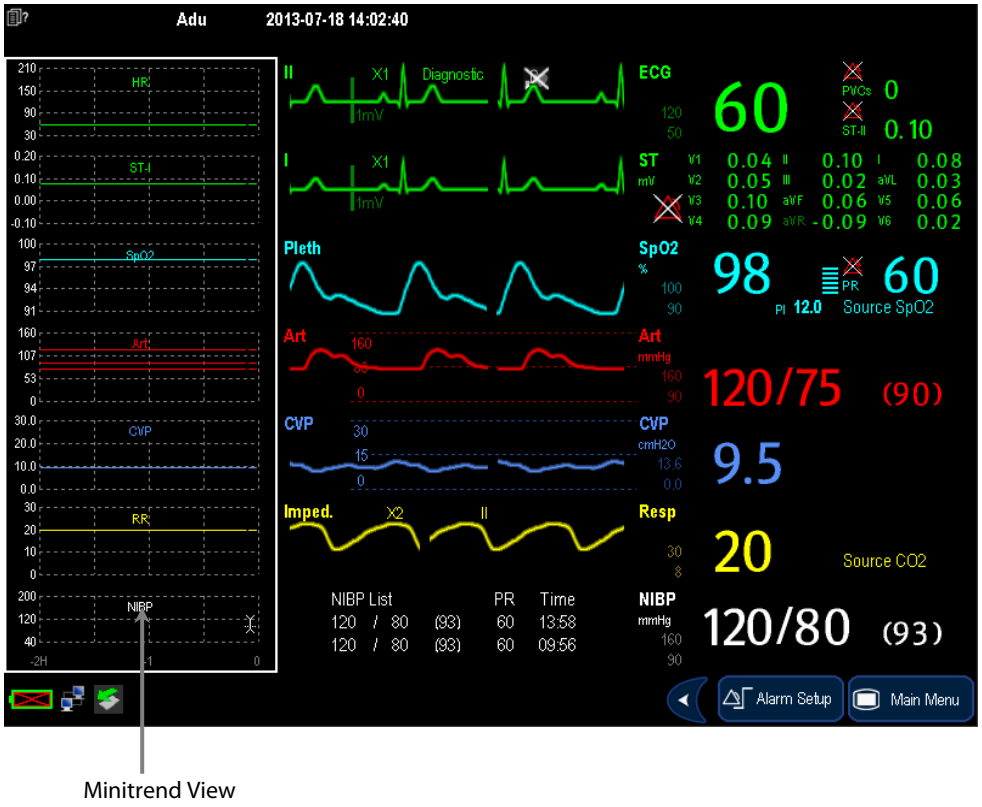
6.2 Viewing Minitrends

6.2.1 Having a Split-Screen View of Minitrends

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

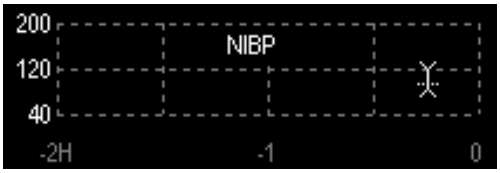
To have a split-screen view of minitrends, you can:

- Select [**Minitrends**] QuickKey
- Select [**Screens**] QuickKey  →[**Choose Screen**]→ [**Minitrends Screen**]→ ✕, or
- Select [**Main Menu**]→[**Screen Setup >>**]→[**Screen Layout >>**]→[**Choose Screen**]→ [**Minitrends Screen**]→ ✕.



Minitrend View

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



6.2.2 Setting Minitrends

Select the minitrends area. From the pop-up [**Minitrend Setup**] menu, you can:

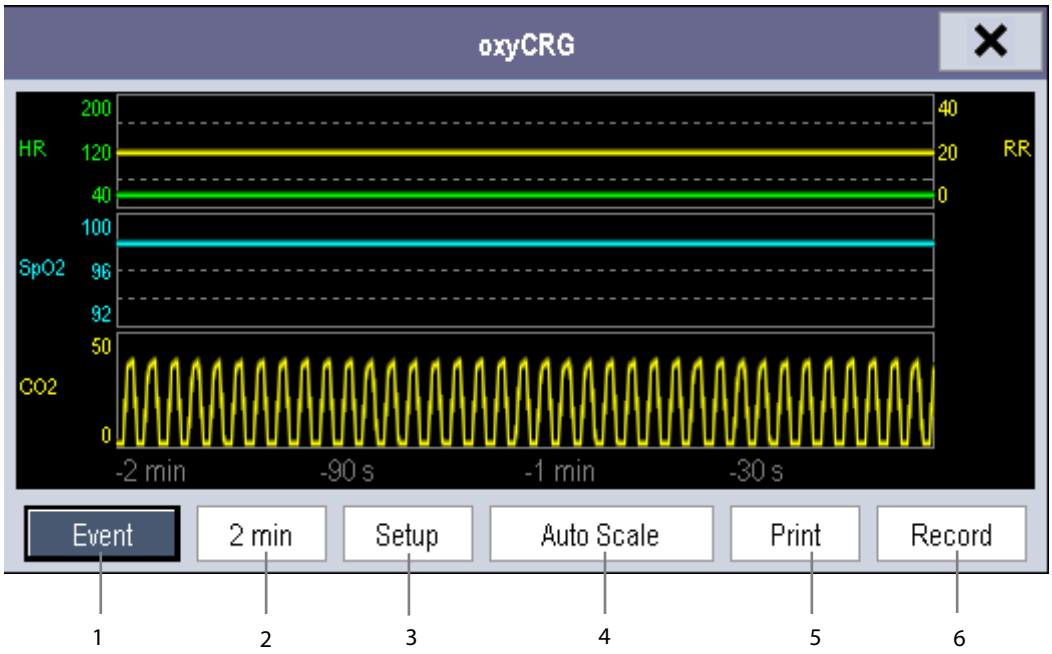
- Select the parameters to be displayed, or
- Select [**Minitrend Length**] and then select the appropriate setting.

6.3 Viewing OxyCRG

To have a split screen view of oxyCRG, you can:

- Select [**OxyCRG**] QuickKey, or
- Select [**Screens**] QuickKey  →[**Choose Screen**]→ [**OxyCRG Screen**]→ ✕, or.

Select [**Main Menu**]→[**Screen Setup >>**]→[**Screen Layout >>**]→[**Choose Screen**]→ [**OxyCRG Screen**]→ ✕.



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

1. OxyCRG Event

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

2. Trend length list box

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

3. Setup

   Select the [**Setup**] button to enter the [**Setup**] menu, in which you can select the parameters for display, the time length to be saved before and after an event, and the scale of the graphic trends and waveform. The trend area can display two parameter trends, e.g. HR trend and RR trend, simultaneously.

4. Auto Scale

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

5. Print

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

6. Record

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

6.4 Viewing Other Patients

6.4.1 Care Group

You can select up to 10 patient monitors (including telemetry) connected to the same central monitoring system into a Care Group. This lets you:

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

To have a Care Group:

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

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

NOTE

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

6.4.2 Viewing the Care Group Overview Bar

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

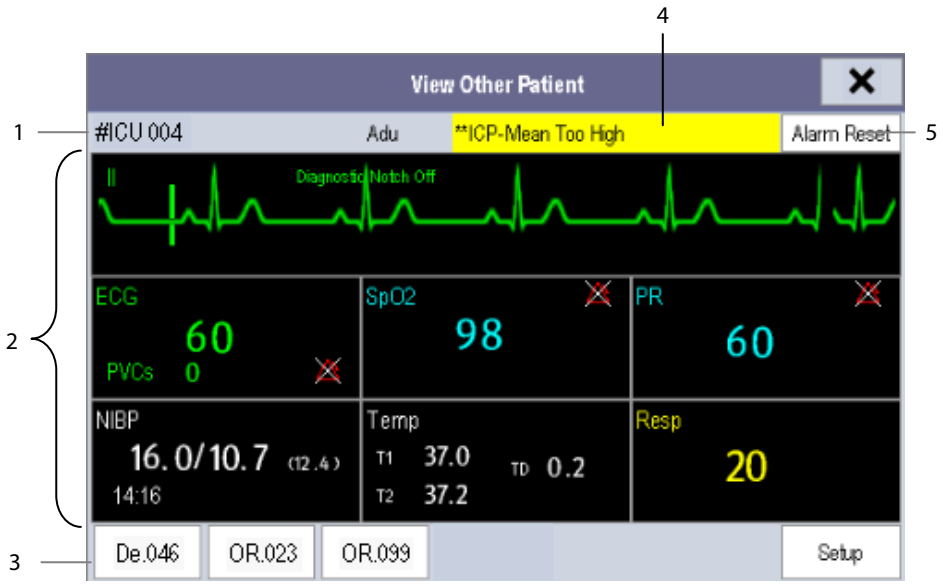
- Red: indicates the bed is giving high-level physiological alarms or the telemetry is giving alarm, such as nurse call or event.
- Yellow: indicates the bed is giving medium- or low-level physiological alarms, or medium-level technical alarms.
- Blue: indicates the bed is giving low-level technical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

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

For more details about Care Group alarms, refer to the chapter ***7 Alarms***.

6.4.3 Understanding the View Other Patient Window

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



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

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

   When [**Reset Other Bed's Alarms**] is set to [**On**] in [**Maintenance**]→[**User Maintenance**]→[**Alarm Setup**], the [**Alarm Reset**] button appears on the [**View Other Patient**] window. You can reset the alarm system for the selected monitor by pressing the button. Refer to ***7.12.3 Resetting Care Group Alarms*** for details. When [**Reset Other Bed's Alarms**] is set to [**Off**], there is no button appearing on the [**View Other Patient**] window.

Additionally, you can change a waveform or parameter for viewing

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

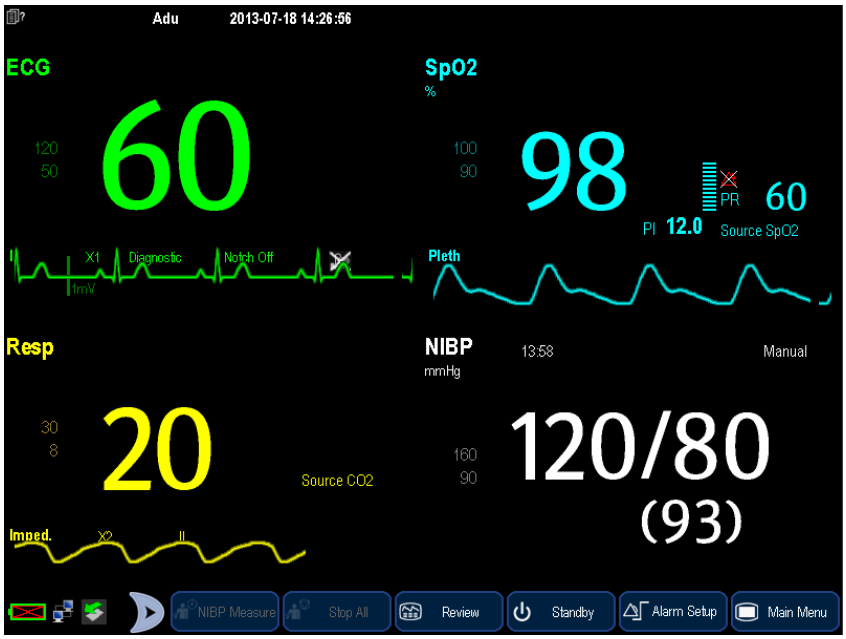
WARNING

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

6.5 Understanding the Big Numerics Screen

To enter the big numerics screen:

1. Select the [**Screens**] QuickKey , or [**Main Menu**]→[**Screen Setup >>**]→[**Screen Layout >>**].
2. Select [**Big Numerics**]→.



You can select your desired parameters to display in this screen: select the [**Screens**] QuickKey →[**Big Numerics Screen Setup**] and then select the parameters you want. For parameters having a waveform, the waveform will also be displayed.

7 Alarms

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

⚠WARNING

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

7.1 Alarm Categories

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

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.

3. Prompt messages

   As a matter of fact, prompt messages are not alarm messages. Apart from the physiological and technical alarm messages, the patient monitor will show some messages telling the system status or patient status. Messages of this kind are included into the prompt message category and usually displayed in the prompt information area. Some prompt messages that indicate the arrhythmia events are displayed in the physiological alarm area. For some measurements, their related prompt messages are displayed in their respective parameter windows.

7.2 Alarm Levels

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

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

7.3 Alarm Indicators

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

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

7.3.1 Alarm Lamp

If a technical alarm or physiological alarm occurs, the alarm lamp will flash. The flashing color and 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 turns yellow without flashing.

7.3.2 Alarm Message

When an alarm occurs, an alarm message will appear in the technical or physiological alarm area. 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: *

Additionally, the alarm message uses different background color to match the alarm level:

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

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

7.3.3 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.

7.3.4 Audible Alarm Tones

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

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

NOTE

- **When multiple alarms of different levels occur simultaneously, the patient monitor will select the alarm of the highest level to light the alarm lamp and give alarm sounds accordingly, while all the alarm messages are displayed circularly on the screen.**
- **Some physiological alarms, such as asystole, are exclusive. They have identical alarm tones and alarm lights with normal high level physiological alarms, but their alarm messages are displayed exclusively. That is to say, when an exclusive physiological alarm and a normal high level physiological alarm are triggered simultaneously, only alarm message of the exclusive physiological alarm is displayed.**

7.3.5 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 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.

7.4.2 Changing the Alarm Volume

1. Select the [**Volume Setup**] QuickKey or the [**Alarm Setup**] QuickKey→[**Others**], or [**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.

7.4.3 Setting the Interval between Alarm Sounds

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.

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.

⚠ 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.**

7.4.4 Changing the Alarm Tone Pattern

To change the alarm tone pattern:

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

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

7.4.5 Setting the Reminder Tones

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

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

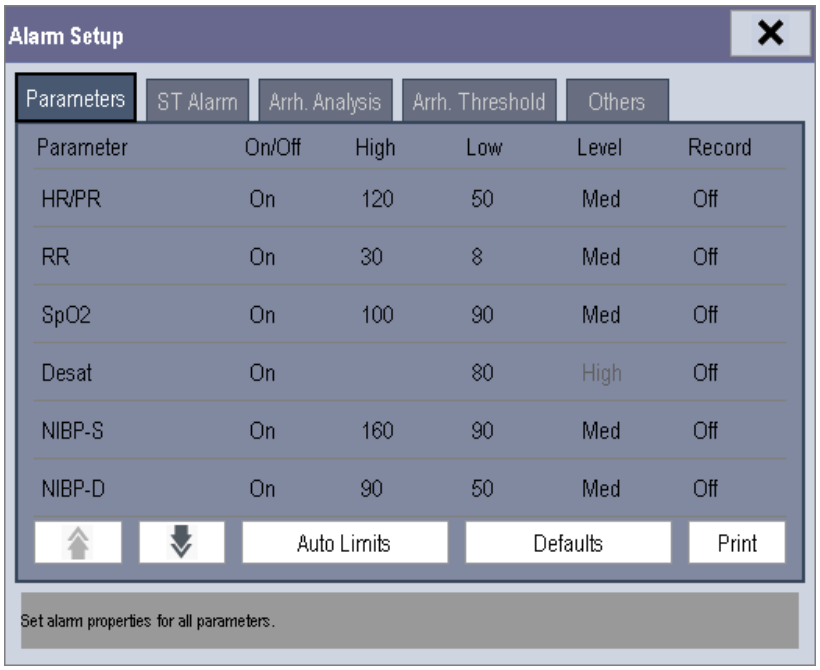
To set the interval between reminder tones, select [**Reminder Interval**] and toggle between [**1min**], [**2min**] and [**3min**].

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

7.5 Understanding the Alarm Setup Menu

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

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



Please refer to the ***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, alarm level and alarm recordings for all parameters.

When a measurement alarm occurs, automatic recording of all the measurement numerics and related waveforms is possible when the measurement's [**On/Off**] and [**Record**] are set on.

⚠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.**
- **When monitoring patients that are not continuously attended by a clinical operator, properly configure the alarm system and adjust alarm settings as per the patient's condition.**

7.5.2 Adjusting Alarm Limits Automatically

The monitor can automatically adjust alarm limits according to the measured vital signs, using the auto limits function. When auto limits are selected, the monitor calculates safe auto limits based on the latest measured values.

To get accurate auto alarm limits, you need to collect a set of measured vital signs as a baseline. Then, in the main menu, select [**Alarm Setup >>**]→[**Parameters**]→[**Auto Limits**] →[**Ok**]. The monitor will create new alarm limits based on the measured values.

Before applying these automatically created alarm limits, confirm if they are appropriate for your patient in the mass alarm setup menu. If not, you can adjust them manually. These alarm limits will remain unchanged until you select auto limits again or adjust them manually.

The monitor calculates the auto limits based on the following rules.

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

Module	Parameter	Low alarm limit		High alarm limit		Auto alarm limits range
		Adult/ pediatric	Neonate	Adult/ pediatric	Neonate	
NIBP	NIBP-S	(SYS × 0.68 + 10) mmHg	(SYS – 15) or 45mmHg (whichever is greater)	(SYS × 0.86 + 38) mmHg	(SYS + 15) or 105mmHg (whichever is smaller)	Adult: 45 to 270 Pediatric: 45 to 185 Neonate: 40 to 115
	NIBP-D	(Dia × 0.68 + 6) mmHg	(Dia – 15) or 20mmHg (whichever is greater)	(Dia × 0.86 + 32) mmHg	(Dia + 15) or 80mmHg (whichever is smaller)	Adult: 25 to 210 Pediatric: 25 to 150 Neonate: 20 to 90
	NIBP-M	(Mean × 0.68 + 8) mmHg	(Mean – 15) or 35mmHg (whichever is greater)	(Mean × 0.86 + 35) mmHg	(Mean + 15) or 95 mmHg (whichever is smaller)	Adult: 30 to 230 Pediatric: 30 to 165 Neonate: 25 to 105
Temp	T1	(T1 – 0.5)°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 45mmHg (whichever is greater)	(SYS × 0.86 + 38) mmHg	(SYS + 15) or 105mmHg (whichever is smaller)	Adult: 45 to 270 Pediatric: 45 to 185 Neonate: 35 to 115
	IBP-D	(Dia × 0.68＋ 6)mmHg	(Dia – 15) or 20mmHg (whichever is greater)	(Dia × 0.86＋ 32)mmHg	(Dia + 15) or 80mmHg (whichever is smaller)	Adult: 25 to 225 Pediatric: 25 to 150 Neonate: 20 to 90
	IBP-M	(Mean × 0.68 + 8)mmHg	(Mean – 15) or 35mmHg (whichever is greater)	(Mean × 0.86 + 35)mmHg	(Mean + 15) or 95mmHg (whichever is smaller)	Adult: 30 to 245 Pediatric: 30 to 180 Neonate: 25 to 105
IBP:PA	IBP-S	SYS × 0.75	SYS × 0.75	SYS × 1.25	SYS × 1.25	3 to 120mmHg
	IBP-D	Dia × 0.75	Dia × 0.75	Dia × 1.25	Dia × 1.25	
	IBP-M	Mean × 0.75	Mean × 0.75	Mean × 1.25	Mean × 1.25	
IBP: CVP/ ICP/ LAP/ RAP/ UVP/ P1-P4 (Venous pressure)	IBP-M	Mean × 0.75	Mean × 0.75	Mean × 1.25	Mean × 1.25	3 to 40mmHg

Module	Parameter	Low alarm limit		High alarm limit		Auto alarm limits range
		Adult/ pediatric	Neonate	Adult/ pediatric	Neonate	
IBCPP: CPP	CPP	CPP × 0.68 + 8mmHg	(CPP – 15) or 35mmHg (whichever is greater)	CPP × 0.86＋ 35mmHg	(CPP＋15) or 95mmHg (whichever is smaller)	Adult: 20 to 235 mmHg Pediatric: 25 to 175 mmHg Neonate: 25 to 100 mmHg
CO_2	$EtCO_2$	0 to 32mmHg: remains the same	0 to 32mmHg: remains the same	0 to 32mmHg: remains the same	0 to 32mmHg: remains the same	Same as the measurement range
		32 to 35mmHg: 29mmHg	32 to 35mmHg: 29mmHg	32 to 35mmHg: 41mmHg	32 to 35mmHg: 41mmHg	
		35 to 45mmHg: ($etCO_2$-6) mmHg	35 to 45mmHg: ($etCO_2$-6) mmHg	35 to 45mmHg: ($etCO_2$+6) mmHg	35 to 45mmHg: ($etCO_2$+6) mmHg	
		45 to 48mmHg:39 mmHg	45 to 48mmHg:39 mmHg	45 to 48mmHg:51 mmHg	45 to 48mmHg:51 mmHg	
		>48mmHg: remains the same	>48mmHg: remains the same	>48mmHg: remains the same	>48mmHg: remains the same	
	$FiCO_2$	N/A	N/A	Same as the default alarm limit	Same as the default alarm limit	Same as the measurement range
	awRR	awRR × 0.5 or 6 rpm (whichever is greater)	(awRR – 10) or 30 rpm (whichever is greater)	awRR × 1.5 or 30 rpm (whichever is smaller)	(awRR+25) or 85 rpm (whichever is smaller)	Adult/pediatric: 6 to 55 Neonate:10 to 90
AG	$EtCO_2$ (AG)	Same as CO_2 module				
	$FiCO_2$ (AG)					
	awRR	awRR × 0.5 or 6 rpm (whichever is greater)	awRR – 10 or 30 rpm (whichever is greater)	awRR × 1.5 or 30 rpm (whichever is smaller)	awRR + 25 or 85 rpm (whichever is smaller)	Adult/pediatric: 6 to 55 Neonate: 10 to 90
	FiAA/ EtAA	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
	FiO_2/ $EtCO_2$	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
	FiN_2O/ EtN_2O	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
C.O.	BT	Adult: (BT – 1)°C	N/A	Adult: (BT – 1)°C	N/A	Same as the measurement range
BIS	BIS	N/A				

7.5.3 Setting Alarm Delay Time

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

To set the alarm delay time,

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

Alarm delay is not applied to the following physiological alarms:

- Apnea
- ST alarms
- Arrhythmia alarms
- ECG Weak Signal
- Resp Artifact
- No Pulse
- Nellcor SpO_2 over alarm limits
- FiO_2 Shortage
- Measurements of noncontinuous parameters over alarm limits
- HR over alarm limits
- Anesthetic Mixture's MAC>3

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

7.5.4 Setting SpO_2 Technical Alarm Delay

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

7.5.5 Setting Recording Length

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

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

7.5.6 Entering CPB Mode

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

1. Press the hardkey on the monitor's front panel to enter [**Main Menu**].
2. Select [**Maintenance >>**]→[**Manage Configuration >>**]. Enter the required password and then select [**OK**].
3. Select [**Change Department >>**]→[**OR**].

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

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

7.5.7 Intubation Mode

When performing intubation during general anesthesia, you can set the patient monitor to enter intubation mode in order to reduce unnecessary alarms. Intubation mode is available for Resp, CO_2, AG and RM parameters. In the setup menu of these parameters, you can choose [**Intubation Mode**] button to disable respective physiological alarms.

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

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

7.6 Pausing Alarms

If you want to temporarily prevent alarms from sounding, you can pause alarms by pressing the hardkey on the monitor's front. When alarms are paused:

- No alarm lamps flash and no alarms are sounded.
- No numeric and alarm limit flash.
- No alarm messages are shown.
- The remaining pause time is displayed in the physiological alarm area.
- The alarms paused symbol is displayed in the alarm symbol area.

If the time interval of the monitor's last shutdown from this starting-up is greater that 2 minutes, the patient monitor enters into the alarm paused status as soon as it is turned on. The alarm pause time is fixed to be 2 minutes.
When the alarm pause time expires, the alarm paused status is automatically cancelled and the alarm tone will sound.
You can also cancel the alarm paused status by pressing the hardkey.

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

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.

2. Select [**Alarm Setup >>**]→[**Alarm Pause Time**] and then select the appropriate setting from the popup list.

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

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

NOTE

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

7.7 Switching Off All Alarms

If [**Alarm Pause Time**] is set to [**Permanent**], the patient monitor enters into the alarm off status after the hardkey is pressed. During the alarm off status,

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

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

WARNING

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

7.8 Resetting Alarms

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

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

- The alarm sound is silenced.
- A √ appears before the alarm message, indicating that the alarm is acknowledged.
- The icon appears in the alarm symbol area.

- The parameter numeric and alarm limits still flash.

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

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

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

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

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

To set [Alarm Light on Alarm Reset]:

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

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

7.9 Latching Alarms

The alarm latching setting for your patient monitor defines how the indicators of the physiological alarms behave when you do not acknowledge them.

- If you do not "latch" the physiological alarms, their alarm indications disappear when the alarm condition ends.
- If you "latch" the physiological alarms, all visual and audible alarm indications last until you acknowledge the alarms, except that the measurement numeric and violated alarm limit stop flashing as soon as the initial alarm condition goes away.

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

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

To latch a physiological alarm:

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

The rules for latching the alarms are:

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

NOTE

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

7.10 Testing Alarms

When the monitor starts up, a selftest 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 CO_2) or use a simulator. 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 ***Alarm Messages***.

7.12 Using Care Group Alarms

7.12.1 Care Group Auto Alarms

When a Care Group is set up on your monitor, a flashing symbol will appear beside the QuickKeys area if any monitor in your Care Group, which is not currently viewed by your monitor, is alarming. The alarm symbol is shown as below.

The background colors of the alarm symbols indicate alarm levels, and are the same as those of the corresponding alarm messages. If multiple alarms are active in the Care Group, the background color is the same as that of the highest-level alarm message. For more information about the alarm message and background color, see ***7.3.2*** Alarm Message.

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

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

7.12.2 Resetting Care Group Alarms

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

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

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

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

⚠WARNING

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

7.12.3 Switching Off the Remote Device Disconnection Alarm

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

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

7.12.4 Setting Care Group Alert Tone

7.12.4.1 Setting the Alarm Reminder

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

1. In the current monitor, select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Alarm Setup>>**]→[**Other Bed Alarm Setup>>**].
2. Set the [**Alarm Reminder**].
   - [**Repeat**]: The monitor gives continuous alert tone when the alarm occurs at the viewed bed is the same level as the setup level in the monitor. To set which alarm level applies to continuous alert tone, see section ***7.12.4.2Setting the Alarm Level***.
   - [**Once**]: The monitor gives a single alert tone when an alarm occurs at the viewed bed.
   - [**Off**]: The monitor do not give any alert tone when an alarm occurs at the viewed bed.

7.12.4.2 Setting the Alarm Level

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

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

NOTE

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

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. This section also tells you about ST monitoring and arrhythmia monitoring. 12-lead monitoring is available for iPM 12/iPM 7 and iPM 10/iPM 6 patient monitors only. ECG monitoring provides two algorithms:

- Mindray algorithm
- Mortara algorithm

The patient monitor incorporating Mortara algorithm is labelled with the logo of Mortara.

8.2 Safety

⚠ WARNING

- **Use only ECG electrodes and cables specified by the manufacturer.**
- **Make sure the conductive parts of electrodes and associated connectors for applied parts, including the neutral electrode, should not contact any other conductive parts including earth.**
- **Periodically inspect the electrode application site to ensure skin quality. If the skin quality changes, replace the electrodes or change the application site.**
- **Use defibrillator-proof ECG cables during defibrillation.**
- **Do not touch the patient, or table, or instruments during defibrillation.**
- **This equipment is not suitable for direct cardiac application.**
- **To reduce the hazard of burns during high-frequency surgical procedure, ensure that the monitor's cables and transducers never come into contact with the electro-surgery unit (ESU).**
- **The neutral electrode of the electro-surgery unit (ESU) shall properly contact the patient. Otherwise, burns may result.**

⚠ CAUTION

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

NOTE

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

8.3 Preparing to Monitor ECG

8.3.1 Preparing the Patient and Placing the Electrodes

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

8.3.2 Choosing AHA or IEC Lead Placement

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

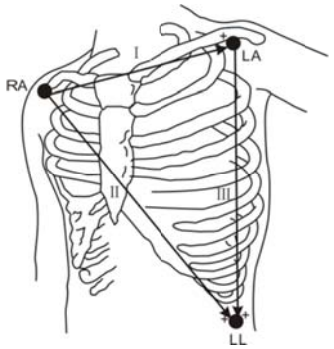
8.3.3 ECG Lead Placements

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

3-Leadwire Electrode Placement

Following is an electrode configuration when using 3 leadwires:

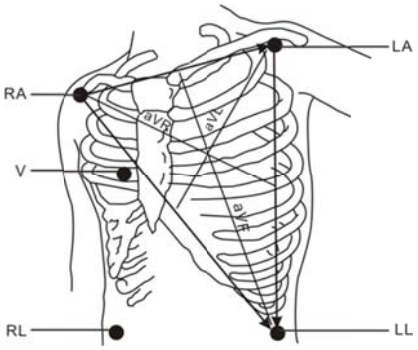
- RA placement: directly below the clavicle and near the right shoulder.
- LA placement: directly below the clavicle and near the left shoulder.
- LL placement: on the left lower abdomen.



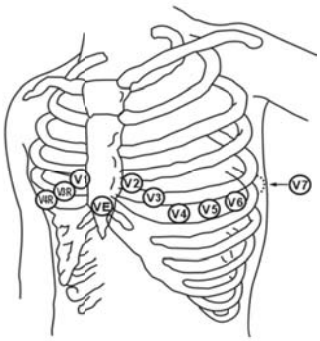
5-Leadwire Electrode Placement

Following is an electrode configuration when using 5 leadwires:

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



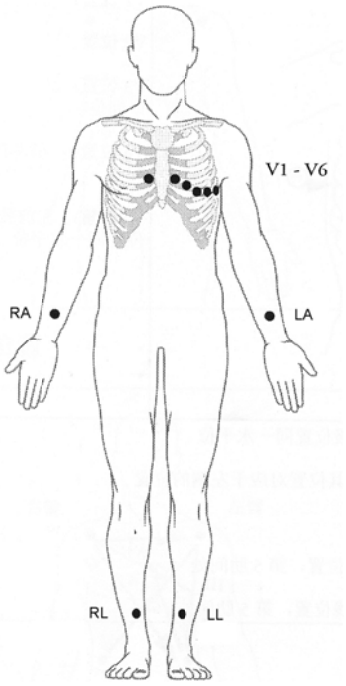
The chest (V) electrode can be placed on one of the following positions:



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

12-Leadwire Electrode Placement

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



Lead Placement for Surgical Patients

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

⚠ WARNING

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

8.3.4 Checking Paced Status

It is important to set the paced status correctly when you start monitoring ECG. The paced symbol  is displayed in the ECG waveform area when 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 ECG waveform area.

To change the paced status, you can select either:

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

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

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

⚠ WARNING

- **For paced patients, you must set [Paced] to [Yes]. If it is incorrectly set to [No], the patient monitor could mistake a pace pulse for a QRS and fail to alarm when the ECG signal is too weak. Do not rely entirely on rate meter alarms when monitoring patients with pacemakers. Always keep these patients under close surveillance.**
- **For non-paced patients, you must set [Paced] to [No].**
- **The auto pacer recognition function is not applicable to pediatric and neonatal patients.**
- **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.**

8.4 Understanding the ECG Display

Your display may be configured to look slightly different.

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

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

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

NOTE

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

For 12-lead ECG display screen, refer to the section ***8.11 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 Setting the ECG Lead Set

You can set the [**Lead Set**] by selecting [**ECG Setup**]→[**Others>>**]. You can set the [**Lead Set**] as [**Auto**] if the auto lead detection function is available.

8.5.7 Choosing an ECG Display Screen

When monitoring with a 5-lead or 12-lead set, you can select the [**Screens**] Quickkey  . In the [**Choose Screen**] window, choose the screen type as:

- [**Normal Screen**]: The ECG waveform area shows 2 ECG waveforms.
- [**ECG 7-Lead Full-Screen**]: The whole waveform area shows 7 ECG waveforms only.
- [**ECG 7-Lead Half-Screen**]: The upper half part of the whole waveform area displays 7 ECG waveforms.

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

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

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

8.5.8 Setting the Notch Filter

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

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

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

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

8.5.9 Changing the Pacer Reject Settings

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

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

NOTE

- **When pace pulses are detected, pace pulse marks "|" are shown on the ECG waveforms. Pacer Rejection setting has no impact on the display of pace pulse marks "|"**
- **When [**Paced**] is set to [**No**], the pace markers are not shown on the ECG wave, and the options of [**Pacer Reject**] are inactivated.**

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

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

To adjust the QRS detection threshold,

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

CAUTION

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

NOTE

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

8.5.11 Enabling Smart Lead Off

When the smart lead off function is set on and there is a "lead off" in the lead that has an ECG waveform in filter mode and notch status, 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.

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

8.5.12 Setting the Alarm Level for ECG Lead Off Alarms

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

8.5.13 Adjusting QRS Volume

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

8.5.14 About the Defibrillator Synchronization

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

⚠WARNING

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

8.6 About ST Monitoring

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

WARNING

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

8.6.1 Switching ST On and Off

To switch ST monitoring on or off:

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

Reliable ST monitoring can hardly be ensured if:

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

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

8.6.2 Changing ST Filter Settings

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

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

8.6.3 Understanding the ST Display

8.6.3.1 ST Numerics

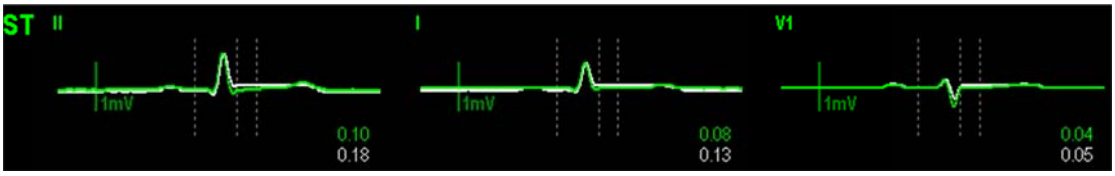
This example shows ST numerics with 5-lead ECG. Your monitor screen may look slightly different from the illustration.

8.6.3.2 ST Segment

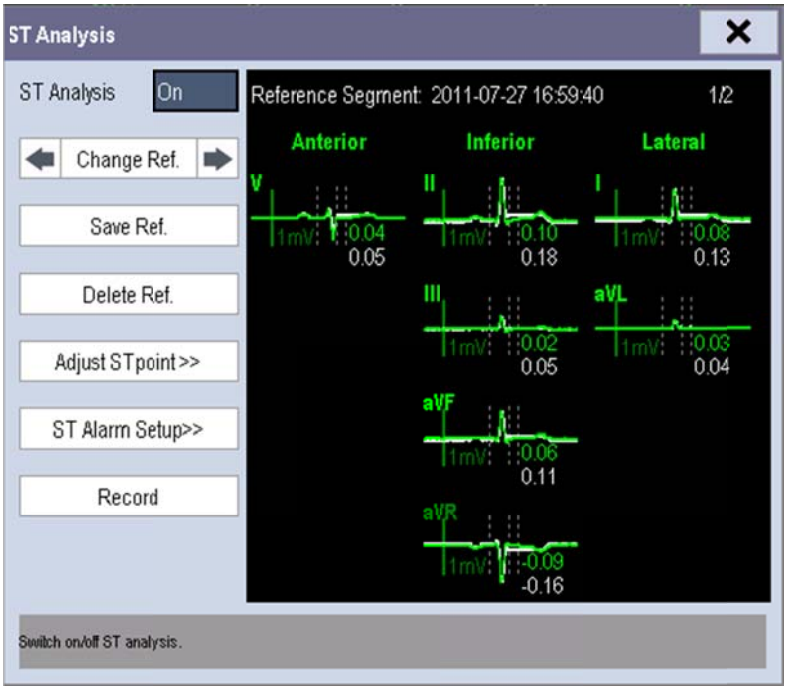
ST segment shows a QRS complex segment for each measured ST lead. The current ST segment is drawn in the same color as the ECG wave, usually green, superimposed over the stored reference segment, drawn in a different color. The information is updated once every ten seconds.

To display the ST segment on normal screen:

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



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



8.6.4 Saving the Current ST Segment as Reference

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

NOTE

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

8.6.5 Changing the Reference Segment

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

8.6.6 Deleting a Reference Segment

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

8.6.7 Recording the ST Segment

To record the current ST segment and reference segment, select [**Record**] in the [**ST Analysis**] menu.

8.6.8 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.

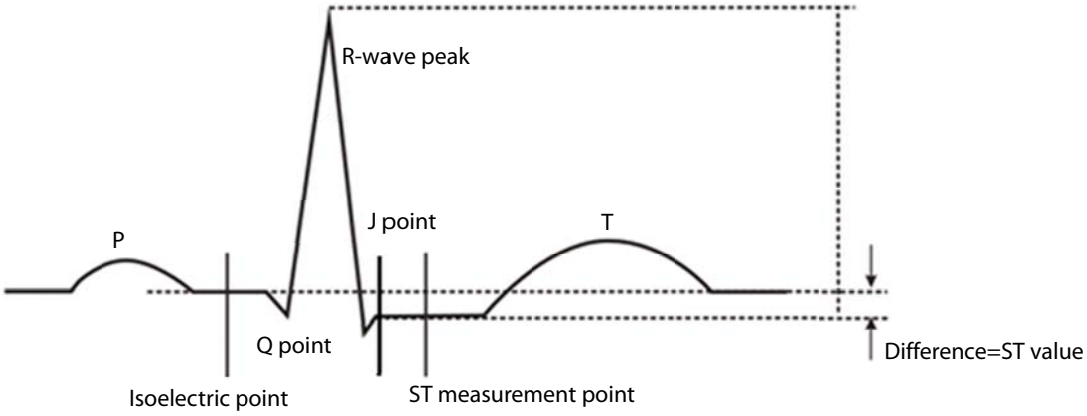
8.6.9 Setting the ST Alarm Delay Time

To set the ST alarm delay time,

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

8.6.10 Adjusting ST Measurement Points

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



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

⚠ WARNING

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

To adjust the ST measurement points:

1. In the [**ST Analysis**] menu, select [**Adjust ST Point >>**]. In the [**Adjust ST Point**] window, three vertical lines represent the ISO, J and ST point positions respectively.
2. Select [**View Leads**] and use the Knob to select an ECG lead with obvious J point and R wave.
3. Select [**ISO**], [**J**] or [**ST Point**] and then use the Knob to adjust the position of each point.

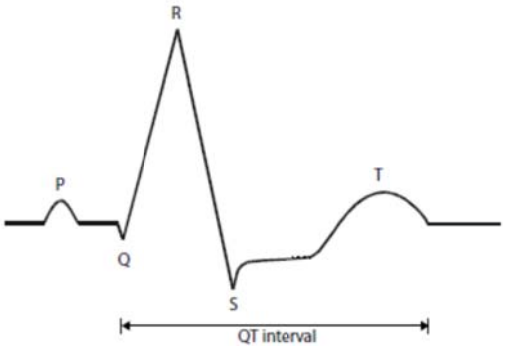
- The ISO-point (isoelectric) position is given relative to the R-wave peak. Position the ISO-point in the middle of the flattest part of the baseline (between the P and Q waves).
- The J-point position is given relative to the R-wave peak and helps locating the ST-point. Position the J-point at the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

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

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

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

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



8.7.1 QT/QTc Monitoring Limitations

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

R-wave amplitudes are too low

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

For these cases you should select a lead with good T-wave amplitude and no visible flutter activity, and without a predominant U-wave or P-wave.

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

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

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

8.7.2 Enabling QT/QTc Monitoring

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

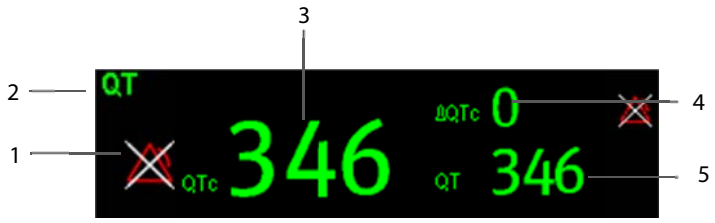
1. In the [**ECG Setup**] menu, select [**QT Analysis>>**] to enter the [**QT Analysis**] menu.
2. Set [**QT Analysis**] to [**On**].

8.7.3 Displaying QT/QTc Parameters and Waveform

To display QT/QTc parameters and waveform:

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

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



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

NOTE

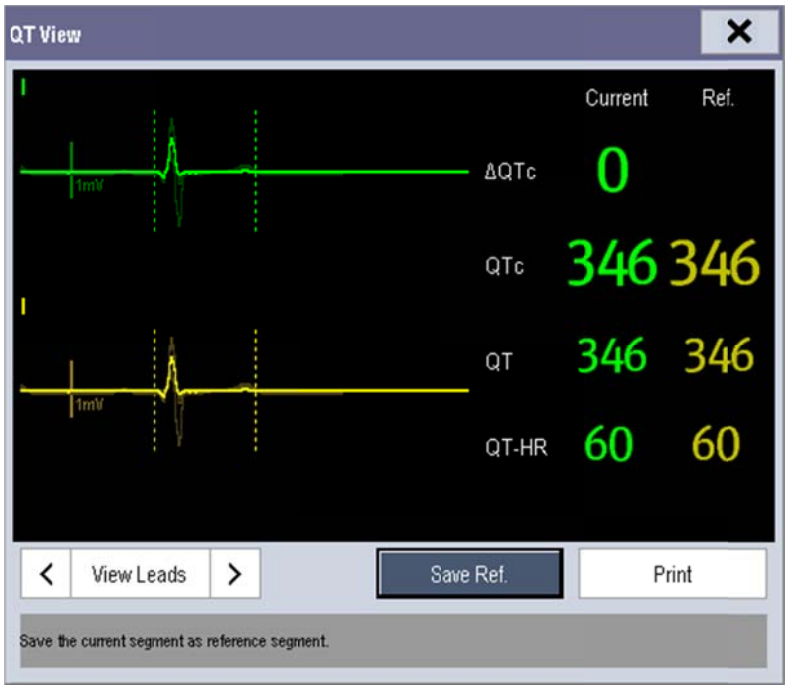
- **QTc values are calculated based on the QT-HR, not the ECG HR. To view the QT-HR, open the QT View window. For more information. see** *8.7.4 Entering the QT View.*

8.7.4 Entering the QT View

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

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

The following picture shows the QT view.



- The current waveform is shown in the upper half in green.
- The reference waveform is shown below in yellow.
- The start of QRS complex and the end of the T wave are marked with vertical lines.
- In some conditions, no QT measurement can be calculated. Then the cause of failed QT measurement is shown at the bottom of the QT numerics area. Additionally the message “Cannot Analyze QT” is shown in the technical alarm area.

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

8.7.5 Saving the Current QTc as Reference

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

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

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

CAUTION

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

8.7.6 Changing QT Settings

8.7.6.1 Setting QT Alarm Properties

To set QT alarm properties,

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

8.7.6.2 Selecting Leads for QT Calculation

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

8.7.6.3 Changing the QTc Formula

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

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

8.8 About Arrhythmia Monitoring

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

⚠ WARNING

- **Arrhythmia analysis program is intended to detect ventricular 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.**
- **Heart-rate reading may be affected by cardiac arrhythmias. Do not rely entirely on heart rate alarms when monitoring patients with arrhythmia. Always keep these patients under close surveillance.**
- **Atrial fibrillation (Afib) detection function is not intended for pediatric and neonatal patients.**

8.8.1 Understanding the Arrhythmia Events

Mindray algorithm

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

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

Mortara algorithm

Arrhythmia Message	Description	Category
Asystole	No QRS complex detected within the set time threshold (in absence of ventricular fibrillation or chaotic signals).	Lethal arrhythmia
Vfib	Ventricular fibrillation occurs and persists for 6 seconds.	
Vtac	Ventricular HR is greater or equal to the preset threshold and the number of consecutive PVCs is greater than the preset threshold.	
PVCs	PVCs/min exceeds high limit	Nonlethal arrhythmia
PNP	No pace pulse detected for (60*1000/pace rate +90) milliseconds following a QRS complex or a pacer pulse (for paced patients only).	
PNC	No QRS complex detected for 300 milliseconds following a pace pulse (for paced patients only).	
Multif. PVC	More than 2 PVCs of different forms occur in the predefined search window (3-31).	
Couplet	Paired PVCs are detected.	
Run PVCs	Ventricular HR is greater than or equal to the preset threshold and the number of PVCs is greater than or equal to 3 but less than the preset threshold.	
Vent. Rhythm	Ventricular HR is less than the preset threshold and the number of PVCs is greater than or equal to 3.	
Bigeminy	A dominant rhythm of N, V,N, V, N, V.	
Trigeminy	A dominant rhythm of N, N, V,N, N, V, N, N, V.	
R on T	R on T is detected.	
Irr. Rhythm	Consistently irregular rhythm	
Missed Beats	No beat detected for 1.75x average R-R interval for HR <120, or No beat for 1 second with HR >120 (for non-paced patients only), or No beat detected for more than the set pause threshold.	
Brady	The HR is less than the set bradycardia low limit.	
Tachy	The HR is greater than the set tachycardia high limit.	

8.8.2 Changing Arrhythmia Alarm Settings

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

⚠ WARNING

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

8.8.3 Changing Arrhythmia Threshold Settings

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

Mindray algorithm

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

Mortara algorithm

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

8.8.4 Setting the Extended Arrhythmia（For Mindray Algorithm only）

The following arrhythmia events are defined as extended arrhythmia:

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

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

⚠CAUTION

- **Set [Extended Arrh.] to [Disable] when the patient monitor is connected to the Central Monitoring System of version prior to 06.01.00. Failure to do so may cause the Central Monitoring System unable to display extended arrhythmia related alarms normally when extended arrhythmia occurs.**

8.8.5 Reviewing Arrhythmia Events

Please refer to the chapter ***21 Review***.

8.9 Viewing the ECG Summary

The ECG summary provides statistics of the patient's ECG activities over the latest 24 hours at most. It provides the following information:

- The heart rate statistics
- The arrhythmia event statistics
- The ST statistics
- TheQT/QTc statistics

You can select any of the four statistics areas to review corresponding trends and events.

To view the ECG summary, select [**ECG Summary >>**] from the [**ECG Setup**] menu.

- Select [**Nighttime**] to define the nighttime. The monitor uses the nighttime to calculate the nighttime average heart rate. The default setting is 22:00 to 6:00.
- Select [**Full Disclosure**] to enter the full disclosure review window.
- Select [**Print**] to print the ECG summary.

8.10 ECG Relearning

8.10.1 Initiating an ECG Relearning Manually

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

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

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

⚠CAUTION

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

8.10.2 Automatic ECG Relearning

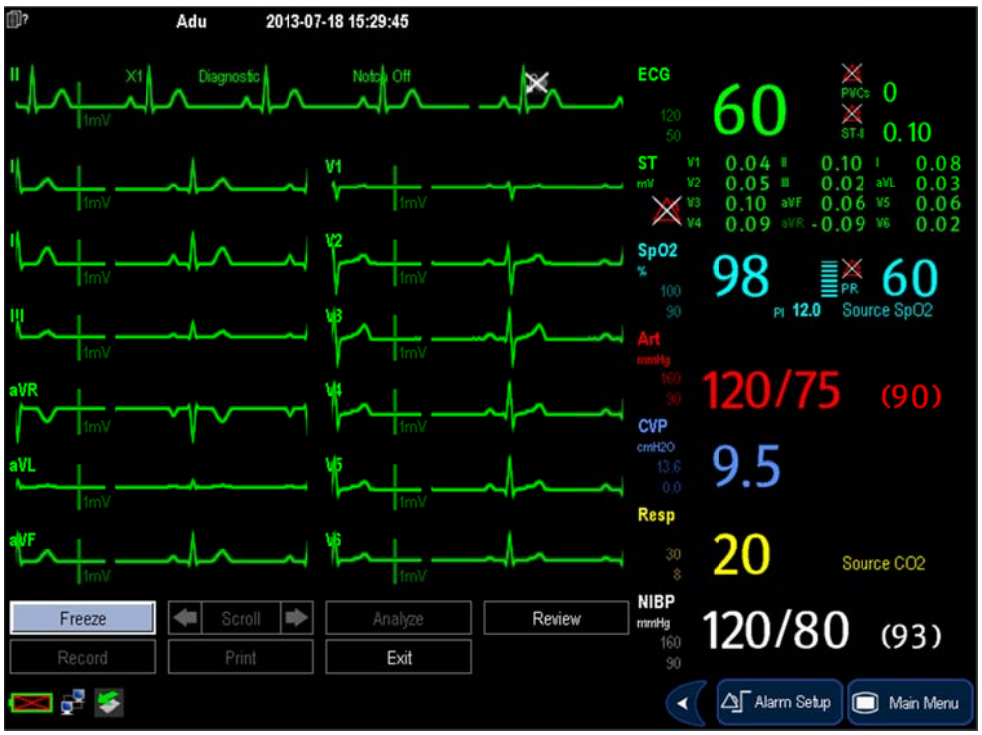
ECG relearning is initiated automatically whenever:

- The ECG lead or lead label is changed
- The ECG lead is re-connected
- A new patient is admitted
- After the calibration is completed, select [**Stop Calibrating ECG**]
- A switch happens between the options of screen type during 5/12-lead ECG monitoring.
- The paced status of the patient is changed.

8.11 12-Lead ECG Monitoring (for iPM 12/iPM 7 and iPM 10/iPM 6 patient monitors only)

1. Refer to the section ***8.3.3 ECG Lead Placements*** for placing the electrodes.

2. In the [**ECG Setup**] menu, select [**Others>>**]→[**Lead Set**]→[**12-Lead**]. Select [**Screens**] Quickkey  →[**Choose Screen**]→[**ECG 12-Lead Full-Screen**].



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

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

To select the sequence of the ECG waveforms,

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

Additionally, the 12-lead ECG monitoring has the following features:

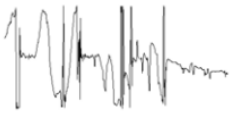
- The [**Filter**] mode is automatically switched to [**Diagnostic**] when the patient monitor accesses the 12-lead full-screen; the [**Filter**] mode resumes to the configuration before accessing the 12-lead full screen when the patient monitor exit the 12-lead full screen.
- In the adult mode, the hardkey on the monitor's front is disabled

8.12 Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting for services. If the problem persists, contact your service personnel.

CAUTION

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

Symptoms	Possible Cause	Correction Action
Noisy ECG traces 	Loose or dry electrodes	Apply fresh and moist electrodes.
	Defective electrode wires	Replace wires if necessary.
	Patient cable or leads are routed too close to other electrical devices	Move the patient cable or leads away from the electrical device.
Excessive Electro-surgical Interference	Wrong ECG cable used	Use ESU-proof ECG cables. For details, refer to ***29.1 ECG Accessories.***
Muscle Noise	Inadequate skin preparation prior to application of electrode, tremors, tense subject, and/or poor electrode placement	Repeat skin preparation as described in ***8.3.1 Preparing the Patient and Placing the Electrodes*** and re-place the electrodes. Apply fresh, moist electrodes. Avoid muscular areas.
Intermittent Signal	Connections not tight and/or properly secured	Check that the cables are properly connected.
	Electrodes dry or loose	Repeat skin preparation as described in ***8.3.1 Preparing the Patient and Placing the Electrodes*** and apply fresh and moist electrodes.
	Cable or lead wires damaged	Change cable and lead wires.

Symptoms	Possible Cause	Correction Action
Excessive alarms: heart rate, lead fault	Electrodes dry	Repeat skin preparation as described in ***8.3.1 Preparing the Patient and Placing the Electrodes*** and apply fresh, moist electrodes.
	Excessive patient movement or muscle tremor	Reposition the electrodes. Replace fresh and moist electrodes if necessary.
Low Amplitude ECG Signal	Gain set too low	Set the gain as required. For details, refer to ***8.5.3 Changing ECG Wave Settings***.
	Electrodes dry / old	Apply fresh and moist electrodes.
	Skin improperly prepared	Repeat skin preparation as described in ***8.3.1 Preparing the Patient and Placing the Electrodes***.
	This could be the patient's normal QRS complex	Verify with another well-functioning monitor.
	Electrode could be positioned over a bone or muscle mass	Move ECG patches away from the bone or muscle mass.
No ECG Waveform	Gain set too low	Set the gain as required. For details, refer to ***8.5.3 Changing ECG Wave Settings***..
	Lead wires and patient cable not fully or properly inserted	Check that the leadwires and patient cables are properly connected.
	Cable or lead wires damaged	Change cable and lead wires.
Base Line Wander	Patient moving excessively	Secure leadwires and cable to patient.
	Electrodes dry or loose	Repeat skin preparation as described in ***8.3.1 Preparing the Patient and Placing the Electrodes*** and apply fresh and moist electrodes.
	ECG Filter set to ST or Diagnostic mode	Set ECG Filter to "Monitor" mode.

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9 Monitoring Respiration (Resp)

9.1 Introduction

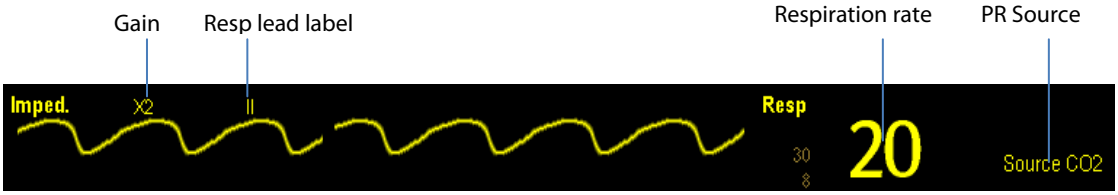
Impedance respiration is measured across the thorax. When the patient is breathing or ventilated, the volume of air changes in the lungs, resulting in impedance changes between the electrodes. Respiration rate (RR) is calculated from these impedance changes, and a respiration waveform appears on the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

9.2 Safety Information

⚠WARNING

- **When monitoring the patient's respiration, do not use ESU-proof ECG cables.**
- **If you do not set the detection level for the respiration correctly in manual detection mode, it may not be possible for the monitor to detect apnea. If you set the detection level too low, the monitor is more likely to detect cardiac activity, and to falsely interpret cardiac activity as respiratory activity in the case of apnea.**
- **The respiration measurement does not recognize the cause of apneas. It only indicates an alarm if no breath is detected when a pre-adjusted time has elapsed since the last detected breath. Therefore, it cannot be used for diagnostic purpose.**
- **If operating under conditions according to the EMC Standard 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



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

NOTE

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

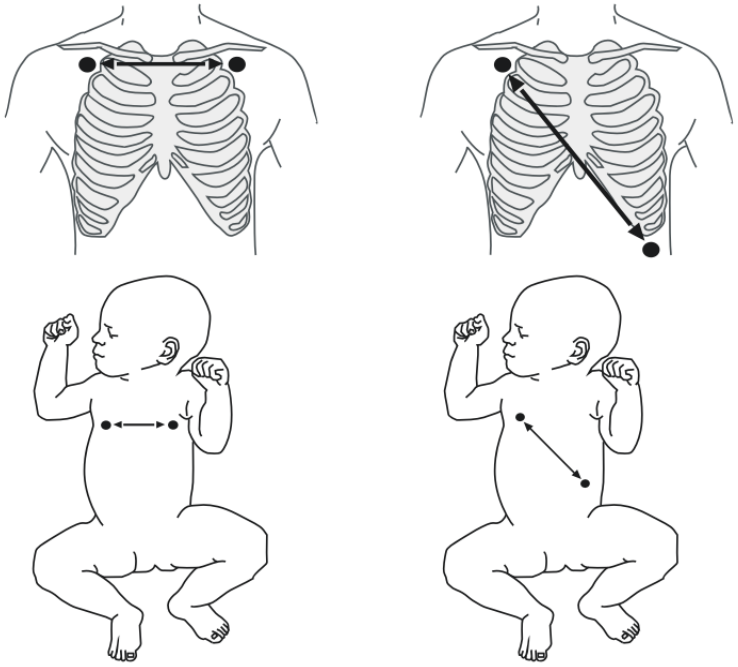
9.4 Placing Resp Electrodes

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

As the Respiration measurement adopts the standard ECG electrode placement, you can use different ECG cables (3-lead, 5-lead or 12-lead). Since the respiration signal is measured between two ECG electrodes, if a standard ECG electrode placement is applied, the two electrodes should be RA and LA of ECG Lead I, or RA and LL of ECG Lead II.

NOTE

- **To optimize the respiration waveform, place the RA and LA electrodes horizontally when monitoring respiration with ECG Lead I; place the RA and LL electrodes diagonally when monitoring respiration with ECG Lead II.**



Lead I Lead II

9.4.1 Optimizing Lead Placement for Resp

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

9.4.2 Cardiac Overlay

Cardiac activity that affects the Resp waveform is called cardiac overlay. It happens when the Resp electrodes pick up impedance changes caused by the rhythmic blood flow. Correct electrodes placement can help to reduce cardiac overlay: avoid the liver area and the ventricles of the heart in the line between the respiratory electrodes. This is particularly important for neonates.

9.4.3 Abdominal Breathing

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

9.4.4 Lateral Chest Expansion

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

9.5 Choosing the Respiration Lead

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

9.6 Changing the Apnea Alarm Delay

The apnea alarm is a high-level alarm used to detect apneas. You can set the apnea alarm delay time after which the patient monitor alarms if the patient stops breathing. In the [**Resp Setup**] menu, select [**Apnea Delay**] and then select the appropriate setting. The [**Apnea Delay**] of Resp, CO_2, and AG 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**] and then selecting ▲ or ▼ beside them. Once set, the detection level will not adapt automatically to different respiration depths. It is important to remember that if the depth of breathing changes, you may need to change the detection level.

  Use manual detection mode for situations where:

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

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

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

9.8 Changing Resp Wave Settings

⚠WARNING

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

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

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

9.9 Setting RR Source

To set RR source:

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

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

 hardkey on the monitor's front during an apnea alarm.

The priority of RR source is (from high to low): CO_2 measurement, and impedance respiration measurement. The [**RR Source**] settings of Resp, CO_2, and AG module are linked.
The RR source options and description are shown in the table below.

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

9.10 Setting alarm properties

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

9.11 Switching Resp Measurement On/Off

To switch Resp measurement on, select [**Imped. Resp Measure. ON**] from the [**Resp Setup**] menu. To switch Resp measurement off, select [**Imped. Resp Measure. OFF**] from the [**Resp Setup**] menu and then select [**Yes**] from the popup dialog box. Then, a line is displayed in the waveform area and no numeric but [**Measurement OFF**] message is displayed in the parameter area.

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 the IBP section). The displayed pulse numeric is color-coded to match its source.

1. PR: detected beats per minute.
2. PR 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 [**SpO2 Setup**] menu.
2. Select [**PR Source**] and then select a label or [**Auto**] from the popup menu.

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

10.3 Selecting the Active Alarm Source

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

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

10.4 QRS Tone

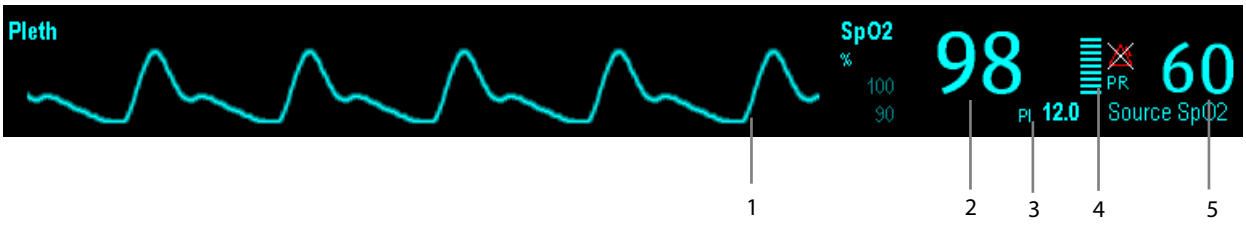
When PR is used as the alarm source, the PR source will be used as a source for the QRS tone. You can change the QRS volume by adjusting [**Beat Vol**] in the [**SpO2 Setup**] menu. When a valid SpO_2 value exists, the system will adjust the pitch tone of QRS volume according to the SpO_2 value.

11 Monitoring SpO_2

11.1 Introduction

SpO_2 monitoring is a non-invasive technique used to measure the amount of oxygenated haemoglobin and pulse rate by measuring the absorption of selected wavelengths of light. The light generated in the probe passes through the tissue and is converted into electrical signals by the photodetector in the probe. The SpO_2 module processes the electrical signal and displays a waveform and digital values for SpO_2 and pulse rate.

This device is calibrated to display functional oxygen saturation. It provides the following 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 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; When PI is below 0.3, a question mark (?) is displayed to the right of the SpO_2 value, indicating that the SpO_2 value may be inaccurate. 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. For Mindray SpO_2 module, PI value can be displayed under the PR value in larger characters if [PI Zoom] is enabled.
4. Perfusion indicator: the pulsatile portion of the measured signal caused by arterial pulsation.
5. Pulse rate (derived from pleth wave): detected pulsations per minute.

NOTE

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

11.2 Safety

⚠ WARNING

- **Use only 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 patient monitor, see the color of the SpO_2 connector and the company logo located at the patient monitor. 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 purple 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 SpO_2 connector.
5. Connect the sensor cable to the adapter cable.

⚠ WARNING

- **If the sensor is too tight because the application site is too large or becomes too large due to edema, excessive pressure for prolonged periods may result in venous congestion distal from the application site, leading to interstitial edema and tissue ischemia.**

11.5 Changing SpO_2 Settings

11.5.1 Accessing SpO_2 Menus

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

11.5.2 Adjusting the Desat Alarm

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

11.5.3 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.

11.5.4 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**].

11.5.5 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.

11.5.6 Sat-Seconds Alarm Management

With traditional alarm management, high and low alarm limits are set for monitoring oxygen saturation. During monitoring, as soon as an alarm limit is violated, an audible alarm immediately sounds. When the patient % SpO_2 fluctuates near an alarm limit, the alarm sounds each time the limit is violated. Such frequent alarm can be distracting. Nellcor's Sat-Seconds alarm management technique is used to reduce these nuisance alarms.

The Sat-Seconds feature is available with the Nellcor SpO_2 module to decrease the likelihood of false alarms caused by motion artifacts. To set the Sat-Seconds limit, select [**Sat-Seconds**] in the [**SpO2 Setup**] menu and then select the appropriate setting.

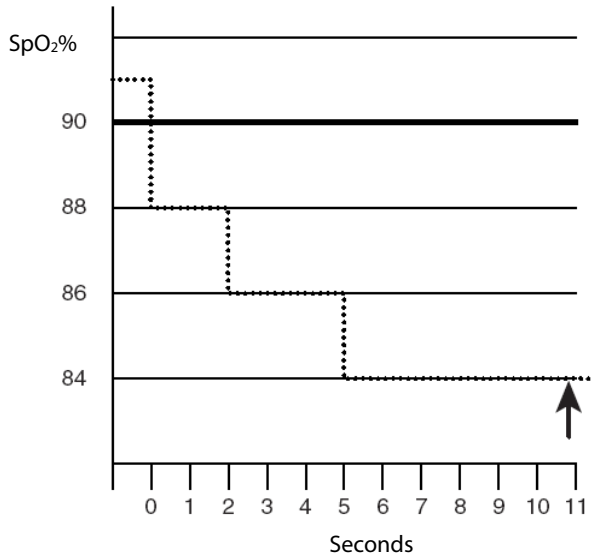
With Sat-Seconds alarm management, high and low alarm limits are set in the same way as traditional alarm management. A Sat-Seconds limit is also set. The Sat-Seconds limit controls the amount of time that SpO_2 saturation may be outside the set limits before an alarm sounds. The method of calculation is as follows: the number of percentage points that the SpO_2 saturation falls outside the alarm limit is multiplied by the number of seconds that it remains outside the limit. This can be stated as the equation:

Sat-Seconds= Points × Seconds

Only when the Sat-Seconds limit is reached, the monitor gives a Sat-Seconds alarm. For example, the figure below demonstrates the alarm response time with a Sat-Seconds limit set at 50 and a low SpO_2 limit set at 90%. In this example, the patient % SpO_2 drops to 88% (2 points) and remains there for 2 seconds. Then it drops to 86% (4 points) for 3 seconds, and then to 84% (6 points) for 6 seconds. The resulting Sat-Seconds are:

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

After approximately 10.9 seconds, a Sat-Second alarm would sound, because the limit of 50 Sat-Seconds would have been exceeded.



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

11.5.7 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.

11.5.8 Zooming PI Value

For Mindray SpO_2 module, you can display PI value in larger characters for better view. To zoom in the display of PI value, set [PI Zoom] to [Yes] from the [SpO2 Setup] menu.

11.5.9 Setting the Alarm Level for SpO_2 Sensor Off Alarm

Select [**Alarm Setup >>**] from the [**User Maintenance**] menu. You can set the [**SpO2 SensorOff Lev.**] in the popup menu.

11.5.10 Setting the SpO_2 Tone Mode

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

⚠WARNING

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

11.6 Measurement Limitations

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

- Ambient light
- Physical movement (patient and imposed motion)
- Diagnostic testing
- Low perfusion
- Electromagnetic interference, such as MRI environment
- Electrosurgical units
- Dysfunctional haemoglobin, such as carboxyhemoglobin (COHb)and methemoglobin (MetHb)
- Presence of certain dyes, such as methylene and indigo carmine
- Inappropriate positioning of the 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, 7,530,955 and other applicable patents listed at: www.masimo.com/patents.htm.

■ No Implied License

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

11.8 Nellcor Information

■ Nellcor Patents

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

■ No Implied License

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

11.9 Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting for services. If the problem persists, contact your service personnel.

CAUTION

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

Symptoms	Possible Cause	Correction Action
Dashes "- -" display in place of numerics.	Measurement is invalid.	Check that the sensor is properly applied. Change the application site if necessary.
Do not see SpO_2 parameter tiles in display.	Parameter not configured to display.	Switch the SpO_2 monitoring function on as described in ***3.11.1Switching the Parameters On/Off***.
Unable to obtain SpO_2 reading	Patient has poor perfusion	Change the application site or notify the physician
	Sensor not on patient	Check if the "SPO_2 Sensor Off" alarm is reported. If so, reapply the sensor. If not, contact the service personnel.
	Cables loose/not connected	Check the cable connections. Switch the cable if necessary.
	Ambient light	Check if the "SpO_2 Too Much Light" alarm is reported. If so, move the sensor to a place with lower level of ambient light or cover the sensor to minimize the ambient light.
No SpO2 waveform	Waveform not selected to display	Switch the SpO_2 monitoring function on as described in ***3.11.1Switching the Parameters On/Off***.
	Cable or sensor not plugged in	Check that the cable is properly connected and sensor securely applied.
Low amplitude SpO_2 signal	SpO_2 sensor on same limb as cuff	Check that the sensor is properly applied. Change the application site if necessary.
	Patient has poor perfusion	Change the application site.

FOR YOUR NOTES

12 Monitoring NIBP

12.1 Introduction

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

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

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

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

As specified by IEC 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 on the limb where skin damage has occurred or is expected.**
- **Use clinical judgement to determine whether to perform frequent unattended blood pressure measurements on patients with severe blood clotting disorders because of the risk of hematoma in the limb fitted with the cuff.**
- **Do not use the NIBP cuff on a limb with an intravenous infusion or arterial catheter in place. This could cause tissue damage around the catheter when the infusion is slowed or blocked during cuff inflation.**
- **NIBP reading can be affected by the measurement site, the position of the PATIENT, exercise, or the patient's physiologic condition. If you doubt the NIBP readings, determines the patient's vital signs by alternative means and then verify that the monitor is working correctly.**
- **Do not use the NIBP cuff on the arm on the side of a mastectomy.**
- **Continuous CUFF pressure due to connection tubing kinking may cause blood flow interference and resulting harmful injury to the patient.**

12.3 Measurement Limitations

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

The measurement may be inaccurate or impossible:

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

12.4 Measurement Methods

There are four methods of measuring NIBP:

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

12.5 Setting Up the NIBP Measurement

12.5.1 Preparing the Patient

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

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

NOTE

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

12.5.2 Preparing to Measure NIBP

1. Power on the monitor.
2. Verify that the patient category is correct. Change it if necessary.
3. Plug the air tubing into the NIBP connector on the patient monitor.
4. Select a correct sized cuff and then apply it as follows:
   - Determine the patient's limb circumference.
   - Select an appropriate cuff by referring to the limb circumference marked on the cuff. The width of the cuff should be 40% (50% for neonates) of the limb circumference, or 2/3 of the upper arm's length. The inflatable part of the cuff should be long enough to encircle at least 50% to 80% of the limb.
   - Apply the cuff to an upper arm or leg of the patient and make sure the Φ marking on the cuff matches the artery location. Do not wrap the cuff too tightly around the limb. It may cause discoloration, and ischemia of the extremities. Make sure that the cuff edge falls within the marked range. If it does not, use a larger or smaller cuff that will fit better.
5. Connect the cuff to the air tubing and make sure that the air tubing is not compressed and twisted.

NOTE

- **The use of the equipment is restricted to one patient at a time.**

12.5.3 Starting and Stopping Measurements

Select the [**NIBP Measure**] QuickKey and you can start the desired measurement from the popup menu. You can select [**Stop All**] QuickKey to stop all NIBP measurements. You can also start and stop measurements by using the  hardkey on the monitor's front panel.

12.5.4 Correcting the Measurement if Limb is not at Heart Level

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

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

12.5.5 Enabling NIBP Auto Cycling and Setting the Interval

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

Or

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

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

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

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

NOTE

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

12.5.6 Starting a STAT Measurement

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

Or

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

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

⚠WARNING

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

12.5.7 Sequence Measurement

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

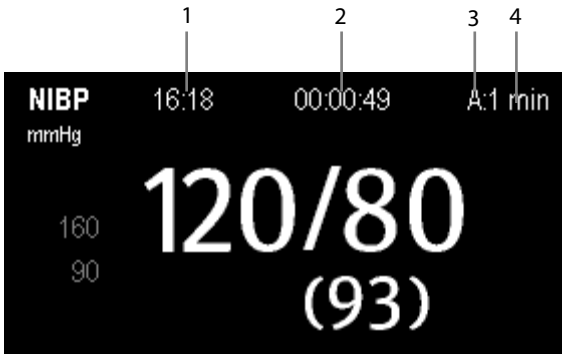
To set the sequence measurement, follow this procedure:

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

To start the sequence measurement, follow this procedure:

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

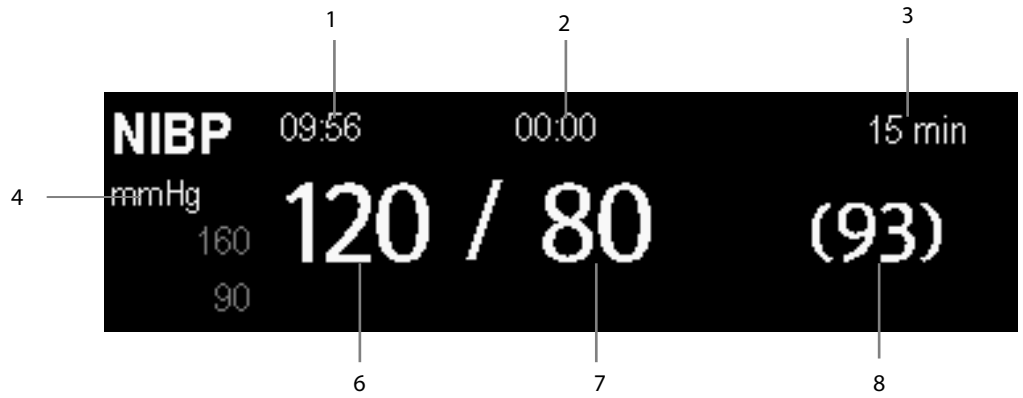
When the NIBP sequence measurement is in use, the NIBP parameter area displays as follows:



1. Time of last measurement
2. Time remaining to next measurement
3. Cycle name
4. NIBP measurement Interval

12.6 Understanding the NIBP Numerics

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



1. Time of last measurement
2. Time remaining to next measurement
3. Measurement mode
4. Unit of pressure: mmHg or kPa
5. Systolic pressure
6. Diastolic pressure
7. Mean pressure obtained after the measurement and cuff pressure obtained during the measurement

If the NIBP measurement exceeds the measurement range or the measurement fails, "---" will be displayed. If you manually stop the measurement, the last measured value will be displayed.

12.7 Changing NIBP Settings

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

12.7.1 Setting the Initial Cuff Inflation Pressure

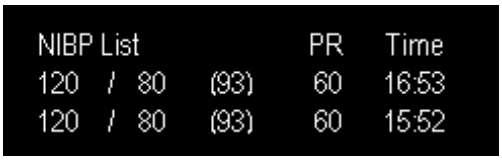
You can set the initial cuff inflation pressure manually. In the [**NIBP Setup**] menu, select [**Initial Pressure**] and then select the appropriate setting.

12.7.2 Setting NIBP Alarm Properties

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

12.7.3 Displaying NIBP List

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



You cannot display NIBP list in some screens such as the big numerics screen.

12.7.4 Setting the Pressure Unit

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

12.7.5 Switching On NIBP End Tone

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

12.8 Assisting Venous Puncture

You can use the NIBP cuff to cause sub-diastolic pressure to block the venous blood vessel and therefore help venous puncture.

1. Select [**VeniPuncture >>**] from the [**NIBP Setup**] menu. In the popup menu, verify that the [**Cuff Press.**] value is appropriate. Change it if necessary.
2. Select [**VeniPuncture**].
3. Puncture vein and draw blood sample.
4. Select the hardkey on the monitor's front, or the [**Stop All**] 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 Introduction

The equipment is used to monitor skin temperature and core temperature. It can simultaneously monitor two temperature sites using the patient monitor.

13.2 Safety

⚠ WARNING

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

13.3 Making a Temp Measurement

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

13.4 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.

13.5 Changing Temperature Settings

13.5.1 Setting the Temperature Unit

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

13.5.2 Setting the Temperature Label

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

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

14 Monitoring IBP

14.1 Introduction

The iPM 12/iPM 7 patient monitor can monitor up to 4 invasive blood pressures and iPM 10/iPM 6 and iPM 8/iPM 5 patient monitors can monitor up to 2 invasive blood pressures. The patient monitor can display 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.**
- **The neutral electrode of the electro-surgery unit (ESU) shall properly contact the patient. Otherwise, burns may result.**

14.3 Measuring an Invasive Blood Pressure

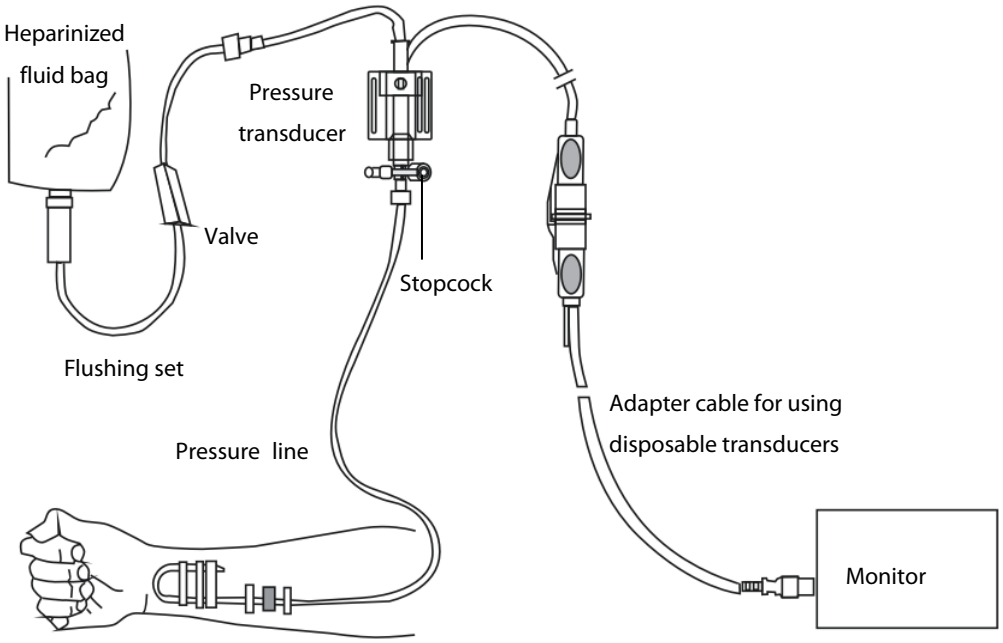
14.3.1 Setting Up the Pressure Measurement

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

⚠ WARNING

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

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



⚠ WARNING

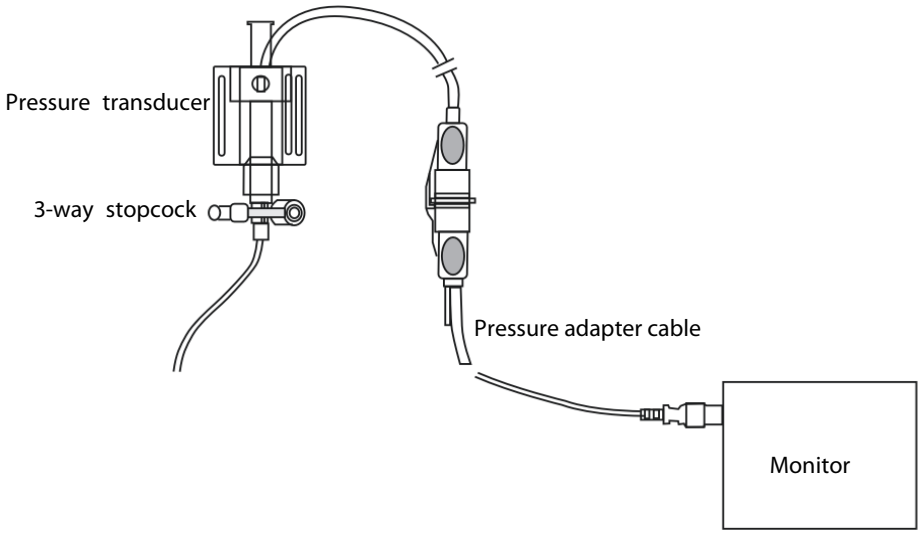
- **If measuring intracranial pressure (ICP) with a sitting patient, level the transducer with the top of the patient's ear. Incorrect leveling may give incorrect values (not applicable if measursing ICP with the Codman ICP transducer).**

14.3.2 Zeroing the Transducer

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

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

1. Turn off the stopcock to the patient.



2. Vent the transducer to the atmospheric pressure by turning on the stopcock to the air.
3. In the setup menu for the pressure (e.g. Art), select [**Art Zero >>**]→[**Zero**]. During zero calibration, the [**Zero**] button appears dimmed. It recovers after the zero calibration is completed. To zero all IBP channels, select [**Zero IBP**] hotkey, and then select [**Zero All Channels**] in the popup menu.
4. After the zero calibration is completed, close the stopcock to the air and open the stopcock to the patient.

Zero calibration may fail in case of pressure fluctuation or pressure exceeding the calibration range. If zero calibration fails, follow this procedure:

1. Check that the three-way valve (the one near the transducer) is open to the air.
2. Perform zero calibration again. Do not sway the IBP transducer and tubing during zero calibration.

NOTE

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

14.4 Measuring ICP Using the Codman ICP Transducer

14.4.1 Zeroing the Codman ICP transducer

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

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

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

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

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

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

14.4.2 Measuring ICP

To monitor ICP, follow this procedure:

1. Zero the Codman ICP transducer. For more information, see section ***14.4.1 Zeroing the Codman ICP transducer***.
2. Disconnect the ICP transducer and ICP adapter cable. Follow the manufacturer's instructions to apply the ICP transducer to the patient.
3. Reconnect the ICP transducer and ICP adapter cable.
4. Check that the zero reference value displayed on the monitor is consistent with that recorded on the ICP transducer.
   - Consistent: select [**Accept**].
   - Incosistent: input the zero reference value recorded on the ICP transducer, and select [**Accept**].

If you have to transfer the patient who is taking ICP measurement, check that the target monitor supports the Codman ICP transducer. For more information, see ***14.4.1 Zeroing the Codman ICP transducer***. If the target monitor does not support the Codman ICP transducer, do not use it for ICP monitoring.

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

1. Disconnect the ICP adapter cable from the measurement module, or remove the module from the monitor.
2. Connect the ICP adapter cable, measurement module, and the target monitor, or insert the measurement module into the target monitor.

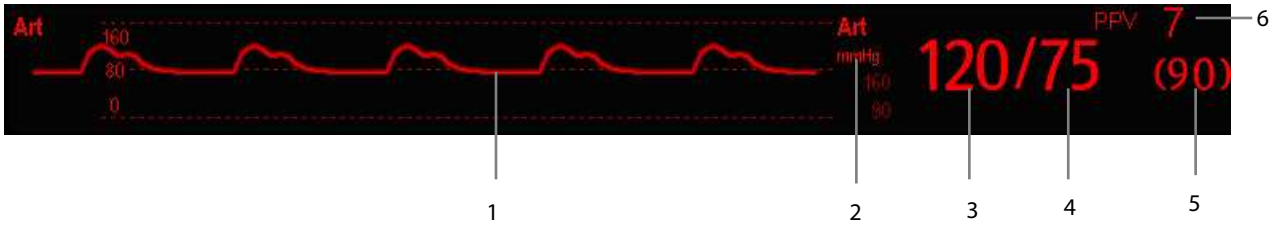
3. Check that the zero reference value displayed on the monitor is consistent with that recorded on the ICP transducer.

   ◆ Consistent: select [**Accept**].

Inconsistent: input the zero reference value recorded on the ICP transducer, and select [**Accept**].

14.5 Understanding the IBP Display

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



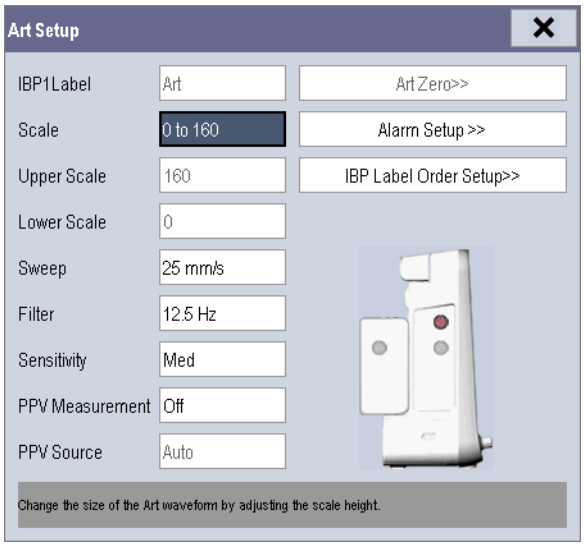
1. Waveform
2. Pressure unit
3. Systolic pressure
4. Diastolic pressure
5. Mean pressure
6. PPV measurement

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

14.6 Changing IBP Settings

14.6.1 Changing a Pressure for Monitoring

1. Select the pressure you want to change to enter its setup menu. 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. The already displayed labels cannot be selected.

Label	Description	Label	Description
PA	Pulmonary artery pressure	CVP	Central venous pressure
Ao	Aortic pressure	LAP	Left atrial pressure
UAP	Umbilical arterial pressure	RAP	Right atrial pressure
BAP	Brachial arterial pressure	ICP	Intracranial pressure
FAP	Femoral arterial pressure	UVP	Umbilical venous pressure
Art	Arterial blood pressure	LV	Left ventricular pressure
CPP	Cerebral perfusion pressure	P1 to P4	Non-specific pressure label

NOTE

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

14.6.2 Setting the Pressure Label Order

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

14.6.3 Setting Alarm Properties

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

14.6.4 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 Up 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.

14.6.6 Enabling PPV Measurement and Setting PPV Source

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

You can select PPV source when PPV measurement is enabled.

⚠WARNING

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

NOTE

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

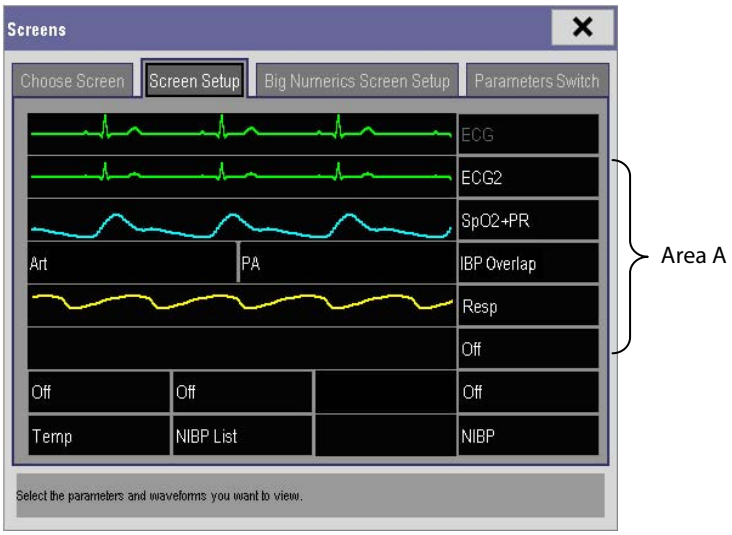
14.6.7 Setting the Pressure Unit

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

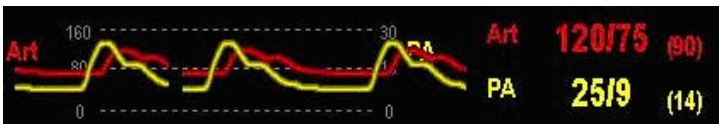
14.7 Overlapping IBP Waveforms

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

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



4. Select ✕ to save the setting and exit the window. The main screen will display the overlapped IBP waves.



Selecting the overlapped IBP waveforms on the main screen pops up the [**Overlapping Waveform Setup**] menu, where you can:

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

You can also change above settings from corresponding IBP setup menu.

Note

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

14.8 Measuring PAWP

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

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

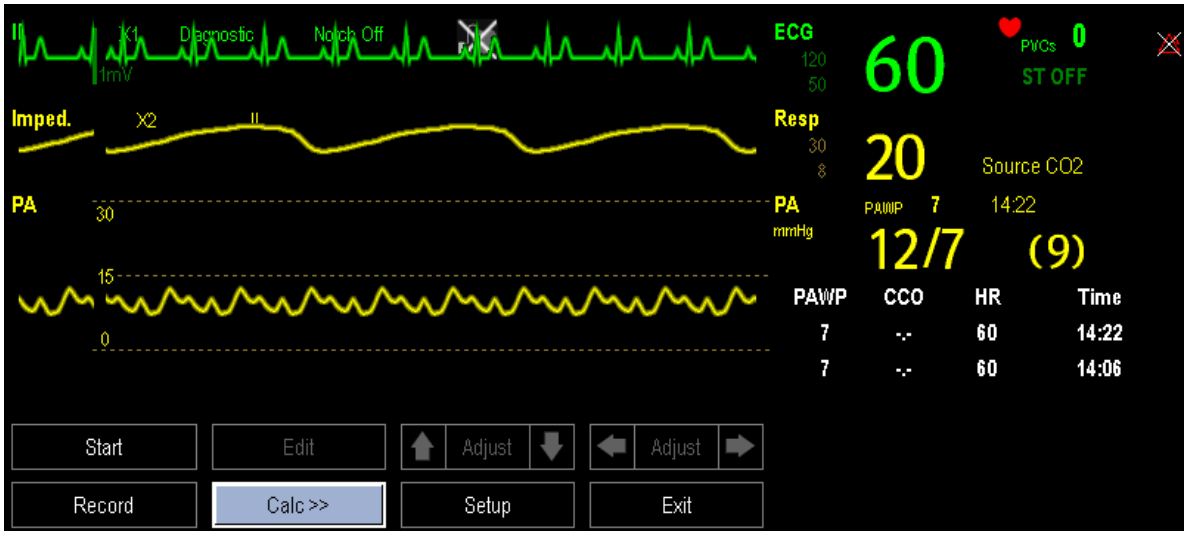
The pulmonary wedge pressure is the left ventricular end diastolic pressure when the airway pressure and valve function are normal. The most accurate PAWP values are obtained at the end of the respiration cycle when the intrathoracic pressure is fairly constant and the artifact caused by respiration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

WARNING

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

14.8.1 Preparing to Measure PAWP

1. Prepare the same accessories as in the C.O. measurement. Connect the parts such as catheter, syringe, etc. following the C.O. measurement steps and use the balloon inflation port.
2. Connect the PAWP cable into the IBP connector on the monitor. Since PAWP is measured on PA, selecting [**PA**] as the IBP label is recommended.
3. Select the PA parameter window or waveform area to enter its setup menu. Then, select [**PAWP**] to enter the PAWP measurement window. You can also enter the PAWP measurement window from the P1-P4 parameter window.

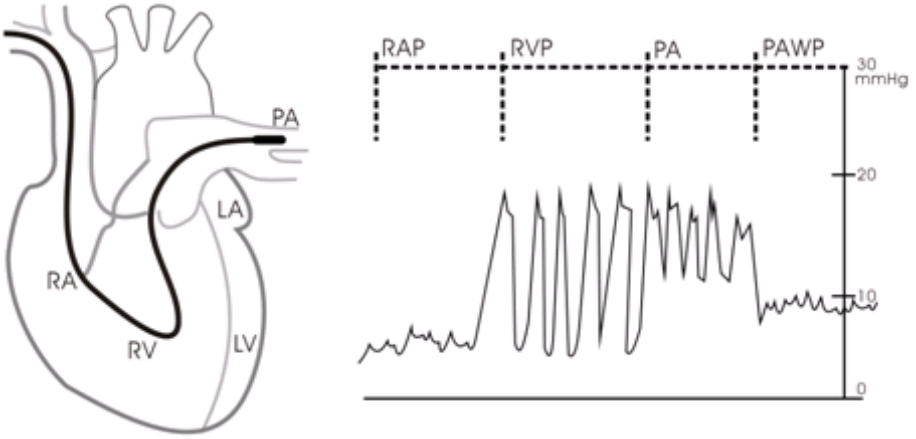


NOTE

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

14.8.2 Setting Up the PAWP Measurement

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



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

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

- Select the or beside the [Adjust] button to adjust the PAWP value.
- Select or beside the [Adjust] button to view the frozen waveforms of 40 seconds.
- Select [Confirm] to save the PAWP value.

⚠WARNING

- **Prolonged inflation can cause pulmonary hemorrhage, infarction or both. Inflate the balloon for the minimum time necessary to get an accurate measurement.**
- **If the PAWP is greater than the PA (systolic), deflate the balloon and report the incident in accordance with hospital policy. Because the pulmonary artery could be accidentally ruptured, and the PAWP value derived will not reflect the patient's hemodynamic state, but will merely reflect the pressure in the catheter or balloon.**

14.8.3 Understanding the PAWP Setup Menu

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

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

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

14.8.4 Performing Hemodynamic Calculation

In the PAWP window, select [**Calc.>>**] to enter the hemodynamic calculation menu. Refer to ***22.5 Hemodynamic Calculations*** for details.

14.9 Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting for services. If the problem persists, contact your service personnel.

CAUTION

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

Symptoms	Possible Cause	Correction Action
Damped invasive waveform	Air bubbles in tubing	Eliminate air from tubing as described in ***14.3.1 Setting Up the Pressure Measurement.***
	Kinked catheter	Change the position of catheter.
	Blood in tubing	Pressurize the solution bag to 300 mmHg. For details, refer to the instructions for use of the solution bag.
IBP not displayed/no IBP waveform	Improper setup	Check display setup in monitor setup.
	Cable not plugged in	Check that the cables are properly connected.
	Transducer not connected.	Check that the transducer is properly connected.
	Stopcock turned improperly.	Check that the stopcock is turned to the correct position.
	Transducer not zeroed	Check and zero the transducer as described in ***14.3.2 Zeroing the Transducer***.
Dashes "- -" display in place of numerics.	The measured result is invalid or out of range. IBP might be set to non-pulsatile labels like CVP, LA, RA, and ICP.	Change to a pulsatile label.

Symptoms	Possible Cause	Correction Action
Abnormally high or low readings	Transducer too High or too Low.	Adjust the position of the transducer and make sure that it is level with the heart, approximately at the level of the midaxillary line. Zero the transducer as described in ***14.3.2 Zeroing the Transducer***.
Unable to Zero	Stopcock not open to atmosphere.	Check the transducer and make sure the stopcock is turned to the air.
PAWP button disabled	One IBP channel must be labeled PA	Label an IBP channel as PA. (Also Label an IBP channel as P1/P2/P3/P4, it will automatically change to PA)

15 Monitoring Cardiac Output

15.1 Introduction

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

⚠WARNING

- **C.O. monitoring is restricted to adult patients only.**

15.2 Understanding the C.O. Display

The C.O. measurement is displayed on the monitor as numeric C.O., C.I. and TB in the C.O. parameter window as shown below. To enter the [**C.O. Setup**] menu, select the C.O. parameter window.

1. Cardiac output
2. Time at which the C.O. average is calculated
3. Cardiac index
4. Blood temperature

15.3 Influencing Factors

The factors that affect cardiac output are:

- temperature of injectate solution,
- volume of injectate solution,
- patient's baseline blood temperature,
- patient's inspiratory/expiratory cycle,

- placement of catheter with relation to proximity of lung field,
- the catheter itself,
- the patient rhythm and hemodynamic status, and
- any other rapid IV solutions which are infused while the C.O. measurement is being performed.

Followings are some technique suggestions to obtain accurate C.O.:

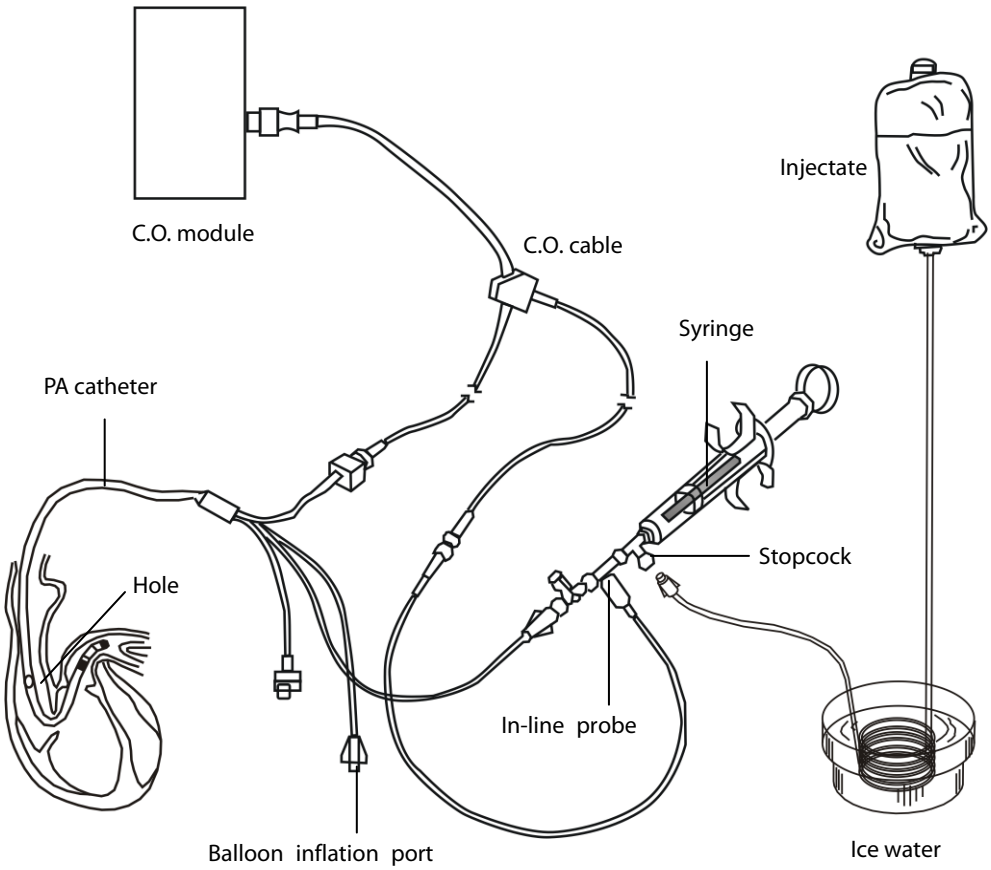
- Injectate solution must be cooler than the patient's blood.
- Inject solution rapidly and smoothly.
- Inject at end expiration.

15.4 Setting Up the C.O. Measurement

⚠WARNING

- **Use only accessories specified in this manual. Make sure that the accessories never come into contact with conductive parts.**

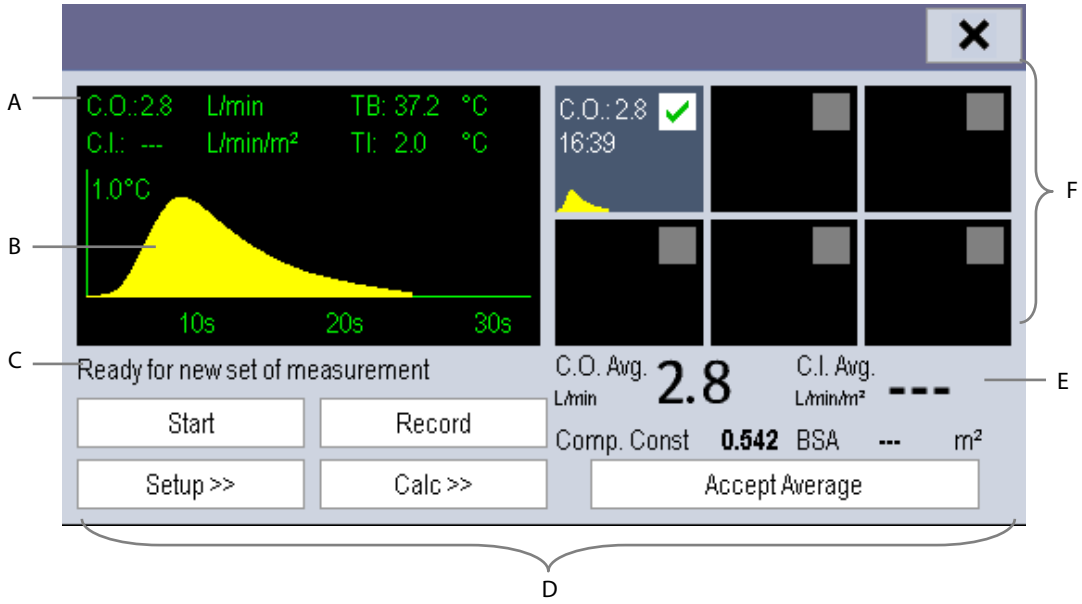
1. Connect the C.O. cable to the C.O. connector on the monitor.
2. Interconnect the C.O. module, catheter and syringe as shown below. Make sure that:
   - The module is securely inserted.
   - The PA catheter is in place in the patient.
   - The C.O. cable is properly connected to the module.



NOTE

- **The above picture is connecting illustration when TI sensor PN 6000-10-02079 is used. The connection may be different if other TI sensors are used.**

3. Select the C.O. parameter window to enter the [**C.O. Setup**] menu. Check if the height and weight are appropriate for your patient. Change if necessary.
4. In the [**C.O. Setup**] menu:
   - Check that the correct computation constant is entered. Refer to the Instruction for Use of pulmonary artery catheter to determine the [**Comp. Const**] according to the entered injectate volume and temperature. To change the computation constant, select [**Comp. Const**] and then enter the correct value. When a new catheter is used, the computation constant should be adjusted in accordance with the manufacturer's instructions for use.
   - Set the [**Auto TI**] to [**Manual**] or [**Auto**]. If you select [**Auto**], the system automatically detects the injectate temperature, and the [**Manual TI(℃)**] is disabled. If you select [**Manual**], you need to enter the injectate temperature at [**Manual TI(℃)**] manually.
   - Set the [**Measuring Mode**] to [**Manual**] or [**Auto**]. In [**Auto**] mode, the monitor automatically takes C.O. measurement after establishing a baseline blood temperature. In [**Manual**] mode, you need to click the [**Start**] button in the C.O. measurements window when the monitor is ready for new C.O. measurement.
5. Select [**Enter C.O. Screen**] to enter the C.O. measurements window.



A. Currently measured numeric
B. Currently measured C.O. curve
C. Prompt message area
D. Buttons
E. Averaged values
F. Measurement windows

6. Proceed as follows.
   - In [**Manual**] measure mode, select the [**Start**] button and then inject the solution quickly when you see the message [**Ready for new set of measurement**]. As shown in the figure above, during the measurement, the currently measured thermodilution curve is displayed. At the end of the measurement, the thermodilution curve is transferred to one of the 6 measurement windows and the monitor prompts you to wait for a certain period of time before starting a new measurement.
   - In [**Auto**] measure mode, the monitor consecutively takes C.O. measurements automatically without the need for pressing the [**Start**] button between two measurements. A new thermodilution measurement is possible as soon as the message [**Inject now!**] is displayed on the screen. The patient monitor automatically detects further thermodilution measurements.
7. Consecutively take 3 to 5 single measurements as instructed by Step 6.

A maximum of 6 measurements can be stored. If you perform more than six measurements without rejecting any, the oldest will automatically be deleted when a seventh curve is stored. Select from the 6 measurement curves and the system will automatically calculate and display the averaged C.O. and C.I. values. Then select the [**Accept Average**] button to accept and store the averaged values.

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

In the buttons area, you can:

- Select [**Start**] to start a C.O. measurement.
- Select [**Stop**] to stop the current measurement.
- Select [**Cancel**] during a measurement to cancel the measurement. Selecting it after a measurement deletes the measured results.
- Select [**Record**] to print out the curves selected for average calculation, numerics and averaged values by the recorder.
- Select [**Setup >>**] to access the [**C.O. Setup**] menu.
- Select [**Calc >>**]→[**Hemodynamic >>**] to access the [**Hemodynamic Calculation**] menu.

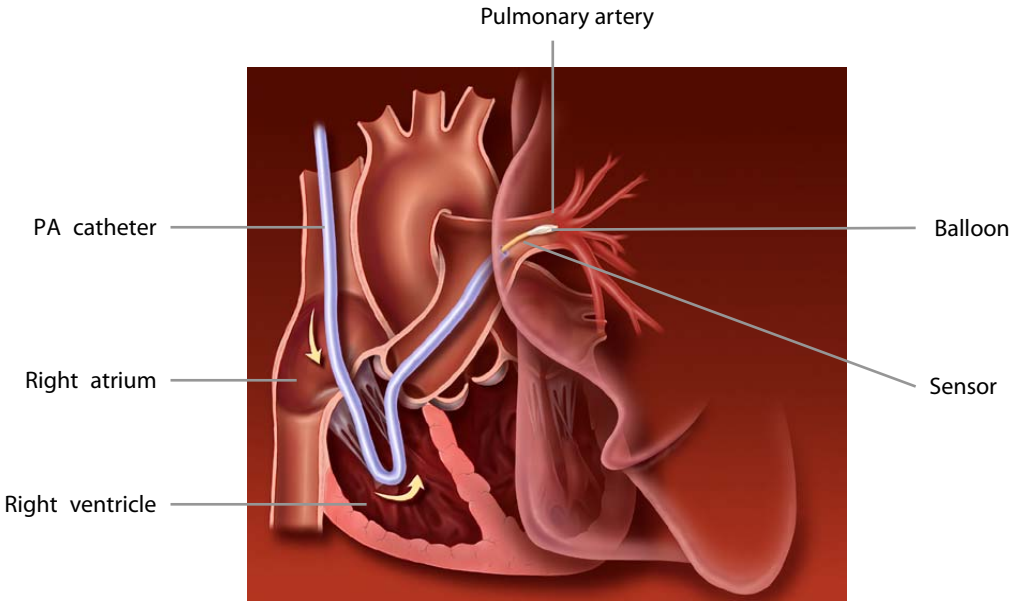
The system can automatically adjust the X-axis scale range to 30 s or 60 s and Y-axis scale range to 0.5°C, 1.0°C, or 2.0°C.

NOTE

- **Starting measuring without blood temperature being stable yet may cause measuring failure.**
- **During the cardiac output measurement, blood temperature alarms are inactive.**
- **Please refer to the Instructions for Use of pulmonary artery catheter delivered with the patient monitor to determine the** [**Comp. Const**] **and the volume of injectate.**

15.5 Measuring the Blood Temperature

As shown below, the blood temperature is measured with a temperature sensor at the distal end of the catheter in the pulmonary artery. During C.O. measurements, blood temperature alarms are suppressed to avoid false alarms. They will automatically recover as soon as the C.O. measurements are completed.



15.6 Changing C.O. Settings

15.6.1 Setting the Temperature Unit

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

15.6.2 Setting Alarm Properties

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

FOR YOUR NOTES

16 Monitoring Carbon Dioxide

16.1 Introduction

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

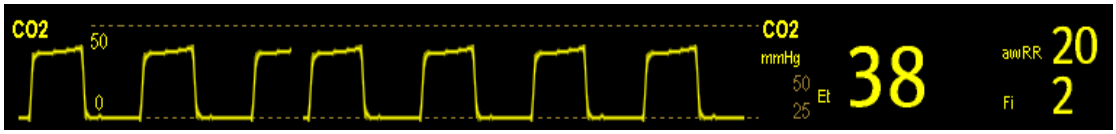
There are two methods for measuring CO_2 in the patient's airway:

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

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

The measurement provides:

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



16.2 Measuring CO_2

⚠WARNING

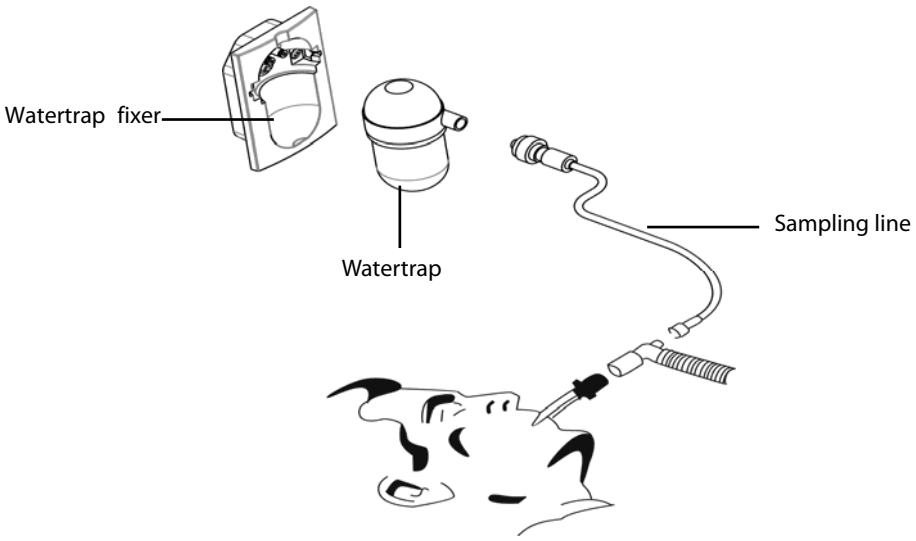
- **Eliminate the exhausted gas before performing the measurement.**
- **Check that the alarm limit settings are appropriate before taking measurement.**

NOTE

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

16.2.1 Making a Sidestream CO_2 Measurement

1. Attach the watertrap to the module and then connect the CO_2 components as shown below.



2. The CO_2 module needs time to warm up to reach the operating temperature. The message [**CO2 Sensor Warmup**] is displayed during warm-up. If you perform CO_2 measurements during warm-up, the measurement accuracy may be compromised.
3. After warm-up is finished, you can perform CO_2 measurements.

⚠CAUTION

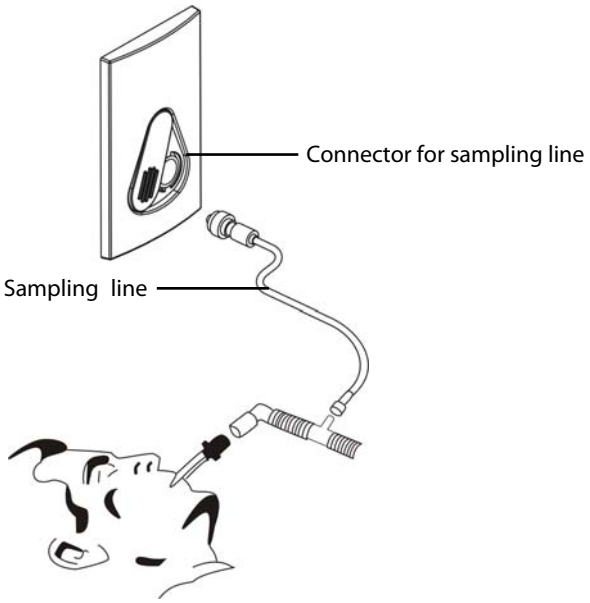
- **The watertrap collects water drops condensed in the sampling line and therefore prevents them from entering the module. If the collected water reaches a certain amount, you should drain it to avoid blocking the airway. Dispose of accumulated fluids in accordance with the hospital policy or your local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

NOTE

- **To extend the lifetime of the watertrap and module, disconnect the watertrap and set the operating mode to standby mode when CO_2 monitoring is not required.**
- **Do not apply adult watertrap to the neonate patient. Otherwise, patient injury could result.**

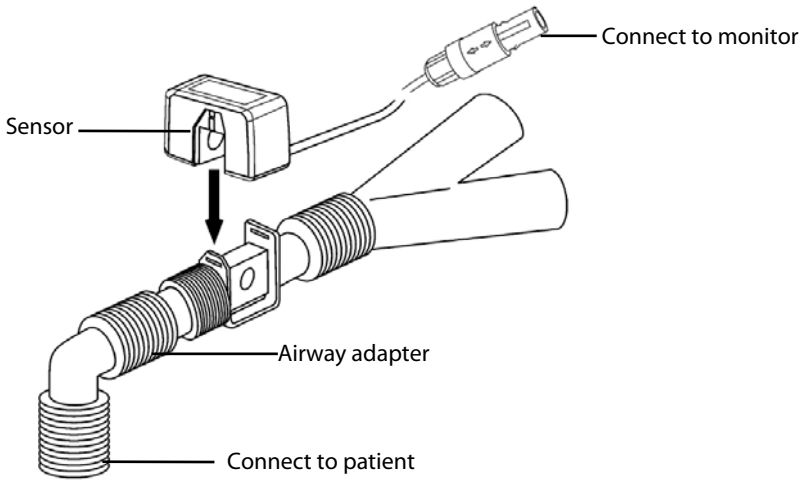
16.2.2 Making a Microstream CO_2 Measurement

Connect the sampling line to the module and then connect the CO_2 components as shown below. After warm-up is finished, you can perform CO_2 measurements.



16.2.3 Making a Mainstream CO_2 Measurement

1. Connect the sensor to the module. The message [**CO2 Sensor Warmup**] appears on the screen when the CO_2 module is plugged.
2. After warm-up is finished, connect the transducer to the airway adapter.
3. Perform a zero calibration per the ***Zeroing the Sensor*** section.
4. After the zero calibration is finished, connect the airway as shown below.



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

NOTE

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

16.3 Changing CO_2 Settings

16.3.1 Accessing CO_2 Menus

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

16.3.2 Entering the Standby Mode

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.

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

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

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

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

16.3.3 Setting the CO_2 Unit

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

16.3.4 Setting up Gas Compensations

⚠WARNING

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

For the sidestream CO_2 module:

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

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

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

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

16.3.5 Setting up Humidity Compensation

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

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

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

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

As the mainstream CO_2 module has a built-in heating component to prevent water vapour from condensing, setting humidity compensation is not needed. For the sidestream and microstream CO_2 module, you can set the humidity compensation on or off according to the actual condition. To set the humidity compensation:

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

16.3.6 Setting the Apnea Alarm Delay

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

⚠WARNING

- **The respiration measurement does not recognize the cause of apneas. It only indicates an alarm if no breath is detected when a pre-adjusted time has elapsed since the last detected breath. Therefore, it cannot be used for diagnostic purpose.**

16.3.7 Choosing a Time Interval for Peak-Picking

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

To set the time interval:

1. Enter the [**CO_2 Setup**] menu.
2. Select [**Max Hold**].
3. Toggle between [**Single Breath**], [**10 s**], [**20 s**] and [**30 s**] if microstream CO_2 module is configured; toggle between [**Single Breath**], [**10 s**] and [**20 s**] if mainstream CO_2 module is configured.
   - [**Single Breath**]: $EtCO_2$ and $FiCO_2$ are calculated for every breath.
   - [**10 s**], [**20 s**], or [**30 s**]: $EtCO_2$ and $FiCO_2$ are calculated using 10, 20 or 30 seconds of data.

16.3.8 Setting the Flow Rate

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

⚠WARNING

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

16.3.9 Setting up the CO_2 Wave

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

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

16.4 Setting RR Source

To set RR source:

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

The [**RR Source**] settings of Resp, CO_2, and AG module are linked. For details, please refer to the section ***9.9 Setting RR Source***.

16.5 Setting Barometric Pressure Compensation

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

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

⚠WARNING

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

16.6 Measurement Limitations

The following factors may influence the accuracy of measurement:

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

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

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

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

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

16.7 Leakage test

When the sidestream CO_2 module needs maintenance, the monitor prompts on the CO_2 waveform area: [**Need maintenance. Enter CO2 setup menu.**] Then, select [**User Maintenance >>**]→ enter the required password→[Module Maintenance >>]→ [**Maintain CO2 >>**], and perform leakage test according to the prompt messages on the menu.

16.8 Troubleshooting the Sidestream CO_2 Sampling System

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

16.9 Removing Exhaust Gases from the System

⚠WARNING

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

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

16.10 Zeroing the Sensor

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

16.10.1 For Sidestream and Microstream CO_2 Modules

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

16.10.2 For Mainstream CO_2 Modules

For mainstream CO_2 modules, zero the sensor whenever:

- A new adapter is used;
- You reconnect the sensor to the module;
- You see the message [**CO2 Zero Required**]. In this case, check the airway adapter for any blockage, e.g. mucus, etc. If a blockage is detected, clear or replace the adapter.

To zero the sensor, follow this procedure:

1. Connect the sensor to the module.
2. In the [**CO2 Setup**] menu, set the [**Operating Mode**] to [**Measure**]. The message [**CO2 Sensor Warmup**] is displayed.
3. After warm-up is finished, connect the sensor to a clean, dry airway adapter. The adapter should be vented to the air and isolated from CO_2 sources, such as ventilator, the patient's breathing, your own breathing, etc.
4. Select [**Start Zero Cal.**] in the [**CO2 Setup**] menu. The message [**CO2 Zero Running**] is displayed.
5. It takes about 15 to 20 seconds. The message disappears when the zero calibration is completed.

⚠WARNING

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

16.11 Calibrating the Sensor

For sidestream or microstream CO_2 modules, a calibration should be performed once every year or when the readings go far beyond the range. For mainstream CO_2 modules, no calibration is required. For details, refer to the chapter ***28 Maintenance.***

16.12 Oridion Information

Microstream

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

Oridion Patents

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

No Implied License

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

17 Monitoring AG

17.1 Introduction

The anaesthetic gas (AG) module measures the patient's anesthetic and respiratory gases by connecting to the airway of intubated patients or collecting the gases with specified accessories. It incorporates the features of the O_2 module as well. AG monitoring is for iPM 12/iPM 7 and iPM 10/iPM 6 patient monitors only. The AG measurement is applicable for adult, pediatric and neonatal patients.

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

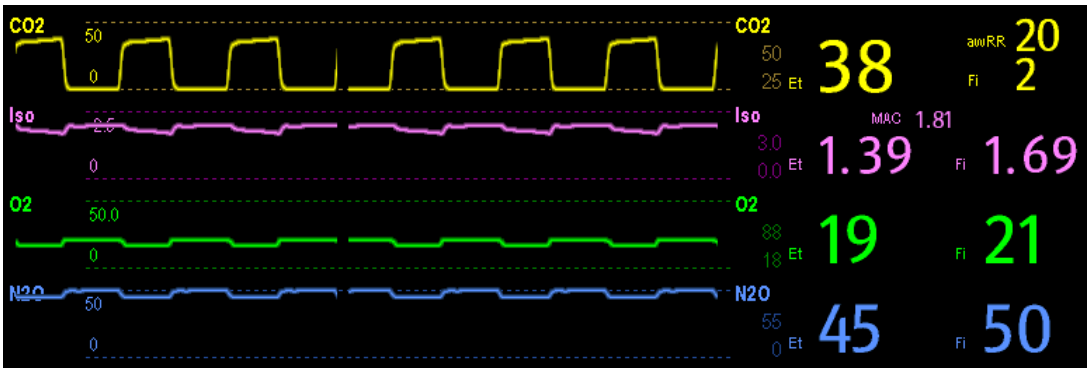
Oxygen does not absorb IR light as other breathing gases and is therefore measured relying on its paramagnetic properties. Inside the O_2 sensor are two nitrogen-filled glass spheres mounted on a strong rare metal taut-band suspension. This assembly is suspended in a symmetrical non-uniform magnetic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

AG module can identify two anesthetic gases in a mixture automatically and distinguish between them according to their contributions to the MAC value for display as the primary and secondary anesthetis agent.

NOTE

- **The AG module is configured with automatic barometric pressure compensation function.**
- **Perform the measurement in a well-ventilated environment.**

17.2 Understanding the AG Display



Gas	N2O	O2	Iso	Sev	
Et	45	19	1.39	0.37	MAC
Fi	50	21	1.69	0.62	1.81

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

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

Where AA represents Des (desflurane), Iso (isoflurane), Enf (enflurane), Sev (sevoflurane), or Hal (halothane).
The AA waveform area displays the primary anesthetic gas's waveform. When O_2 module does not exist, no O_2 waveform will be displayed. When O_2 module exists, the O_2 waveform will be displayed only when the O_2 waveform is currently switched on.

⚠WARNING

- **To avoid explosion hazard, do not use flammable anesthetic agent such as ether and cyclopropane for this equipment.**

17.3 MAC Values

Minimum alveolar concentration (MAC) is the minimum concentration of the agent in the alveoli. It is a basic index to indicate the depth of anesthesia. The standard ISO 21647 defines MAC as this: alveolar concentration of an inhaled anesthetic agent that, in the absence of other anesthetic agents and at equilibrium, prevents 50% of patients from moving in response to a standard surgical stimulus.

Minimum alveolar concentration (MAC) values are listed below:

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

* The data is taken from a patient of 25 years old.

NOTE

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

The formula to calculate the MAC value is as follows:

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

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

The formula for calculating age correction of 1 MAC is:

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

For example, the Des concentration at 1 MAC of a 60-year old patient is $6\% \times 10^{(-0.00269 \times (60 - 40))} = 6\% \times 0.88$. The AG module measures there are 4% of Des, 0.5% of Hal and 50% of N_2O in this patient's end-tidal gas:

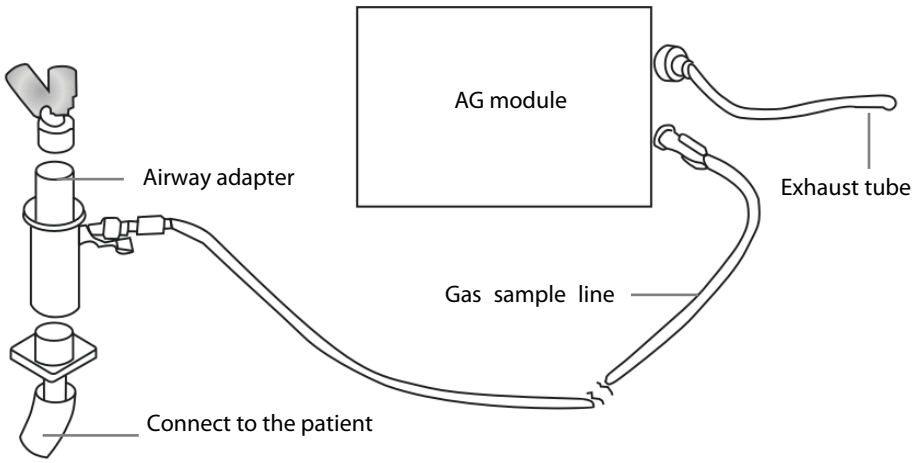
$$MAC = \frac{4.0\%}{6\% \times 0.88} + \frac{0.5\%}{0.77\% \times 0.88} + \frac{50\%}{105\% \times 0.88} = 2.04$$

NOTE

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

17.4 Preparing to Measure AG

1. Select an appropriate watertrap according to patient category and attach it to the module.
2. Connect the gas sample line to the connector of the watertrap.
3. Connect the other end of the gas sampling line to the patient via the airway adapter.
4. Connect the gas outlet to a scavenging system using an exhaust tube.



5. Insert the AG module to the patient monitor and the patient monitor will prompt [**AG Startup**]. Then the AG module starts to warmup and at the same time the patient monitor prompts [**AG Warmup**]. After 45 seconds, the AG module enters the iso accuracy mode. After 10 minutes, the module enters the full accuracy mode.

⚠WARNING

- **Make sure that the connections are tight. Any leak in the system can result in erroneous readings due to ambient air mixing with patient gases.**
- **Do not apply adult watertrap to the neonate patient. Otherwise, patient injury could result.**
- **Using high-frequency electrosurgical units may increase the risk of skin burn. In this case, do not use antistatic or conductive respiratory tubing.**

⚠CAUTION

- **Position the airway adapter so that the part connecting to the gas sample line is pointing upwards. This prevents condensed water from passing into the gas sample line and causing an occlusion.**
- **The watertrap collects water drops condensed in the sampling line and therefore prevents them from entering the module. If the collected water reaches to a certain amount, you should drain it to avoid blocking the airway. Dispose of accumulated fluids in accordance with the hospital policy or your local regulations.**
- **The watertrap has a filter preventing bacterium, water and secretions from entering the module. After a long-term use, dust or other substances may compromise the performance of the filter or even block the airway. In this case, replace the watertrap. Replacing the watertrap once a month is recommended.**
- **Check that the alarm limit settings are appropriate before taking measurement.**

17.5 Changing AG Settings

17.5.1 Setting Gas Unit

For N_2O and AA, the unit of the measured gas is fixed to "%".

Select [**Unit Setup >>**] from the [**User Maintenance**] menu. In the popup menu, you can select [**CO2 Unit**] or [**O2 Unit**] and toggle between [**mmHg**], [**%**] and [**kPa**].

17.5.2 Setting the Apnea Alarm Delay

In the [**AG Setup**] menu, select [**Apnea Delay**] and select the appropriate setting. The monitor will alarm if the patient has stopped breathing for longer than the preset apnea time.

The [**Apnea Delay**] of Resp, CO_2, and AG module keeps consistent with each other.

⚠WARNING

- **The respiration measurement does not recognize the cause of apneas. It only indicates an alarm if no breath is detected when a pre-adjusted time has elapsed since the last detected breath. Therefore, it cannot be used for diagnostic purpose.**

17.5.3 Changing the Sample Flow Rate

In the setup menu for any gas, select [**Flow Rate**] and then choose either:

- [**High**]: 200 ml/min for adult and pediatric patients, and 120 ml/min for neonatal patients.
- [**Med**]: 150 ml/min for adult and pediatric patients, and 90 ml/min for neonatal patients.
- [**Low**]: 120 ml/min for adult and pediatric patients, and 70 ml/min for neonatal patients.

17.5.4 Setting up the O_2 Compensation

If the AG module does not incorporate the O_2 module, you need to manually select [**O2 Compen**] and then select [**Off**] or an appropriate setting according to the amount of O_2 in the ventilation gas mixture. When the amount of O_2 is less than 30%, you'd better switch this compensation off.

If the AG module incorporates the O_2 module, the system will directly use the O_2 concentration detected by the O_2 module to make compensation. At this time, the [**O2 Compen**] in the setup menu for any gas is fixed to [**Off**].

⚠WARNING

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

17.5.5 Entering the Standby Mode

For the AG module, the default operating mode is measure. When you set the AG module to the standby mode, the AG gas sample intake pump automatically sets the sample flow rate to zero. When exiting the standby mode, the AG module continues to work at preset sample flow rate with no need to warm up again. After nearly 1 minute, the module enters the full accuracy mode. The standby mode of the AG module relates to the standby mode of the monitor as follows:

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

To enter or exit the standby mode manually, in the agent's setup menu, select [**Operating Mode**] and then toggle between [**Standby**] and [**Measure**]. You can also set a period of time after which the AG module enters the standby mode automatically if no breath is detected since the last detected breath. To set the standby time, in the agent's setup menu, select [**Auto Standby (min)**] and then select the appropriate setting.

17.5.6 Setting up the AG Wave

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

- Select [**CO2 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(CO2/O2)**], [**Sweep(AA)**] or [**Sweep(N2O)**] to change the wave sweep.. The faster the wave sweeps, the wider the wave is.
- Select [**CO2 Scale**], [**AA Scale**] or [**N2O Scale**] to change the size of the waveform.

17.5.7 Setting RR Source

To set RR source:

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

The [**RR Source**] settings of Resp, CO_2, and AG module are linked. For details, please refer to the section ***9.9 Setting RR Source***..

17.6 Changing the Anesthetic Agent

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

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

17.7 Measurement Limitations

The following factors may influence the accuracy of measurement:

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

17.8 Troubleshooting

17.8.1 When the Gas Inlet is Blocked

If the gas inlet (including watertrap, sampling line and airway adapter) is occluded by condensed water, the message [**AG Airway Occluded**] will appear.

To remove the occlusion:

- Check the airway adapter for an occlusion and replace if necessary.
- Check the sampling line for an occlusion or kinking and replace if necessary.
- Check the watertrap for a build up of water. Empty the watertrap. If the problem persists, replace the watertrap.

17.8.2 When an Internal Occlusion Occurs

Condensed water may enter the module and cause contamination and/or internal occlusions. In this case, the message [**AG Airway Occluded**] will be displayed.

To remove the occlusion:

- Check for any occlusion in the gas inlet and/or outlet system.
- If the problem persists, internal occlusions may exist. Contact your service personnel.

17.9 Removing Exhaust Gases from the System

⚠WARNING

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

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

18 Monitoring BIS

18.1 Introduction

Bispectral index (BIS) monitoring is for use on adult and pediatric patients within a hospital or medial facility providing patient care to monitor the state of the brain by data acquisition of EEG signals.

The BIS, a processed EEG variable, may be used as an aid in monitoring the effects of certain anesthetic agents. Use of BIS monitoring to help guide anesthetic administration may be associated with the reduction of the incidence of awareness with recall during general anesthesia or sedation.

BISx is for brain's single side BIS monitoring. BISx4 is for brain's single side or both sides BIS monitoring. BISx4 can be used for brain's both sides BIS monitoring only when BIS Bilateral Sensor is connected.

The BISx or BISx4 equipment must be used under the direct supervision of a licensed healthcare practitioner or by personnel trained in its proper use.

18.2 Safety Information

For patients with neurological disorders, patients taking psychoactive medication, and children below the age of 1 year, BIS values should be interpreted cautiously.

⚠WARNING

- **The conductive parts of sensors and connectors should not come into contact with other conductive parts, including earth.**
- **To reduce the hazard of burns in the high-frequency surgical neutral electrode connection, the BIS sensor should not be located between the surgical site and the electro-surgical unit return electrode.**
- **To reduce the hazard of burns during use of brain-stimulating devices (e.g., transcranial electrical motor evoked potential), place stimulating electrodes as far as possible from the BIS sensor and make certain that sensor is placed according to package instructions.**
- **The BIS sensor must not be located between defibrillator pads when a defibrillator is used on a patient connected to the patient monitor.**
- **The BIS component using on our monitor is purchased from Aspect Medical System. It is important to recognize this index is derived using solely that company's proprietary technology. Therefore, it is recommended that clinicians have reviewed applicable information on its utility and/or risks in published articles and literature/web site information from Aspect Medical Systems, Inc. or contact that company itself at www.aspectmedical.com, if you have clinical-based BIS questions relating to this module portion of the patient monitor. Failure to do so could potentially result in the incorrect administration of anesthetic agents and/or other potential complications of anesthesia or sedation. We recommend that clinicians also review the following practice advisory (that includes a section on BIS monitoring): The American Society of**

Anesthesiologists, Practice Advisory for Intraoperative Awareness and Brain Function Monitoring (Anesthesiology 2006;104:847-64). Clinicians are also recommended to maintain current knowledge of FDA or other federal-based regulatory, practice or research information on BIS and related topics.

- **The Bispectral Index is a complex technology, intended for use only as an adjunct to clinical judgment and training.**
- **The clinical utility, risk/benefit and application of the BIS component have not undergone full evaluation in the pediatric population.**

18.3 Understanding the BIS Display

18.3.1 BIS Parameter Area

For brain's single side BIS monitoring, the BIS parameter area displays the following parameters:

■ Bispectral Index (BIS)

The BIS numeric reflects the patient's level of consciousness. It ranges from 100 for wide awake to 0 in the absence of brain activity.

BIS numeric	Description
100	The patient is widely awake.
70	The patient is underdosed but still unlikely to become aware.
60	The patient is under general anesthesia and loses consciousness.
40	The patient is overdosed and in deep hypnosis.
0	The EEG waveform is displayed as a flat line, and the patient has no electrical brain activity.

■ Electromyograph (EMG)

EMG bar graph reflects the electrical power of muscle activity and high frequency artifacts. The power range is 30-55 dB. When the EMG indicator is low, it indicates that EMG activity is low. BIS monitoring conditions are optimal when the bar is empty.

1 bar represents power in the 31-35 range.

2 bars represent power in the 36-40 range.

3 bars represent power in the 41-45 range.

4 bars represent power in the 46-50 range.

5 bars represent power greater than 51.

- ◆ EMG>55 dB: this is an unacceptable EMG.
- ◆ EMG<55 dB: this is an acceptable EMG.
- ◆ EMG≤30 dB: this is an optimal EMG.

- Suppression Ratio (SR)

  SR numeric is the percentage of time over the last 63-second period during which the EEG is considered to be in a suppressed state.

- Spectral Edge Frequency (SEF)

  The SEF is a frequency below which 95% of the total power is measured.

- Signal Quality Index (SQI)

  The SQI numeric reflects signal quality and provides information about the reliability of the BIS, SEF, TP, and SR numerics during the last minute. Signal quality is optimal when all five bars of the SQI icon are filled with color. SQI ranges from 0-100%.

  1 bar represents SQI in the 1%-20% range.

  2 bars represent SQI in the 21%-40% range.

  3 bars represent SQI in the 41%-60% range.

  4 bars represent SQI in the 61%-80% range.

  5 bars represent SQI in the 81%-100% range.

  - ◆ 0 to 15%: the numerics cannot be derived.
  - ◆ 15% to 50%: the numerics cannot be reliably derived.
  - ◆ 50% to 100%: the numerics are reliable.

- Total Power (TP)

  TP numeric which only monitors the state of the brain indicates the power in the frequency band 0.5-30Hz. The useful range is 40-100db.

- Burst Count (BC)

  A burst means a period (at least 0.5 second) of EEG activity followed and preceded by inactivity. The BC numeric helps you quantify suppression by measuring the number of EEG bursts per minute. This parameter is intended for the BIS module with the Extend Sensor or Bilateral Sensor only. BC numeric is valid only when SQI≥15% and SR≥5%.

For brain's both sides BIS monitoring, the BIS parameter area displays the following parameters (L: Left brain hemisphere; R: Right brain hemisphere):

- BIS L BIS R
- EMG L EMG R
- SR L SR R
- SEF L SEF R

- SQI L SQI R
- TP L TP R
- BC L BC R
- sBIS L sBIS R

sBIS (BIS Variability Index)

This numeric represents the standard deviation of the BIS variable over the last three minutes.

- sEMG LsEMG R

  sEMG (EMG Variability Index)

  This numeric represents the standard deviation of the EMG value over the last three minutes.

- ASYM

Asymmetry (ASYM) is a processed variable indicating the percentage of EEG power present in left or right hemispheres with respect to total (left and right) EEG power.

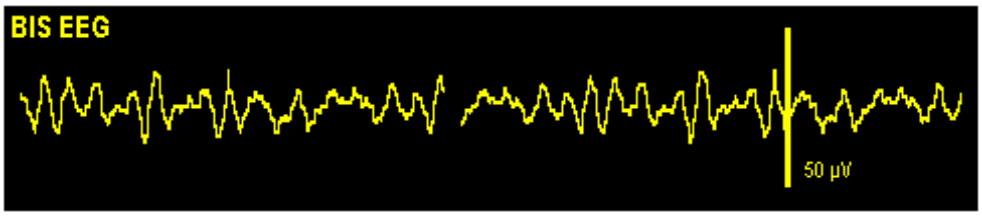
Designation 'L' of the asymmetry data indicates asymmetry to the left side.

Designation 'R' of the asymmetry data indicates asymmetry to the right side.

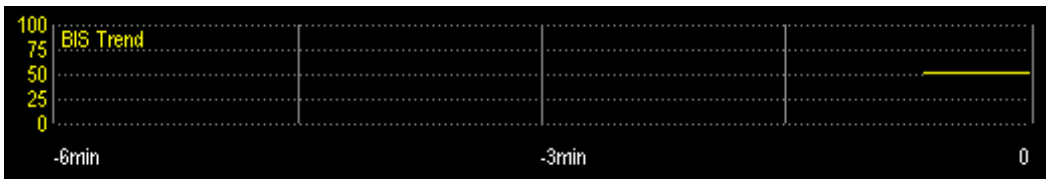
18.3.2 BIS Waveform Area

The BIS waveform area allows you to view either EEG waveform or BIS trend. A secondary parameter's trend line can also be displayed together with BIS trend line.

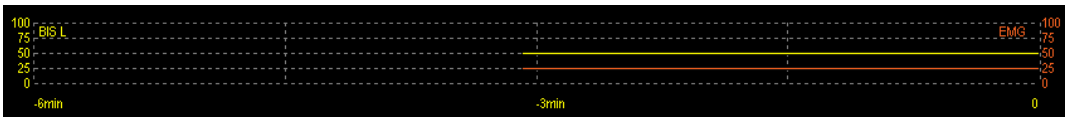
1. Enter the [**BIS Setup**] menu.
2. Select [**Display**] and then select the desired option.
   - [**EEG**]



   - [**BIS Trend**]



   - The available options for BIS trend superimpose display include: [**BIS+EMG Trend**], [**BIS+SQI Trend**], [**BIS+SR Trend**], [**BIS L+R Trend**], [**BIS+BC Trend**], [**BIS+sBIS Trend**] or [**BIS+sEMG Trend**], depending on the sensor type.

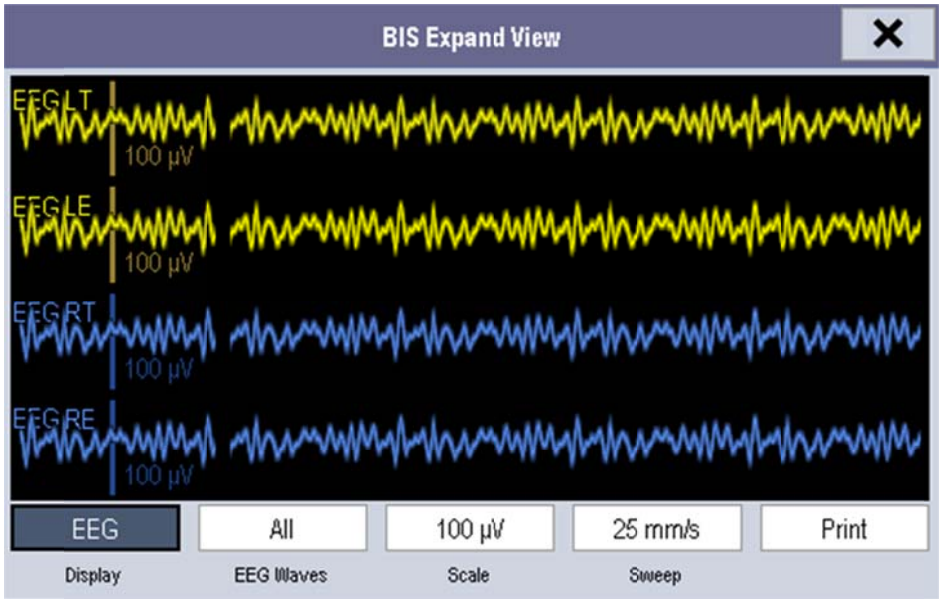


18.3.3 BIS Expand View

When BIS Bilateral Sensor is used for bilateral monitoring, BIS expand view can be displayed.

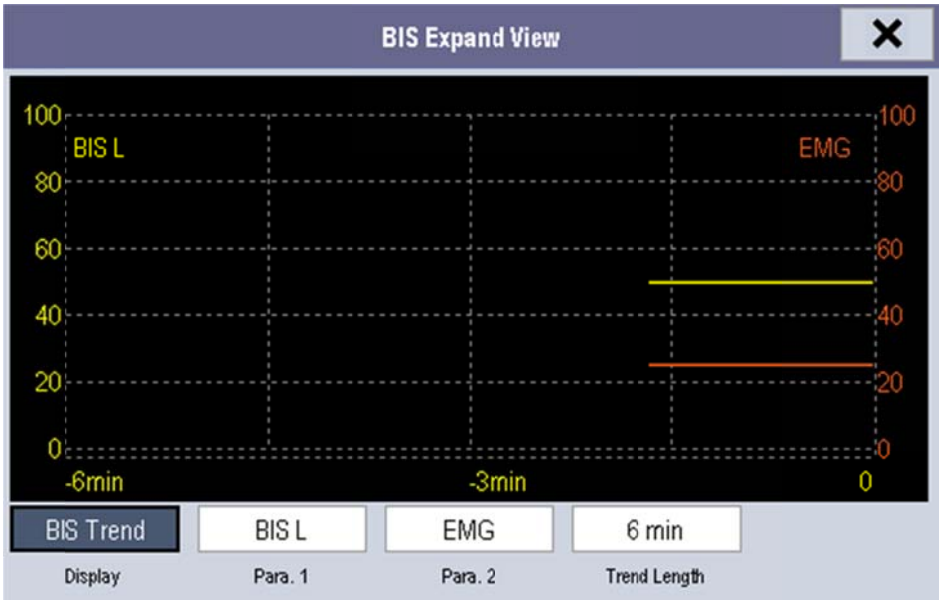
1. Enter the [**BIS Setup**] menu.
2. Select [**BIS Expand View >>**].
3. Select [**Display**] and then toggle between [**EEG**], [**BIS Trend**] and [**DSA**].

18.3.3.1 Displaying EEG Waveforms



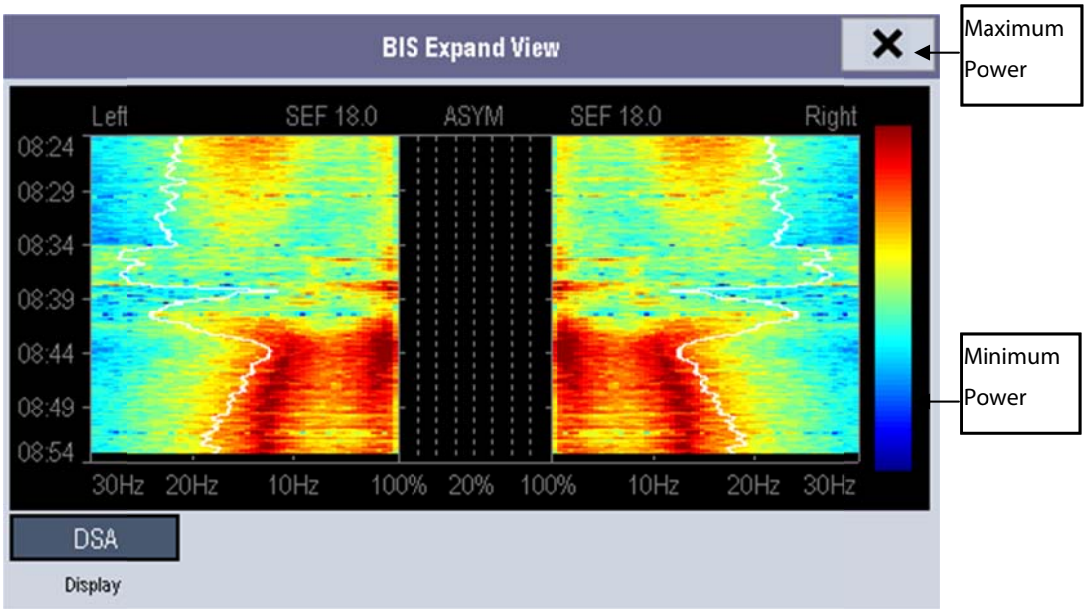
You can select the EEG waveforms to be displayed. You can also select the desired scale and sweep speed.

18.3.3.2 Displaying BIS Trend



You can the desired trend lines to be displayed and set the time scale. The artifact mark is displayed at the bottom to indicate SQI value. When SQI<15%, the artifact mark is yellow and the corresponding trend lines of BIS, SR, BC and sBIS are not displayed. When 15%≤SQI<50%, the artifact mark is brown.

18.3.3.3 Displaying DSA



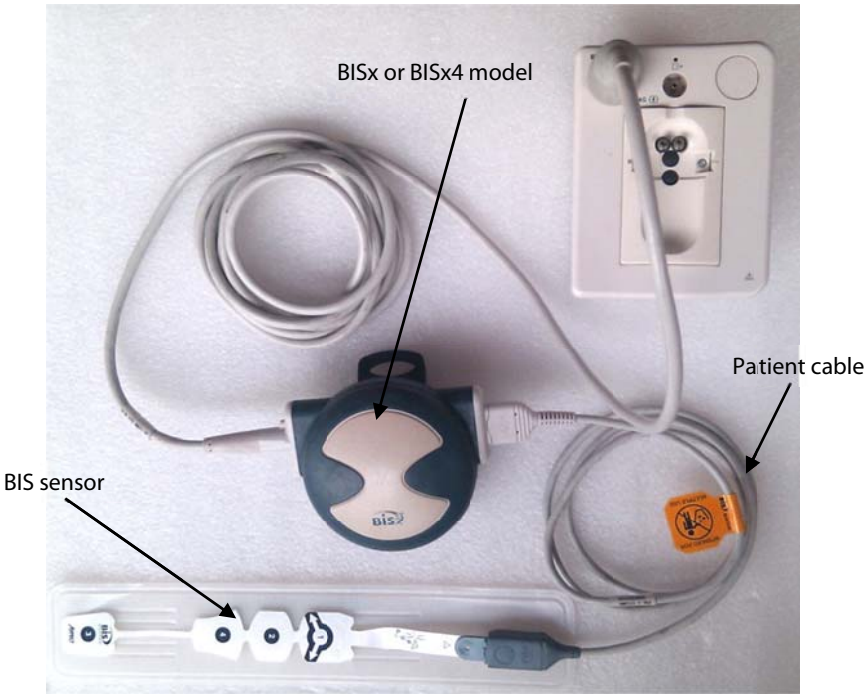
The Density Spectral Array (DSA) shows changes in the power spectrum distribution over a certain time period. The DSA represents the power spectra ranging from 49-94 dB. The color bar to the right of the time scale shows the range of colors used to indicate minimum and maximum power. The frequency scale is shown on the horizontal axis with a range from 0-30 Hz.

A white Spectral Edge line is superimposed on the graph where 95% of the total power lies on one side of the line (toward the inside of the graph) and 5% lies on the other. The Spectral Edge Frequency value (SEF) displays above the graph.

The ASYM graph in the center of the screen shows the degree of asymmetry in EEG power between the left and right hemispheres. The ASYM scale begins at 20% at the center line and runs left or right to 100%. Asymmetry data less than 20% are not displayed on the graph, but are available in the tabular trends.

18.4 Setting up the BIS Measurement

1. Connect the BISx or BISx4 model to the BIS module.
2. Use the attachment clip to secure the BISx near, but not above the level of the patient's head.
3. Connect the BISx or BISx4 model to the patient cable.
4. Attach the BIS sensor to the patient following the instructions supplied with sensor.



NOTE

- **Make sure the patient's skin is dry. A wet sensor or a salt bridge could result in erroneous BIS and impedance values.**

5. Connect the BIS sensor to the patient interface cable.

⚠CAUTION

- **Do not use if sensor is dry. To avoid dry out, do not open pack until ready for use. Due to intimate skin contact, reuse may pose risk of infection. If skin rash or other unusual symptom develops, stop use and remove. Limited to short-term use (maximum of 24 hours). Do not cut sensor components, as this can result in improper operation.**

18.5 Auto Impedance Check

By default, this check is switched on. It checks:

- The combined impedance of the signal electrodes plus the reference electrode. This is done automatically and continuously and does not affect the EEG wave. As long as the impedances are within the valid range, there is no prompt message of this check or its results.
- The impedance of the ground electrode. This is done every ten minutes and takes approximately four seconds. It causes an artifact in the EEG wave, and the message [**BIS Ground Checking**] is displayed on the monitor during the check. If the ground electrode does not pass this check, another check is initiated. This continues until the ground electrode passes the check.

If the auto impedance check interferes with other measurements, it can be switched off. To do this:

1. Select [**Sensor Check**] in the [**BIS Setup**] menu to open the sensor check window.
2. Set [**Automatic Check**] to [**Off**].

CAUTION

- **Switching the auto impedance check off will disable automatic prompt to the user of impedance value changes, which may lead to incorrect BIS values. Therefore, this should only be done if the check interferes with or disturbs other measurements.**

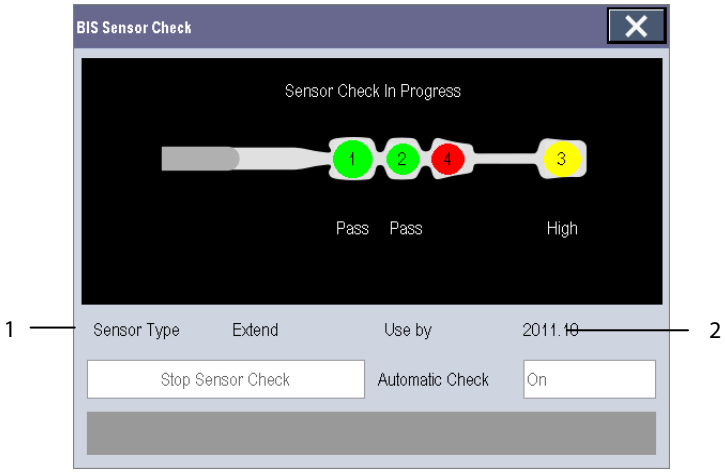
18.6 Sensor Check

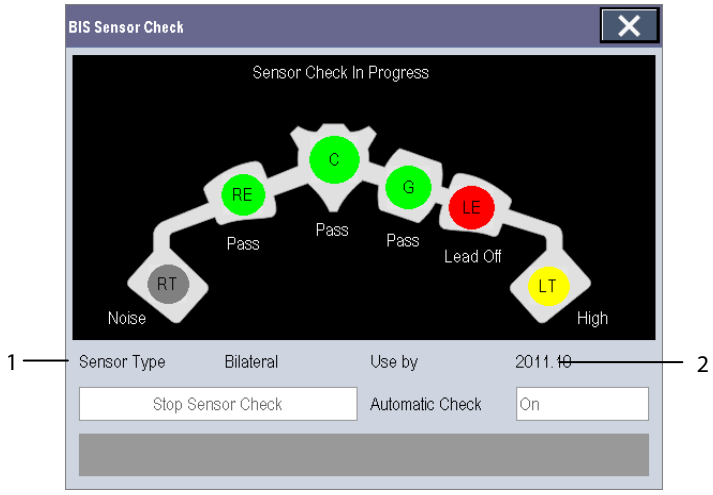
This measures the exact impedance of each individual electrode. It causes a disturbed EEG wave, and a prompt message is displayed on the monitor

- The sensor check is automatically initiated when a sensor is connected. To manually start a sensor check, you can either:
  - Press the hardkey on the BIS module.
  - Select [**Sensor Check**] in the [**BIS Setup**] menu.
  - Select [**Start Sensor Check**] in the BIS sensor window.
- The sensor check stops automatically if the impedances of all electrodes are within the valid range. To manually stop a sensor check, you can either:
  - Press the hardkey on the BIS module.
  - Select [**Stop Sensor Check**] in the sensor check window.

18.7 BIS Sensor Check Window

To open the sensor check window, select [**Sensor Check**] in the [**BIS Setup**] menu. The graphic in the BIS sensor check window automatically adapts to show the type of sensor you are using, show each electrode as required. Each symbol in the graphic represents an electrode and illustrates the most recently-measured impedance status of the electrodes.





1. Sensor Type 2. Expiration Time or Usable Times

Different colors indicate different statuses. The electrode status is displayed below each electrode:

Color	Status	Description	Action
Red	[**Lead Off**]	Electrode falls off and has no skin contact	Reconnect electrode, or check the sensor-to-skin contact. If necessary, clean and dry skin.
Grey	[**Noise**]	The EEG signal is too noisy. Impedance cannot be measured	Check the sensor-to-skin contact. If necessary, clean and dry skin.
Yellow	[**High**]	The impedance is above the limit	
Green	[**Pass**]	The impedance is within valid range	No action necessary.

Although BIS may still be measured when the electrode status is [**Noise**] or [**High**], for best performance, all electrodes should be in [**Pass**] status.

18.8 Choosing the BIS Smoothing Rate

To change the smoothing rate:

1. Select the BIS parameter window to enter the [**BIS Setup**] menu.
2. Select [**Smoothing Rate**] and then toggle between [**10 s**], [**15 s**] and [**30 s**]

The smoothing rate defines how the monitor averages the BIS value. With the smoothing rate becoming smaller, the monitor provides increased response to changes in the patient's state. Contrarily, the monitor provides a smoother BIS trend with decreased variability and sensitivity to artifacts.

NOTE

- **When [**Smoothing Rate**] is set as [10 s] or [30 s], sBIS and sEMG are displayed as invalid values.**

18.9 Changing the Secondary Parameters

You can choose the desired secondary parameters for display on the screen.

1. Enter the [**BIS Setup**] menu.
2. Select [**Change Secondary Parameter**>>] and then select at most 2 desired parameters from the popup menu.

18.10 Changing the EEG Wave Size

1. Enter the [**BIS Setup**] menu.
2. Select [**EEG**] from [**Display**].
3. Select [**Scale**] and then select the appropriate setting.

18.11 Changing the Speed of the EEG Wave

1. Enter the [**BIS Setup**] menu.
2. Select [**EEG**] from [**Display**].
3. Select [**Sweep**] and then select the appropriate setting. The faster the wave sweeps, the wider the wave is.

18.12 Setting the Trend Length

1. Enter the [**BIS Setup**] menu.
2. Select a BIS trend option from [**Display**].
3. Select [**Trend Length**] and then select the appropriate BIS time length setting.

18.13 Switching the Filter On or Off

1. Enter the [**BIS Setup**] menu.
2. Select [**Filter**] and then toggle between [**On**] and [**Off**]. The default is [**On**].

The filter screens out undesirable interference from the raw EEG wave display. The notch filter includes filters for both 50 and 60 Hz. Filter settings do not affect processing of the trend variables (i.e., BIS, EMG, and SR).

19 Clinical Score

19.1 Overview

The Clinical Score facilitates a clinician to quickly determine the severity of illness of a patient based on a calculated score, so that the clinician can take necessary measure according to the indication provided by the Clinical Score.

The monitor supports the following scores:

- MEWS (Modified Early Warning Score)
- NEWS (National Early Warning Score)
- Customizable Score

⚠WARNING

- **The Clinical Score is intended to be used only by healthcare professionals and to be serviced by trained personnel.**
- **The scores and clinical responses in the clinical scores are for reference only and cannot be directly used for diagnostic interpretation.**
- **Both MEWS and NEWS are not applicable to pregnant woman, COPD (Chronic Obstructive Pulmonary Disease) patients and those under 16 years old.**

19.1.1 MEWS (Modified Early Warning Score)

The MEWS calculates a total score and provides a clinical response based on the following five parameters:

- Pulse Rate
- Systolic NIBP
- Respiration Rate
- Temperature
- AVPU (Alert, Reacting to Voice, Reacting to Pain, and Unresponsive)

This score is only applicable to adult.

19.1.2 NEWS (National Early Warning Score)

The NEWS calculates a total score and provides a clinical response based on the following seven parameters:

- Respiration Rate
- SpO_2
- Supplemental Oxygen

- Temperature
- Systolic NIBP
- Pulse Rate
- AVPU

This score is only applicable to adult.

19.1.3 Customizable Score

The customizable score can react based on the selected multiple parameters or single parameter.

- Multiple parameter score: calculate a total score and provide a clinical response based on the multiple parameters which are defined.
- Individual parameter score (IPS): indicate the clinical response whenever any individual parameter value is out of range.

The available parameters in customizable score include:

- Respiration Rate
- SpO_2
- Supplemental Oxygen
- Temperature
- Systolic NIBP
- Pulse Rate
- Level of Consiousness (support AVPU and GCS)
- Blood Sugar
- Urine Output
- Catheter
- Pain Score
- Pain
- Inspired O_2%
- Airway
- Three customizable parameters

You can define the applicable patient category with Mindray Clinical Score Config Tool. Refer to ***Clinical Score Config Instruction for Use*** (P/N: 046-007126-00) for customizable scores.

19.2 Entering Score

To enter the score, follow this procedure:

1. Configure to display the clinical score tile in the parameter area (area C). Refer to ***3.7 Setting the Screen*** to display the tile.
2. Select the tile to display the score screen.

19.3 Calculating a Score

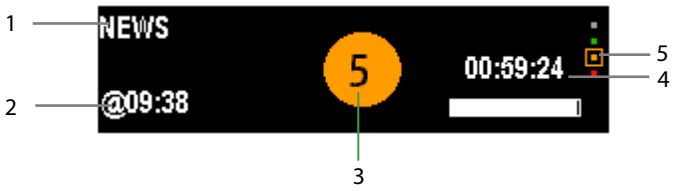
To calculate a score, follow this procedure:

1. Select the default score or load a score for the applicable patient category. Refer to ***19.7.2 Selecting Default Score*** or ***19.7.4 Loading a Score.***
2. Select an operator ID. Refer to ***19.8.1 Selecting an Operator ID***.
3. Obtain the value of all parameters, and then calculate the score. Refer to ***19.5 Obtaining the Total Score***.
4. If necessary, record the score data. Refer to ***19.4 Clinical Score*** Screen.

19.4 Clinical Score Screen

19.4.1 Score Tile in the Main Screen

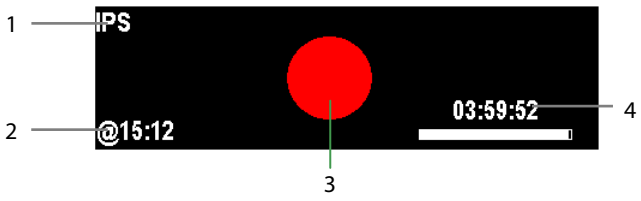
The MEWS, NEWS and multi-parameter score tile display as following:



1. Name for clinical score
2. Last measurement time
3. Total score: the background color indicates the current score level.
4. Countdown to the next calculation
5. Score level indicator

   It indicates that the warning level increases from top to bottom. The current level is enclosed in the square frame.

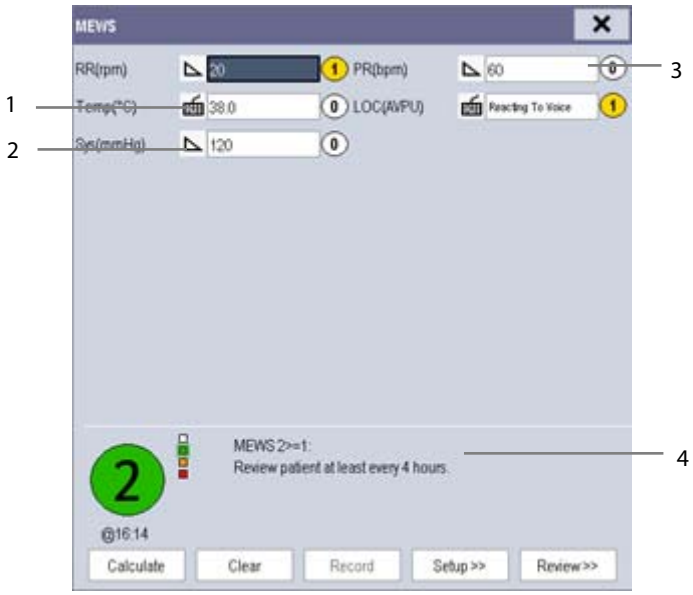
The IPS score tile displays as following:



1. Clinical score name
2. Last measurement time
3. Score Status
   - Red: indicates that at least one parameter is out of the defined range.
   - White: indicates that all the parameters are whitin the normal range.
4. Countdown to the next calculation

19.4.2 Score Screen

The MEWS, NEWS or multi-parameter score screen display as following:

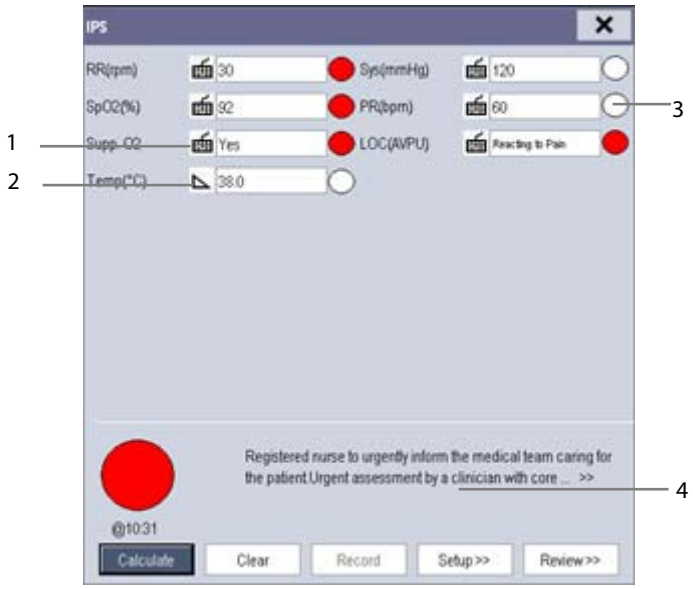


1. Manual input icon

   You need to manually input the parameter.
2. Monitoring icon

   The parameter value is from the monitor.
3. Score for single parameter
4. Recommended clinical response

IPS score screen displays as following:



1. Manual input icon

   You need to manually input the parameter.

2. Monitoring icon

   The parameter value is from monitor.

3. Score status for single parameter

   - Red: indicates that the parameter is out of the defined range.
   - White: indicates that the parameter is within the normal range.

4. Recommended clinical response

In the above screens, you can:

- Select [**Clear**] to clear the parameter area, total score and clinical response.
- Select [**Review>>**] to open the score review screen. Refer to ***19.9 Reviewing*** for details.
- Select [**Record**] to print the current patient score data with a recorder.

19.5 Obtaining the Total Score

The IPS only calculates the parameter status. The IPS does not have total score.

For other scores, when each parameter tile has a value, the total score can be calculated. To calculate a score, follow this procedure:

1. Select [**Clear**]. The parameters in monitoring will obtain the value automatically.
2. Manually input the value for the parameter not in monitoring.
3. Select [**Calculate**].

The parameter input range is shown in following:

Parameter	Range
Pulse Rate	20 bpm -350 bpm
Systolic NIBP	-50 mmHg -360 mmHg
Respiration Rate	0-200 rpm
Temperature	0.1°C – 50.0°C (32.1°F – 122.0°F)
Level of Consciousness	AVPU: Alert, Reacting to Voice, Reacting to Pain, Unresponsive GCS: 1-15
Supplemental Oxygen	Yes, No
SpO_2	0% – 100%
Urine Output	0 -300 mml/h (0 – 10 ml/h/kg)
Catheter	Yes, No
Blood Sugar	1.0 mg/dl -720.0 mg/dl (0.06 mmol/L -40.00 mmol/L)
Pain Score	0-10
Pain	None, Mild, Moderate, Severe
Inspired O_2%	21% -100%
Airway	Clear, Obstruction
Customizable parameter	The input range depends on the decimal point. The decimal point is customizable in Mindray Clinical Score Config Tool. 0 – 9999 (decimal point as 1) 0.0 – 999.9 (decimal point as 0.1) 0.00 – 99.99 (decimal point as 0.01)

19.6 Setting the Interval of Calculating a Score

You can set up the interval between two calculations. To set up the interval, follow this procedure:

1. Enter the score.
2. Select [**Setup>>**].
3. Select [**Interval**] and set the interval.

19.7 Managing Scores

19.7.1 Importing the Score

You can import MEWS, NEWS and customized scores into the monitor. Up to five scores can be imported into the monitor.

1. Connect the USB drive to the USB connector on the monitor.
2. Select [**Main Menu**]→[**Maintenance>>**] →[**User Maintenance>>**]→Enter the required password→[**EWS Setup>>**]→[**Import Score>>**].
3. In the [**Import Score**] menu, select the scores to be imported. Then select [**Import**].

19.7.2 Selecting Default Score

The monitor does not provide default score. To select a default score:

1. Select [**Main Menu**]→[**Maintenance>>**] →[**User Maintenance>>**] →Enter the required password→[**EWS Setup>>**]→[**Select Default Score>>**].
2. Set the default score for the patient category.

After the default score is set, when a patient category is changed, the monitor will automatically use the default score.

19.7.3 Deleting the Score

To delete the score, follow this procedure:

1. Select [**Main Menu**]→[**Maintenance>>**] →[**User Maintenance>>**] →Enter the required password→[**EWS Setup>>**]→[**Delete Score**].
2. In the [**Delete Score**] menu, select the score to be deleted.
3. Select [**Delete**].

19.7.4 Loading a Score

The default score may not be appropriate for the new patient. You can load a score so as to ensure that the score is appropriate for your patient.

To load a score, follow this procedure:

1. Enter the score.
2. Select [**Setup>>**]→[**Load Score>>**].
3. Select the desired score to be loaded.
4. Select [**Load**].

19.8 Setting Operator ID

NOTE

- **The operator ID settings are available only when it is enabled in the [User Maintenance>>]→ [EWS Setup>>]→ [Operator ID].**

19.8.1 Selecting an Operator ID

To select an operator ID, follow this procedure:

1. Enter the score.
2. Select [**Setup>>**], and then the [**Score Setup**] menu pops up.
3. Select an operator ID in the [**Operator ID**] field.

19.8.2 Adding an Operator ID

You can add the operator ID through manually input operation or a bar scanner. The score system can store a maximum of 20 operator IDs.

To add an operator ID by manual input:

1. Enter the score.
2. Select [**Setup>>**]→ [**Manage Operator ID>>**].
4. Select [**Add ID**].
3. Input a new ID, and then select [**Ok**].

19.8.3 Deleting Operator ID

If the operator ID number reaches the maximum, you need to delete the existing IDs to save a new one.

To delete the operator ID:

1. Enter the score.
2. Select [**Setup>>**]→[**Manage Operator ID>>**].
3. Select the check box before the operator ID to be deleted.
4. Select [**Delete**]. A prompt message will pop up for your confirmation.
5. Select [**Yes**].

19.8.4 Setting Operator ID Timeout

The operator ID can be valid for a period of time. To set the retention time:

1. Select [**Main Menu**] →[**Maintenance>>**] →[**User Maintenance>>**] →Enter the required password→[**EWS Setup>>**]→[**Operator ID Timeout**].
2. Set the time to [**10 min**], [**15 min**], [**30 min**], [**1 h**], [**2 h**] or [**Off**].

19.9 Reviewing

Enter the score, and then select [**Review**] to access the Review screen.

In the [Review] screen, you can:

- Select [**Score**] to select the score you want to review.
- Select or to turn the page.
- Select or beside [Scroll] to browse the parameter data.
- Select [Print] to print the historic score data of the selected patient with the recorder.

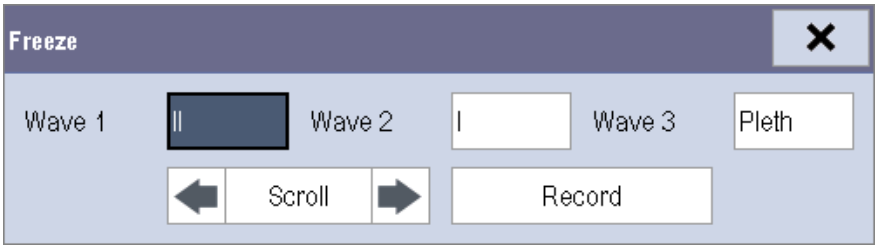
FOR YOUR NOTES

20 Freezing Waveforms

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

20.1 Freezing Waveforms

1. To freeze waveforms, select the hardkey on the monitor's front.
2. The system closes the displayed menu (if any), and opens the [**Freeze**] menu.



3. All displayed waveforms are frozen, i.e. the waveforms stop being refreshed or scrolling.

The freeze feature exerts no effect on the split-screen view of minitrends, OxyCRG and other patients.

20.2 Viewing Frozen Waveforms

To view the frozen waveforms, you can either:

- Select the [**Scroll**] button and then rotate the Knob clockwise or counter-clockwise, or
- Directly select the or beside the [**Scroll**] button using the touchscreen.

The frozen waveforms will scroll left or right accordingly. And meanwhile, at the lower right corner of the bottommost waveform, there is an upward arrow. The freeze time is displayed below the arrow and the initial frozen time is [0 s]. With the waveforms scrolling, the freeze time changes at intervals of 1 second. This change will be applied for all waveforms on the screen.

20.3 Unfreezing Waveforms

To unfreeze the frozen waveforms, you can either:

- Select the button at the upper right corner of the [**Freeze**] menu,
- Select the hardkey on the monitor's front, or
- Perform any other action that causes the screen to be readjusted or opens a menu, such as plugging in or out a module, pressing the hardkey, etc.

20.4 Recording Frozen Waveforms

1. In the [**Freeze**] menu, select, in turn, [**Wave 1**], [**Wave 2**] and [**Wave 3**] and then select your desired waveforms.
2. Select the [**Record**] button. The selected waveforms and all numerics at the frozen time are printed out by the recorder.

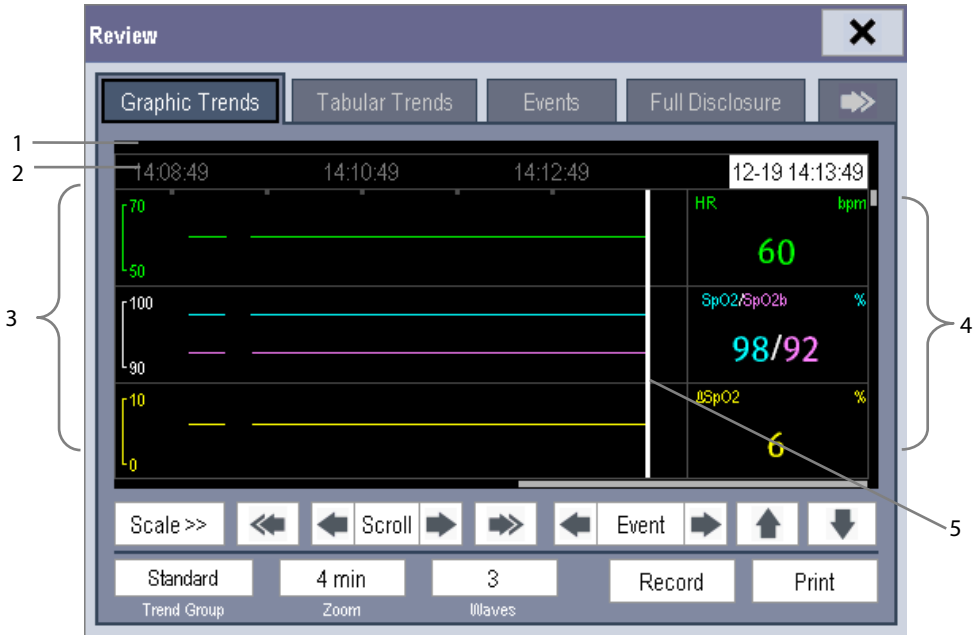
21 Review

21.1 Accessing Respective Review Windows

1. Select the [**Review**] QuickKey, or [**Main Menu**]→[**Review >>**].
2. Select [**Graphic Trends**], [**Tabular Trends**], [**Events**], [**Full Disclosure**] or [**12-lead ECG**] to access their respective review windows.

21.2 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 popup menu. If [**Custom 1**] or [**Custom 2**] is selected, you can further select [**Define Trend Group**]. Then you can select the parameters for viewing in the popup menu.
- You can set the time length of the review window by selecting [**Zoom**].
- You can set the number of waves displayed in one page by selecting [**Waves**].

- Select [**Scale >>**] to enter the [**Scale**] menu.
  - Set the [**Upper Scale**] or [**Lower Scale**] of Resp, ECG, SpO_2, Temp, IBP, or NIBP when [**Auto Scale**] is [**Off**].
  - Restore the scales of all parameters to auto adjustment by selecting the [**All Auto**] button at the lower right corner of the [**Scale**] menu.
- To browse the graphic trends, you can either:
  - Select or beside [**Scroll**] to move the cursor one step to the left or right to navigate through the graphic trends, or
  - Select or to move the cursor one page to the left or right to navigate through the graphic trends.

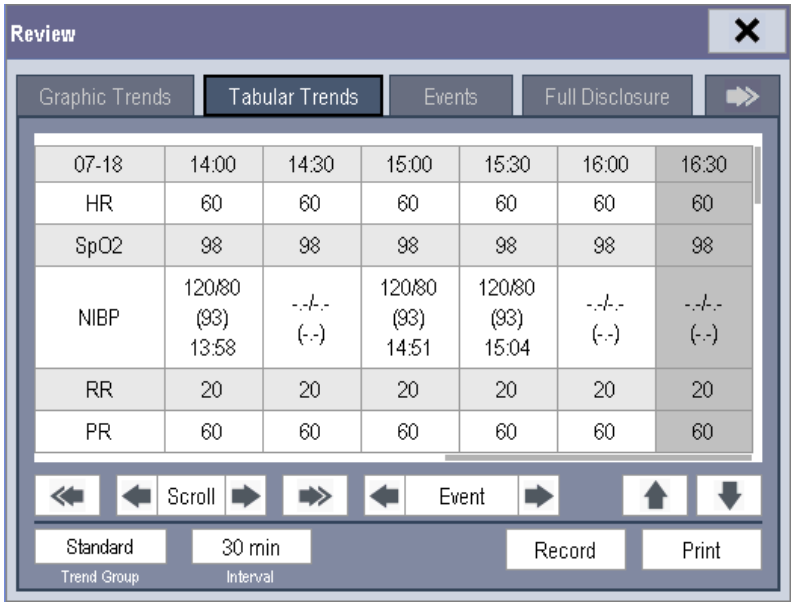
  A time indicating your current position is displayed above the parameter area. Numeric measurement values corresponding to the cursor location change as the cursor is moved. The measurement value that triggered high level alarm has red background. The one that triggered medium/low level alarm has yellow background.
- By selecting or beside [**Event**], you can position the cursor to different event time.
- By selecting the [**Record**] button, you can print out the currently displayed graphic trends by the recorder.
- By selecting the [**Print**] button, you can set and print out the graphic trends report by the printer. For how to set the graphic trends report, please refer to the chapter ***24 Printing***.

NOTE

- **The scales of the graphic trends restore to auto adjustment when you discharge a patient, change a unit or restart the monitor.**
- **Only the scales of Resp, ECG, SpO_2, Temp, IBP and NIBP support manual adjustment.**

21.3 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.

- You can change the resolution of the trend data by selecting [**Interval**] and then selecting the appropriate setting:
  - [**5 s**] or [**30 s**]: select to view up to 4 hours of tabular trends at 5- or 30-second resolution.
  - [**1 min**], [**5 min**], [**10 min**], [**15 min**], [**30 min**], [**1 h**], [**2 h**] or [**3 h**]: select to view up to 120 hours of tabular trends at your selected resolution.
  - [**NIBP**]: select to view the tabular trends when NIBP measurements were acquired.
- To browse the tabular trends, you can either:
  - Select  or  beside [**Scroll**] to drag the scrollbar left or right to navigate through the trend database, or
  - Select  or  to scroll left or right to navigate through the trend database.

The measurement value that triggered high level alarm has red background. The one that triggered medium/low level alarm has yellow background.

- By selecting  or  beside [**Event**], you can position the cursor to different event time.
- By selecting the [**Record**] button, you can access the [**Record Setup**] menu and set the start and end time of the tabular trends you want to record. This feature is not available when reviewing a history patient. By further selecting [**Record**], you can print out the currently displayed tabular trends by the recorder.
- By selecting the [**Print**] button, you can set and print out the tabular trends report by the printer. For how to set the tabular trends report, please refer to the chapter ***24 Printing***.

21.4 Events

21.4.1 Marking Events

During patient monitoring, some events may exert effects on the patient and as a result change the waveforms or numerics displayed on the monitor. To help analysing the waveforms or numerics at that time, you can mark these events.

Select [**Main Menu**]→[**Mark Event >>**]. In the popup menu, you can select the waves to be stored when a manual event is triggered. You can select [**Trigger Manual Event**] from the [**Mark Event**] menu or the [**Manual Event**] QuickKey to trigger a manual event and store it at the same time.

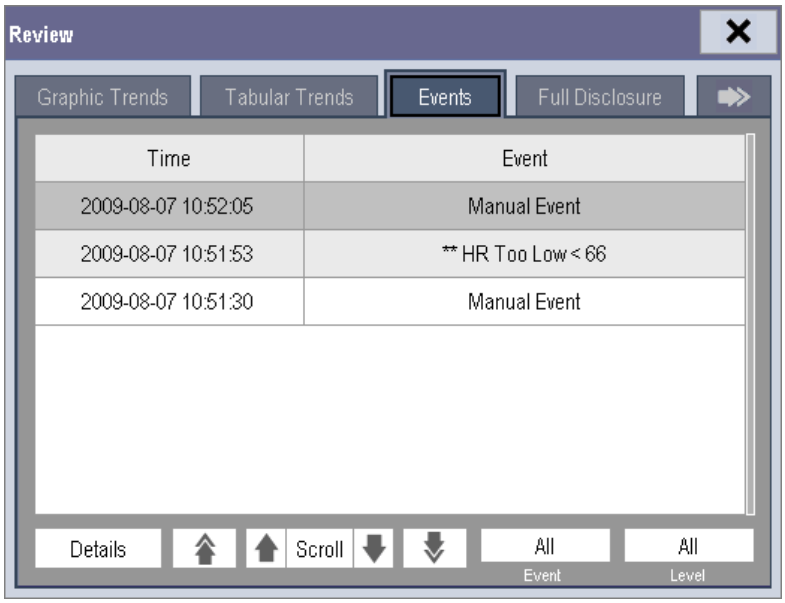
When you are reviewing graphic trends, tabular trends or full-disclosure waveforms, the manual event symbol is displayed at the time the event is triggered.

21.4.2 Reviewing Events

The monitor saves the events in real time. You can review these events.

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

The events that can be reviewed include parameter alarm events, arrhythmia alarm events and manual events. When an event occurs, all the measurement numerics at the event trigger time and related waveforms 4 seconds, 8 seconds, or 16 seconds, as per the setting of recording length, respectively before and after the event trigger time are stored.



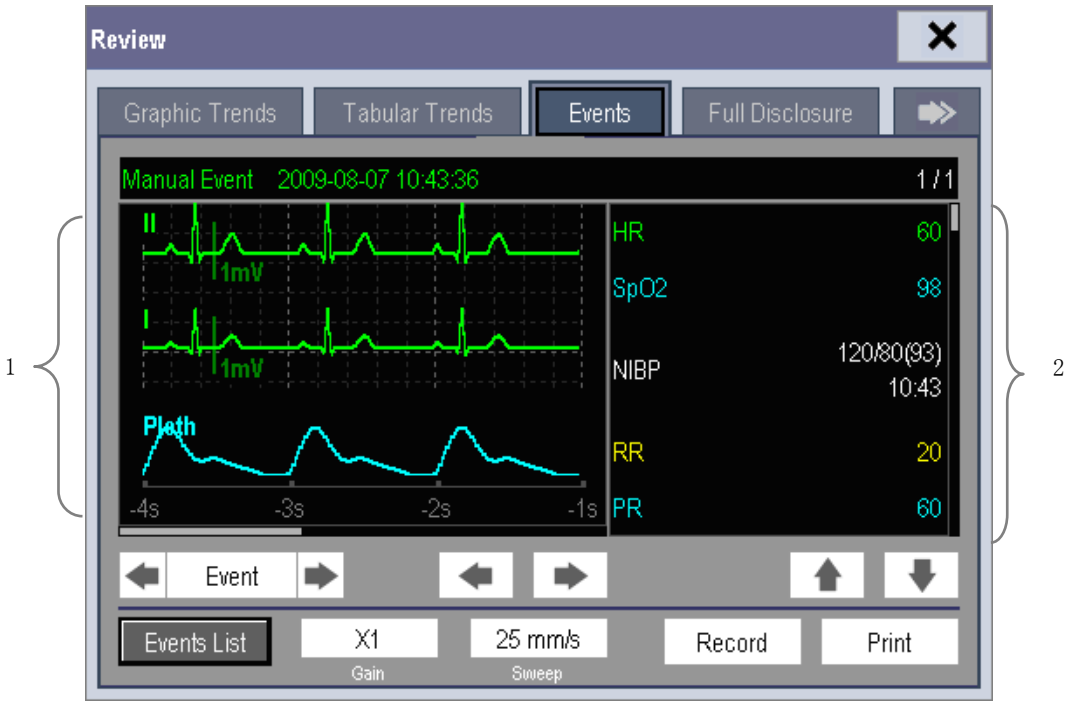
In this window:

- You can view the desired events by selecting [**Event**].
- You can view the desired events according to the level by selecting [**Level**].

After selecting the desired event, you can select [**Details**] to access the following window. In this window, the waveform area displays the waveforms related to the event, and the parameter area displays the parameter values happened at the event trigger time.

NOTE

- **Pausing or switching off alarms will not be recorded as events. The time of these operations will not be recorded in the system log.**
- **A total loss of power has no impact on the saved events.**
- **Earlier-recorded events might be overwritten by later ones if it reaches capacity.**



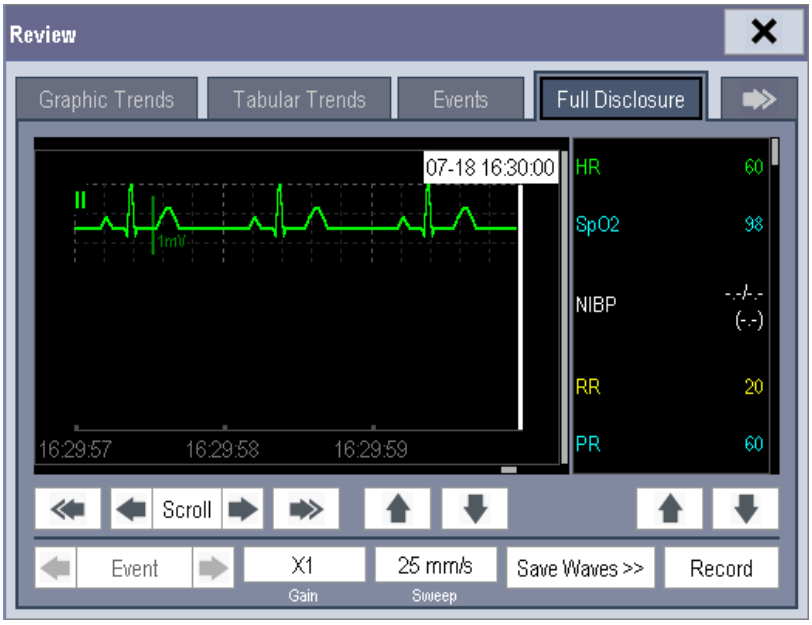
1. Waveform area
2. Parameter area

In this window:

- You can select ◀ or ▶ to navigate through the waveforms.
- You can select ◀ or ▶ beside the [**Event**] button to switch between events.
- You can set the desired [**Gain**] for ECG waveform.
- You can set the desired [**Sweep**].
- By selecting the [**Record**] button, you can print out the currently displayed alarm events by the recorder.
- By selecting the [**Print**] button, you can print out the currently displayed alarm events by the printer.
- By selecting the [**Events List**] button, you can view the events list.

21.5 Reviewing Waveforms

In the [**Review**] menu, select [**Full Disclosure**] to access the following window.



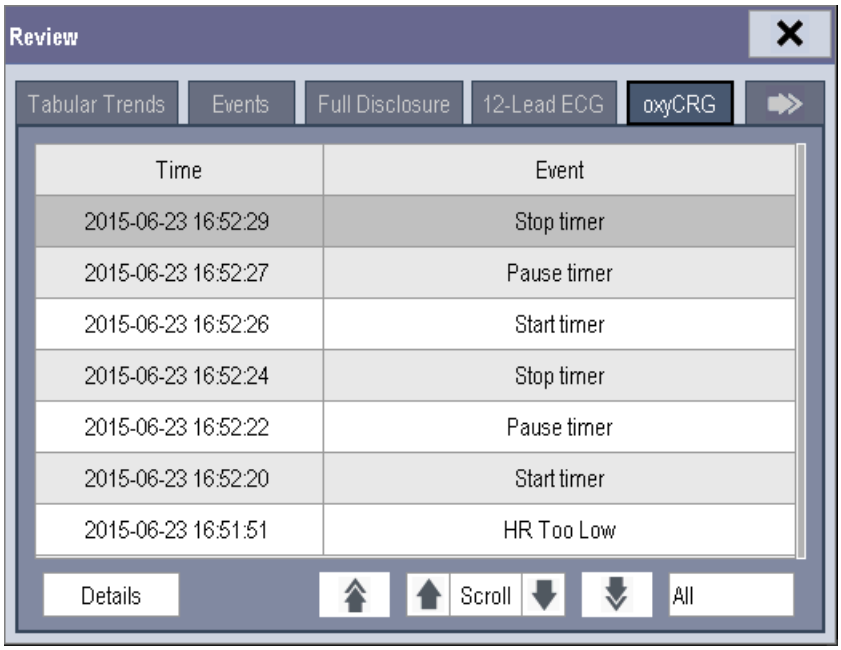
In this review window:

- To review full-disclosure waveforms, you need to save waveforms first. Select [**Save Waves >>**] and then select the parameters whose waveforms you want to view. To save full-disclosure waveform, your monitor must be equipped with a storage card.
- To view the waveforms, you can either:
  - Select or beside the [**Scroll**] button to move the cursor one step left or right to navigate through the waveforms, or
  - Select or to move the cursor one page left or right to navigate through the waveforms.

  A time indicating your current position is displayed at the top of the waveform area. Numeric measurement values corresponding to the cursor location are displayed in the parameter area, and change as the cursor is moved.
- You can change the ECG wave gain by selecting [**Gain**] and then selecting the appropriate setting.
- You can change the waveform sweep speed by selecting [**Sweep**] and then selecting the appropriate setting.
- By selecting the [**Record**] button, you can print out the first three waveforms and measurement numerics by the recorder.
- By selecting or beside the [**Event**] button, you can position the cursor between events.

21.6 Reviewing OxyCRG

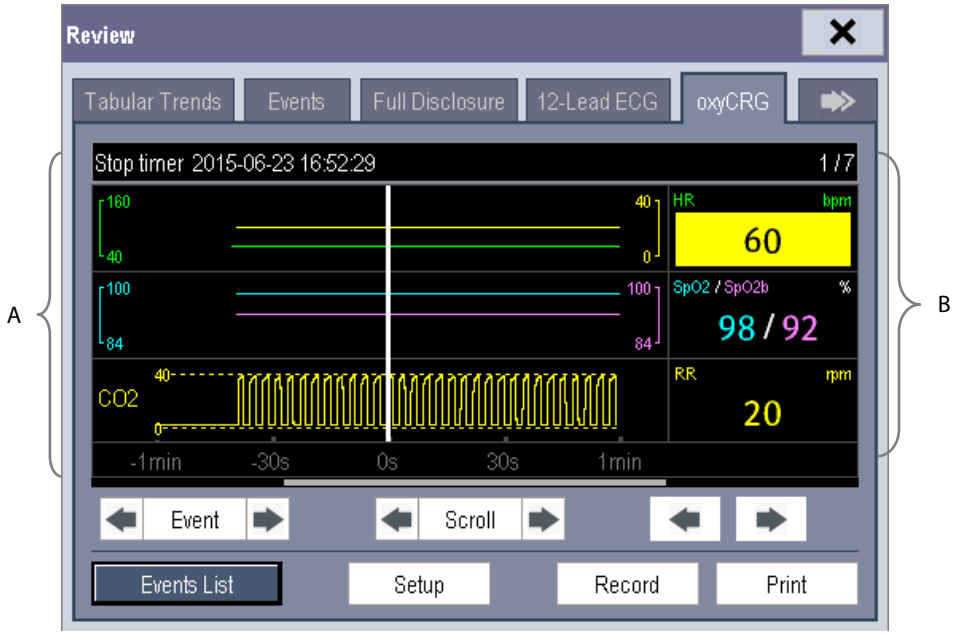
In the [**Review**] menu, select [**OxyCRG**] tab to access the following window.



In this window:

- Select [**Details**] to view the trends, waveform and measurement numerics of selected parameters.
- Select or beside the [**Scroll**] button to switch between events.
- Select or to switch between pages.
- Select the button at the lower right corner of this window to change the parameter events to be displayed.

After selecting the [**Details**] button, you can access the following window. In this window, the waveform area displays the trends and waveform of the OxyCRG, and the parameter area displays the parameter values happened at the event trigger time.



A. Waveform area B. Parameter area

In this window:

- Select [**Events List**] to switch to the OxyCRG events list.
- Select [**Setup**] to change the displayed parameters.
- Select ◄ or ► beside the [**Event**] button, you can position the cursor between events.
- Select ◄ or ► beside the [**Scroll**] button to move the cursor one step left or right to navigate through the trends and waveform.
- Select ◄ or ► to navigate through the parameter trends and waveform.
- Select the [**Record**] button to print out the currently displayed trends, waveform, and measurement numerics by the recorder.
- Select the [**Print**] button to print to the independent printer.

NOTE

- **Pausing or switching off alarms will not be recorded as events. The time of these operations will not be recorded in the system log.**
- **Earlier-recorded OxyCRG events might be overwritten by later ones if it reaches capacity.**
- **A total loss of power has no impact on the saved events.**

22 Calculations

22.1 Introduction

The calculation feature is available with your patient monitor. The calculated values, which are not directly measured, are computed based on the values you provide.

Your can perform the following calculations:

- Dose calculations
- Oxygenation calculations
- Ventilation calculations
- Hemodynamic calculations
- Renal calculations

To perform a calculation, select [**Main Menu**] → [**Calc >>**], or the [**Calculations**] QuickKey and then select the calculation you want to perform.

⚠ WARNING

- **After the calculation is finished, verify the entered values are correct and the calculated values are appropriate. We assume no responsibility for any consequences caused by wrong entries and improper operations.**

NOTE

- **The calculation feature is independent of other monitoring functions and can be therefore used for patients being monitored by other monitors. Any operation in a calculation window does not affect the patient monitoring by the local patient monitor.**

22.2 Dose Calculations

22.2.1 Performing Calculations

To perform a dose calculation:

1. Select [**Main Menu**]→[**Calculations >>**]→[**Dose >>**], or select [**Calculations**] QuickKey→[**Dose >>**].
2. Select, in turn, [**Patient Cat.**] and [**Drug Name**] and then select the appropriate settings. The dose calculation program has a library of commonly used drugs, of which Drug A through Drug E are for those not specified in this library.
   - ◆ Drug A, B, C, D, E
   - ◆ Aminophylline
   - ◆ Dobutamine
   - ◆ Dopamine
   - ◆ Epinephrine
   - ◆ Heparin
   - ◆ Isuprel
   - ◆ Lidocaine
   - ◆ Nipride
   - ◆ NItroglycerin
   - ◆ Pitocin
3. The system gives a set of default values when the above steps are finished. However, these values cannot be used as the calculated values. The user must enter values following the doctor's instructions, and then the calculated values can only be used
4. Enter the patient's weight.
5. Enter other values.
6. Verify if the calculated values are correct.

22.2.2 Selecting the Proper Drug Unit

Each drug has its fixed unit or unit series. Among a unit series, one unit may change to another automatically depending on the entered value.

The units for each drug are as follows:

- ■ Drug A, B, C, Aminophylline, Dobutamine, Dopamine, Epinephrine, Isuprel, Lidocaine, Nipride and NItroglycerin use the unit series: g, mg and mcg.
- ■ Drug D, Heparin and Pitocin use the unit series: Unit, KU (kilo units) and MU (million units).
- ■ Drug E uses the unit: mEq (milli-equivalents).

You must select the proper drug name (A, B, C, D or E) according to the units when you define a drug not listed in this library.

NOTE

- **For neonate patients, [Drip Rate] and [Drop Size] are disabled.**

22.2.3 Titration Table

To open the titration table, select [**Titration Table >>**] in the [**Dose Calculation**] window after the dose calculation is finished.

In the titration table, when you change:

- [**Reference**]
- [**Interval**]
- [**Dose Type**]

The titrated values change accordingly.

You can also:

- Select ⏫ or ⏬, or 🔼 or 🔽 beside the vertical scrollbar to view more values.
- Select [**Record**] to print out the currently displayed titrated values by the recorder.

22.2.4 Drug Calculation Formulas

Abbreviation	Unit	Formula
Conc.	g/ml, unit/ml or mEq/ml	Amount / Volume
Dose	Dose/hr, Dose/kg/min	Rate × Conc.
Volume	ml	Rate × Duration
Amount	g, unit, mEq	Rate × Duration
Duration	h	Amount/Dose
Drip Rate	gtt/min	INF Rate × Drop Size / 60

22.3 Oxygenation Calculations

22.3.1 Performing Calculations

To perform an oxygenation calculation:

1. Select [**Main Menu**]→[**Calculations >>**]→[**Oxygenation >>**], or select [**Calculations**] QuickKey→ [**Oxygenation >>**].
2. Enter values for calculation.
3. Select the [**Calculate**] button. The system performs a calculation per the current settings and displays the calculated values.
   - ◆ If a calculated value is outside the range, its background will highlight in yellow. You can select [**Range**] to view its normal range in the unit field.
   - ◆ Invalid values are displayed as [**---**].

In the [**Oxygenation Calculation**] window, you can:

- Change the pressure unit, Hb unit and oxygen content unit by selecting [**Press. Unit**], [**Hb Unit**] and [**OxyCont Unit**] and then selecting the appropriate settings. The changes take effect automatically.
- Trigger a recording by selecting the [**Record**] button. The currently displayed oxygenation calculations are printed out by the recorder.
- Review the previously performed calculations by selecting [**Review**].

22.3.2 Entered Parameters

Abbreviation	Unit	Full spelling
C.O.	L/min	cardiac output
FiO_2	%	percentage fraction of inspired oxygen
PaO_2	mmHg	partial pressure of oxygen in the arteries
$PaCO_2$	mmHg	partial pressure of carbon dioxide in the arteries
SaO_2	%	arterial oxygen saturation
PvO_2	mmHg	partial pressure of oxygen in venous blood
SvO_2	%	venous oxygen saturation
Hb	g/L	hemoglobin
CaO_2	ml/L	arterial oxygen content
CvO_2	ml/L	venous oxygen content
VO_2	ml/min	oxygen consumption
RQ	None	respiratory quotient
ATMP	mmHg	atmospheric pressure
Height	cm	height
Weight	kg	weight

22.3.3 Calculated Parameters and Formulas

Abbreviation	Unit	Full spelling	Formula
BSA	m^2	body surface area	$Wt^{0.425} \times Ht^{0.725} \times 0.007184$
VO_2 calc	ml/min	oxygen consumption	$C(a\text{-}v)O_2 \times$ C.O.
$C(a\text{-}v)O_2$	ml/L	arteriovenous oxygen content difference	$CaO_2 - CvO_2$
O_2ER	%	oxygen extraction ratio	$100 \times C(a\text{-}v)O_2 / CaO_2$
DO_2	ml/min	oxygen transport	C.O. $\times CaO_2$
PAO_2	mmHg	partial pressure of oxygen in the alveoli	$FiO_2 / 100 \times (ATMP - 47) - PaCO_2 \times [FiO_2 / 100 + (1 - FiO_2 / 100) / RQ]$
$AaDO_2$	mmHg	alveolar-arterial oxygen difference	$PAO_2 - PaO_2$
CcO_2	ml/L	capillary oxygen content	$Hb \times 1.34 + 0.031 \times PAO_2$
Qs/Qt	%	venous admixture	$100 \times [1.34 \times Hb \times (1 - SaO_2 / 100) + 0.031 \times (PAO_2 - PaO_2)] / [1.34 \times Hb \times (1 - SvO_2 / 100) + 0.031 \times (PAO_2 - PvO_2)]$
C.O. calc	L/min	calculated cardiac output	$VO_2 / (CaO_2 - CvO_2)$

22.4 Ventilation Calculations

22.4.1 Performing Calculations

To perform a ventilation calculation:

1. Select [**Main Menu**]→[**Calculations >>**]→[**Ventilation >>**], or select [**Calculations**] QuickKey→ [**Ventilation >>**].
2. Enter values for calculation. If the patient monitor is connected to an anesthesia machine or a ventilator, the system automatically loads the supported parameter values to the [**Ventilation Calculation**] window.
3. Select the [**Calculate**] button. The system performs a calculation per the current settings and displays the calculated values.
   - ◆ If a calculated value is outside the range, its background will highlight in yellow. You can select [**Range**] to view its normal range in the unit field.
   - ◆ Invalid values are displayed as [**---**].

In the [**Ventilation Calculation**] window, you can:

- ■ Change the pressure unit by selecting [**Press. Unit**] and then selecting the appropriate setting. Corresponding pressure values shall convert and update automatically.
- ■ Trigger a recording by selecting the [**Record**] button. The currently displayed ventilation calculations are printed out by the recorder.
- ■ Review the previously performed calculations by selecting [**Review**].

22.4.2 Entered Parameters

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

22.4.3 Calculated Parameters and Formulas

Abbreviation	Unit	Full spelling	Formula
PAO_2	mmHg	partial pressure of oxygen in the alveoli	(ATMP－47) × FiO_2 /100 －$PaCO_2$ × [FiO_2 /100 ＋ (1 －FiO_2 /100) / RQ]
$AaDO_2$	mmHg	alveolar-arterial oxygen difference	PAO_2 － PaO_2
Pa/FiO_2	mmHg	oxygenation ratio	100 × PaO_2 / FiO_2
a/AO_2	%	arterial to alveolar oxygen ratio	100 × PaO_2 / PAO_2
MV	L/min	minute volume	(TV × RR) / 1000
Vd	ml	volume of physiological dead space	TV × (1 － $PeCO_2$ / $PaCO_2$)
Vd/Vt	%	physiologic dead space in percent of tidal volume	100 × Vd/TV
VA	L/min	alveolar volume	(TV－ Vd) × RR / 1000

22.5 Hemodynamic Calculations

22.5.1 Performing Calculations

To perform a hemodynamic calculation:

1. Select [**Main Menu**]→[**Calculations >>**]→[**Hemodynamic >>**], or select [**Calculations**] QuickKey→ [**Hemodynamic >>**].
2. Enter values for calculation.
   - ◆ For a patient who is being monitored, [**HR**], [**Art mean**], [**PA mean**] and [**CVP**] are automatically taken from the currently measured values. If you just have performed C.O. measurements, [**C.O.**] is the average of multiple thermodilution measurements. [**Height**] and [**Weight**] are the patient's height and weight you have entered. If the monitor does not provide these values, their fields appear blank.
   - ◆ For a patient who is not being monitored, confirm the values you have entered.
3. Select the [**Calculate**] button. The system performs a calculation per the current settings and displays the calculated values.
   - ◆ If a calculated value is outside the range, its background will highlight in yellow. You can select [**Range**] to view its normal range in the unit field.
   - ◆ Invalid values are displayed as [**---**].

In the [**Hemodynamic Calculation**] window, you can:

- ■ Trigger a recording by selecting the [**Record**] button. The currently displayed hemodynamic calculation are printed out by the recorder.
- ■ Review the previously performed calculations by selecting [**Review**].

22.5.2 Entered Parameters

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

22.5.3 Calculated Parameters and Formulas

Abbreviation	Unit	Full spelling	Formula
BSA	m^2	body surface area	$Wt^{0.425} \times Ht^{0.725} \times 0.007184$
C.I.	$L/min/m^2$	cardiac index	C.O. / BSA
SV	ml	stroke volume	C.O. / HR × 1000
SI	ml/m^2	stroke index	SV/ BSA
SVR	DS/cm^5	systemic vascular resistance	79.96 × (AP MAP − CVP) / C.O.
SVRI	$DS{\cdot}m^2/cm^5$	systemic vascular resistance index	SVR × BSA
PVR	DS/cm^5	pulmonary vascular resistance	79.96 × (PAMAP − PAWP) / C.O.
PVRI	$DS{\cdot}m^2/cm^5$	pulmonary vascular resistance index	PVR × BSA
LCW	kg·m	left cardiac work	0.0136 × APMAP × C.O.
LCWI	$kg{\cdot}m/m^2$	left cardiac work index	LCW / BSA
LVSW	g·m	left ventricular stroke work	0.0136 × APMAP× SV
LVSWI	$g{\cdot}m/m^2$	left ventricular stroke work index	LVSW / BSA
RCW	kg·m	right cardiac work	0.0136 × PAMAP × C.O.
RCWI	$kg{\cdot}m/m^2$	right cardiac work index	RCW / BSA
RVSW	g·m	right ventricular stroke work	0.0136 × PAMAP × SV
RVSWI	$g{\cdot}m/m^2$	right ventricular stroke work index	RVSW / BSA
EF	%	ejection fraction	100 × SV / EDV

22.6 Renal Calculations

22.6.1 Performing Calculations

To perform a renal calculation:

1. Selecting [**Main Menu**]→[**Calculations >>**]→[**Renal >>**], or select [**Calculations**] QuickKey→[**Renal >>**].
2. Enter values for calculation.
3. Select the [**Calculate**] button. The system performs a calculation per the current settings and displays the calculated values.
   - ◆ If a calculated value is outside the range, its background will highlight in yellow. You can select [**Range**] to view its normal range in the unit field.
   - ◆ Invalid values are displayed as [**---**].

In the [**Renal Calculation**] window, you can:

- ■ Trigger a recording by selecting the [**Record**] button. The currently displayed renal calculations are printed out by the recorder.
- ■ Review the previously performed calculations by selecting [**Review**].

22.6.2 Entered Parameters

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

22.6.3 Calculated Parameters and Formulas

Abbreviation	Unit	Full spelling	Formula
URNaEx	mmol/24h	urine sodium excretion	Urine × URNa / 1000
URKEx	mmol/24h	urine potassium excretion	Urine × URK / 1000
Na/K	%	sodium potassium ratio	100 × URNa / URK
CNa	ml/24h	clearance of sodium	URNa × Urine / SerNa
Clcr	ml/min	creatinine clearance rate	Ucr × Urine / Cr / (BSA / 1.73) / 1440
FENa	%	fractional excretion of sodium	100 × (URNa × Cr) / (SerNa × Ucr)
Cosm	ml/min	osmolar clearance	Uosm × Urine / Posm / 1440
CH_2O	ml/h	free water clearance	Urine × (1－Uosm / Posm) / 24
U/P osm	None	urine to plasma osmolality ratio	Uosm / Posm
BUN/Cr	None*	blood urea nitrogen creatinine ratio	1000 × BUN / Cr
U/Cr	None	urine-serum creatinine ratio	Ucr / Cr

*: BUN/Cr is a ratio under the unit of mol.

22.7 Understanding the Review Window

With the review feature, you can review oxygenation, ventilation, hemodynamic and renal calculations. The review window for each calculation is similar. Take the hemodynamic calculations review window for example, you can access it by selecting [**Review**] in the [**Hemodynamic Calculation**] window.

In this review window:

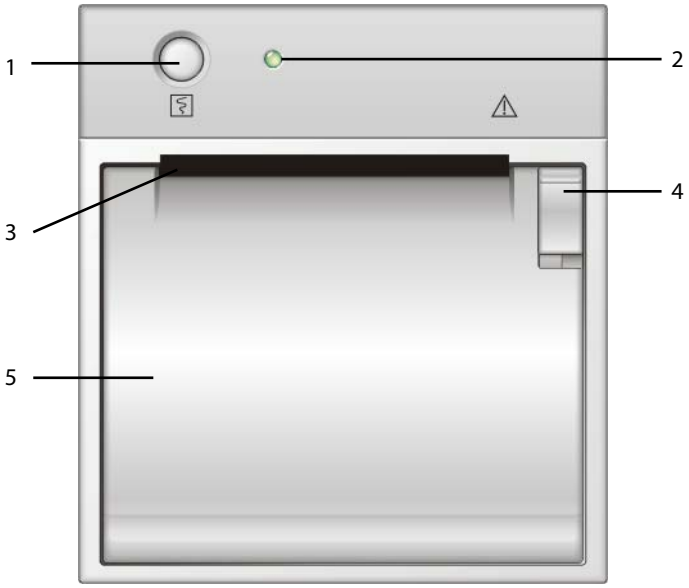
- You can select ◀, ▶, ◀◀ or ▶▶ to view more values.
- The values that exceed the range are displayed in yellow background. The [**Unit**] field displays parameter units. If some parameter values are outside of their normal ranges, you can view their normal range in the [**Unit**] field by selecting [**Range**].
- You can review an individual calculation by selecting its corresponding column and then selecting [**Original Calc**]. You can record the currently displayed calculations or perform another calculation is this window.

FOR YOUR NOTES

23 Recording

23.1 Using a Recorder

The thermal recorder records patient information, measurement numerics, up to three waveforms, etc.



1. Start/Stop key: press to start a recording or stop the current recording.
2. Indicator
   - On: when the recorder works correctly.
   - Off: when the monitor is switched off.
   - Flashes: if an error occurred to the recorder, e.g., the recorder runs out of paper.
3. Paper outlet
4. Latch
5. Recorder door

23.2 Overview of Recording Types

By the way recordings are triggered, the recordings can be classified into the following categories:

- Manually-triggered realtime recordings.
- Timed recordings.
- Alarm recordings triggered by an alarm limit violation or an arrhythmia event.
- Manually-triggered, task-related recordings.

23.3 Starting and Stopping Recordings

To manually start a recording, you can either:

- Select the hardkey on the front of either the patient monitor or the recorder module, or
- Select the [**Record**] button from the current menu or window.

Automatic recordings will be triggered in the following conditions:

- Timed recordings will start automatically at preset intervals.
- If both [**Alarm**] and [**Alm Rec**] for a measurement are set on, an alarm recording will be triggered automatically as alarms occur.

To manually stop a recording, you can either:

- Select the hardkey again, or
- Select [**Clear All Tasks**] in the [**Record Setup**] menu.

Recordings stop automatically when:

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

When a recording is stopped, the following markers will be added:

- Automatically stopped recording: print two columns of '*' at the end of the report.
- Manually or abnormally stopped recording: print one column of '*' at the end of the report.

23.4 Setting up the Recorder

23.4.1 Accessing the Record Setup Menu

By selecting [**Main Menu**]→[**Record Setup >>**], you can access the [**Record Setup**] menu.

23.4.2 Selecting Waveforms for Recording

The recorder can record up to 3 waveforms at a time. You can select, in turn, [**Waveform 1**], [**Waveform 2**] and [**Waveform 3**] in the [**Record Setup**] menu, and then select the waveforms you want. You can also turn off a waveform recording by selecting [**Off**]. These settings are intended for realtime and scheduled recordings.

23.4.3 Setting the Realtime Recording Length

After starting a realtime recording, the recording time depends on your monitor's settings. In the [**Record Setup**] menu, select [**Length**] and toggle between [**8 s**] and [**Continuous**].

- [**8 s**]: record 4-second waveforms respectively before and after current moment.
- [**Continuous**]: record the waveforms from the current moment until stopped manually.

23.4.4 Setting the Interval between Timed Recordings

Timed recordings start automatically at preset intervals. Each recording lasts 8 seconds. To set the interval between timed recordings: in the [**Record Setup**] menu, select [**Interval**] and then select the appropriate setting.

23.4.5 Changing the Recording Speed

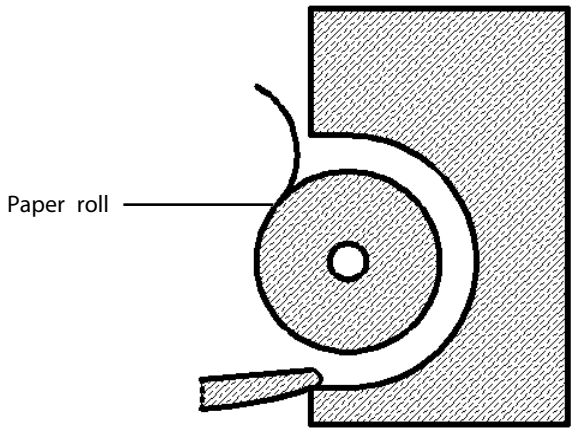
In the [**Record Setup**] menu, select [**Paper Speed**] and toggle between [**25 mm/s**] and [**50 mm/s**]. This setting is for all recordings containing waveforms.

23.4.6 Clearing Recording Tasks

In the [**Record Setup**] menu, select [**Clear All Tasks**]. All queued recording tasks are cleared and the current recording is stopped.

23.5 Loading Paper

1. Use the latch at the upper right of the recorder door to pull the door open.
2. Insert a new roll into the compartment as shown below.
3. Close the recorder door.
4. Check if paper is loaded correctly and the paper end is feeding from the top.



⚠CAUTION

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

23.6 Removing Paper Jam

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

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

23.7 Cleaning the Recorder Printhead

If the recorder has been used for a long time, deposits of paper debris may collect on the printhead compromising the print quality and shortening the lifetime of the roller. Follow this procedure to clean the printhead:

1. Take measures against the static electricity such as Disposable Wrist Strap for the work.
2. Open the recorder door and take out the paper.
3. Gently wipe around the printhead using cotton swabs dampened with alcohol.
4. After the alcohol has completely been dried, reload the paper and close the recorder door.

⚠CAUTION

- **Do not use anything that may destroy the thermal element.**
- **Do not add unnecessary force to the thermal head.**

24 Printing

24.1 Printer

The monitor can output patient reports via a connected printer. So far, the monitor supports the following printer:

- HP LaserJet 1505n
- HP LaserJet P2035n
- HP LaserJet P4015n
- HP LaserJet Pro 400 M401n
- HP LaserJet 600 M602
- HP LaserJet M202DW

The specifications of the reports the monitor prints are:

- Paper: A4, Letter
- Resolution: 300 dpi

For more details about the printer, see the document accompanying the printer. With the upgrading of products, the monitor will support more printers and no prior notice will be given. If you have any doubt about the printer you have purchased, contact our company.

24.2 Connecting a printer

To print the reports or the trend data of a patient, you can choose either:

- the local printer

  Connect the printer and the patient monitor through network, and then start printing what you want.

- the Central Monitoring System

  If your monitor is connected to a central monitoring system, it is recommended to use the central monitoring system for printing.

24.3 Setting Up 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

  Select [**Paper Size**] and toggle between [**A4**] and [**Letter**].

24.4 Starting Report Printouts

Reports	Contents	Procedures
ECG reports	ECG waveforms and relevant parameter values	Select [**Main Menu**]→[**Print Setup >>**]→[**ECG Reports >>**]→[**Print**]
Tabular trends	Depend on the selected parameter group, resolution and time period	Select [**Main Menu**]→[**Print Setup >>**]→[**Tabular Trends Reports >>**]→[**Print**], or select [**Main Menu**]→[**Review >>**]→[**Tabular Trends**]→[**Print**]→[**Print**]
Graphic trends	Depend on the selected parameter group, resolution and time period	Select [**Main Menu**]→[**Print Setup >>**]→[**Graphic Trends Reports >>]**→[**Print**], or select [**Main Menu**]→[**Review >>**]→[**Graphic Trends**]→[**Print**]→[**Print**]
Arrh. alarm review	ECG waveforms and relevant parameter values	Select [**Print**] in [**Arrh. Events**]
Parameter alarm review	Depend on the selected alarms	Select [**Main Menu**]→[**Review >>**]→[**Alarms**]→[**Print**]
Realtime waves	Depend on the selected waveforms	Select [**Main Menu**]→[**Print Setup >>**]→[**Realtime Reports >>**]→[**Print**]

24.5 Stopping Reports Printouts

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

24.6 Setting Up Reports

24.6.1 Setting Up ECG Reports

You can print out ECG reports only under full-screen, half-screen or 12-lead monitoring 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.

24.6.2 Setting Up Tabular Trends Reports

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

- Start time: You can set a time period whose trend data will be printed out by setting [**From**] and [**Back**]. For example, if you set [**From**] as 2007-4-2 10:00:00 and [**Back**] as [**2 h**], the outputted data will be from 2007-4-2 08:00:00 to 2007-4-2 10:00:00. In addition, the [**Back**] can be set to either:
  - [**Auto**]: If [**Report Layout**] is set to [**Time Oriented**], the report will be printed by time. If [**Report Layout**] is set to [**Parameter Oriented**], the report will be printed by parameters.
  - [**All**]: If you select [**All**], all trend data will be printed out. In this case, it is no need to set [**From**].
- [**Interval**]: choose the resolution of the tabular trends printed on the report.
- [**Report Layout**]: If you select [**Time Oriented**], the report will be printed by time. If you select [**Parameter Oriented**], the report will be printed by parameters.
- [**Select Parameter >>**]: from the popup menu, you can:
  - [**Currently Displayed Trended Parameters**]: print the parameter trend data selected from the [**Tabular Trends**].
  - [**Standard Parameter Group**]: select the standard parameter group for printing.
  - [**Custom**]: You can define a parameter group for printing from the parameters displayed in the low part of the menu.

24.6.3 Setting Up Graphic Trends Reports

To set up graphic trends reports, select [**Main Menu**]→[**Print Setup >>**]→[**Graphic Trends Reports >>**]. As setting up graphic trends reports is similar with tabular trends reports, you can refer to section ***24.6.2 Setting Up Tabular Trends Reports*** for details.

24.6.4 Setting Up Realtime Reports

To set up realtime reports, select [**Main Menu**]→[**Print Setup >>**]→[**Realtime Reports >>**].

- [**Sweep**]: set the wave print speed to 12.5 mm/s, 25 mm/s, 50 mm/s, or Auto.
- [**Select Wave >>**]: from the popup menu, you can:
  - [**Current**]: select the currently displayed waves for printing.
  - [**Select Wave**]: select the desired waves for printing.

24.7 End Case Reports

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

For example, to set ECG report as end case report:

1. select [**Main Menu**]→[**Print Setup >>**]→[**ECG Report >>**].
2. select [**End Case Report**]→[**Set as End Case Report**] and then select [**Ok**] from the popup dialog box.
3. set as described in the ***24.6.1 Setting Up ECG Reports***.

24.8 Printer Statuses

24.8.1 Printer Out of Paper

When the printer runs out of paper, the print request will not be responded. If there are too many print jobs that are not responded, a printer error may occur. In these cases, you need to install paper and then re-send the print request. Restart the printer if necessary.

Therefore, you'd better ensure that there is enough paper in the printer before sending a print request.

24.8.2 Printer Status Messages

If the monitor prompts that selected printer is not available, check that the printer is switched on, correctly connected, and installed with paper.

25 Other Functions

25.1 Analog Output

The patient monitor provides analog output signals to accessory equipment via the multifunctional connector on the rear of the monitor. To obtain analog output signals, connect the accessory equipment such as an oscillograph, etc. to the monitor.

NOTE

- **The analog output feature is seldom applied in clinical applications. You can contact your service personnel for more details.**

25.2 Exporting the Log

The monitor stores system status information, including failures, abnormity, and technical alarms, into the log. You can export the log to a USB drive.

To export the log,

1. Connect a USB drive to the monitor's USB connector. See ***2.2.3 Rear View*** for the proper location of the USB connector.
2. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→ [**Others >>**].
3. Select [**Export Log**].

25.3 Transferring Data

You can transfer the patient data saved in the monitor to a PC via a crossover network cable or within a LAN for data management, review or print.

25.3.1 Data Export System

You must install the data export system on the intended PC before performing the data transfer operation. Refer to the document accompanying the installation CD-ROM for installation instructions.

The data transfer feature supports patient management, data review, data format conversion, print, etc. in addition to data transfer. Refer to the help file of the system software for more details.

25.3.2 Transferring Data by Different Means

NOTE

- **Never enter the data transfer mode when the patient monitor is in normal operation or performs monitoring. You must re-start the patient monitor to exit the data transfer mode.**

Transfer data via a crossover network cable

Before transferring data using a crossover network cable, do as follows:

1. Connect one end of the crossover network cable to the patient monitor and the other end to the PC.
2. Set the IP address of the PC. This IP address must be in the same network segment with that of the patient monitor.
3. Make sure that the data export system is active on the PC.

Then, follow this procedure to transfer data:

1. Select [**Main Menu**]→[**Patient Data >>**]→[**Transfer Data**].
2. Select [**Yes**] from the popup message box.
3. Input the IP address already set on the PC.
4. Select [**Start**] to start transferring data.

Transfer data within a LAN

Before transferring data within a LAN, do as follows:

1. Connect the patient monitor and the intended PC into the same LAN and acquire the PC's IP address.
2. Make sure that the data export system is active on the PC.

Follow the same procedure as via a crossover network cable to transfer data.

25.4 Nurse Call

The patient monitor also provides nurse call signals to a nurse call system connected to the monitor via the multifunctional connector. To obtain nurse call signals, connect a nurse call system to the monitor and then follow this procedure:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Others >>**] to access the [**Others**] menu.
3. Select [**Nurse Call Setup >>**] to change the nurse call settings as follows:

- Select [**Signal Type**] and toggle between [**Pulse**] and [**Continuous**].
  - [**Pulse**]: the nurse call signals are pulse signals and each pulse lasts 1 second. When multiple alarms occur simultaneously, only one pulse signal is outputted. If an alarm occurs but the previous one is not cleared yet, a new pulse signal will also be outputted.
  - [**Continuous**]: the nurse call signal lasts until the alarm ends, i.e. the duration of a nurse call signal equals to that of the alarm condition.
- Select [**Contact Type**] and toggle between [**Normally Open**] and [**Normally Closed**].
  - [**Normally Open**]: select if your hospital's nurse call relay contact is normally open.
  - [**Normally Closed**]: select if your hospital's nurse call relay contact is normally closed.
- Select [**Alm Lev**] and set the alarm level for nurse call-triggering alarms.
- Select [**Alarm Cat.**] and then select the category to which the nurse call-triggering alarms belong.

Alarm conditions are indicated to nurses only when:

- The nurse call system is enabled,
- An alarm that meets your preset requirements occurs, and
- The monitor is not in the alarm paused or reset status.

⚠WARNING

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

NOTE

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

25.5 Network Connection

25.5.1 Setting the Monitor Network

The patient monitor supports both wired and wireless network. To set the monitor network:

1. Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Network Setup >>**]→[**Monitor Network Setup >>**].
2. In the Monitor Network Setup menu, set the [**Network Type**] or [**Address Type**].

The network type can be set to [**WLAN]** or [**LAN**].

The address type can be set to [**DHCP**] or [**Manual**].

- If [**Address Type**] is set to [**DHCP**], the monitor can automatically acquire network parameters.
- If [**Address Type**] is set to [**Manual**], you need to manually input the monitor IP address, subnet mask and gateway address.

25.5.2 Wireless Network

The patient monitors can be connected to a wireless network via a built-in Wi-Fi module. To set the wireless network:

1. Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Network Setup >>**]→[**Monitor Network Setup >>**].
2. In the Monitor Network Setup menu, set the [**Network Type**] to [**WLAN**].
3. Select [**WLAN Setup >>**] to access the [**WLAN Setup**] menu.
4. Configure the [**Network Name (SSID)**], [**Security**], [**EAP Method**], [**AUT Protocol**], [**Identify**], [**Anonymity**], [**Password**] and [**CA Certificate**].
5. Click [**OK**] to confirm the setting.

25.5.3 WLAN Test

To test the availability of the wireless network, follow this procedure:

1. Select [**WLAN Test >>**] in the [**Network Setup**] menu.
2. Enter the [**IP Address**] of wireless AP in the [**WLAN Test >>**] menu.
3. Click [**Connection Test**].

The Wi-Fi device used in the monitor is in compliance with IEEE 802.11a/b/g/n.

You should not change the patient monitor's IP address randomly. If you want to know details about IP address setup, contact the technical personnel in charge of the CMS.

NOTE

- **The design, installation, restruction and maintenance of the wireless network's distribution shall be performed by authorized service personnel of our company.**
- **The existence of obstacles (such as wall) will exert impact on data transferring or even cause network interruption.**
- **The Central Monitoring System is capable of connecting up to 32 bedside monitors via the wireless network.**

25.5.4 WLAN Setup

To set the properties of wireless network, follow this procedure:

1. Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Network Setup >>**]→[**WLAN Setup >>**].
2. Set [**WLAN Band**]**,** [**Aut. Server Type**], [**BG Channel**] and [**A Channel**]

WLAN band can be set to: AUTO, 5G and 2.4G.

25.5.5 Viewing the MAC Address

You can get the MAC address from the monitor for network management.

To view the MAC address:

1. Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→select [**Ok**].
2. Select [**Network Setup** >>].
3. Select [Monitor Network Setup >>].

25.5.6 Enabling the Data Encryption

If you enable the data encryption, the patient's MRN (Medical Record Number), visit number, first name and last name are encrypted when transferring data to the CMS or eGateway.

To enable the data encryption:

1. Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→select [**Ok**].
2. Select [**Network Setup** >>].
3. Set [**Network Encrypt Switch**] to [**On**].

25.5.7 Settting DNS

You can set DNS for connectiong the server using domain name. Only ADT and MLDAP services support the domain name method.

To set DNS:

1 Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→select [**Ok**].

2 Select [**Network Setup** >>].

3 Select [Monitor Network Setup >>]→[**DNS Setup** >>].

4 Set the desired [Address Type].

- [**Manual**]: the address of the DNS server must be manually entered.
- [**DHCP**]: the monitor will automatically acquire the address of the DNS server. This is only avaliable when [Address Type] is set to [DHCP] in the [Monitor Network Setup >>] menu.

5. If [**Manual**] was selected in Step 4, set [**Preferred DNS Server**] and [**Alternate DNS Server**].

25.5.8 Certificates Maintenance

To import the certificates to the monitor, follow this procedure:

1. Create a folder named “cert” in the USB drive.
2. Copy the certificates to the “cert” file.
3. Insert the USB drive into the monitor’s USB port.
4. Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Network Setup >>**]→[**Certificates Maintenance >>**]→[**Import certificates**].

To delete the certificates, select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Network Setup >>**]→[**Certificates Maintenance >>**]→[**Delete certificates**].

25.5.9 Setting the Multicast Parameters

Whether the equipment is presented by broadcast or multicast is defined before the equipment leaves the factory. If [Multicast] is selected, you need to set the multicast parameters.

To do so,

1 Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Network Setup >>**]→[**Multicast Setup >>**].

2. Set [**Multicast Addr**] and [**TTL**].

25.5.10 Connecting the monitor to the CMS

To connect the monitor to the CMS, proceed as follows:

1 Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Network Setup >>**]→[**Monitor Network Setup >>**].

2. In the [Monitor Network Setup] menu, set [**Network Type**] and [**Address Type**].
3. Input the monitor IP address, subnet mask and gateway address if the [**Address Type**] is set to [Manual]
4. Connect the monitor to the CMS through either of the following methods:
   - ◆ Admit the monitor on the CMS. Refer to the ***Hypervisor VI Operator's Manual (PN: H-300B-20-47610)*** for details of admitting a monitor.
   - ◆ Setting the CMS (refer to section ***25.5.10.1 Setting the CMS*** for details), and then selecting a CMS (refer to section ***25.5.10.2 Selecting a CMS*** for details).

25.5.10.1 Setting the CMS

You can configure up to 30 central stations (CMS) for your monitor. To set the CMSs,

1 Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password.→[**Network Setup >>**].

2. Set [**Select CMS**] to [**On**].
3. Select [**Central Station Setup >>**].
4. Set CMS names and corresponding IP addresses.

25.5.10.2 Selecting a CMS

If [**Select CMS**] is enabled, you can select the CMS for the current monitoring.

To select the CMS, select the prompt message area at the bottom of the screen. Then the selected CMS name will display.

If the CMS you select does not have a name, this area displays "???".

FOR YOUR NOTES

26 Batteries

26.1 Overview

This monitor is designed to operate on rechargeable Lithium-ion battery power during intra-hospital patient transfer or whenever the power supply is interrupted. The battery is charged automatically when the monitor is connected to AC/DC power, no matter the monitor is powered on or not. Whenever the AC/DC power is interrupted during patient monitoring, the patient monitor automatically runs power from the internal battery. iPM 12/iPM 7 patient monitor is available for up to two batteries. iPM 10/iPM 6 or iPM 8/iPM 5 patient monitor is available for only one battery.

On-screen battery symbols indicate the battery status as follows:

-  Indicates that the battery works correctly. The solid portion represents the current charge level of the battery in proportion to its maximum charge level.
-  Indicates that the battery has low charge level and needs to be charged. In this case, the patient monitor provides an alarm message.
-  Indicates that the battery is almost depleted and needs to be charged immediately. Otherwise, the patient monitor shuts down automatically.
-  Indicates that no battery is installed.

The capacity of the internal battery is limited. If the battery charge is too low, a technical alarm will be triggered and the message [**Low Battery**] or [**Battery Depleted**] displayed. At this moment, apply AC/DC power to the patient monitor. Otherwise, the patient monitor will power off automatically before the battery is completely depleted.

NOTE

- **Remove the battery before transporting the equipment or if the equipment will not be used for a long time.**

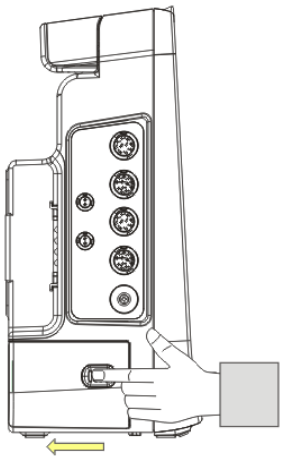
26.2 Replacing a Battery

When the iPM 12/iPM 7 patient monitor uses two battery packs, one battery pack can be easily exchanged while the patient monitor operates from the other. If the iPM 12/iPM 7 patient monitor uses one battery pack, you should insert a new battery pack before the old one depletes.

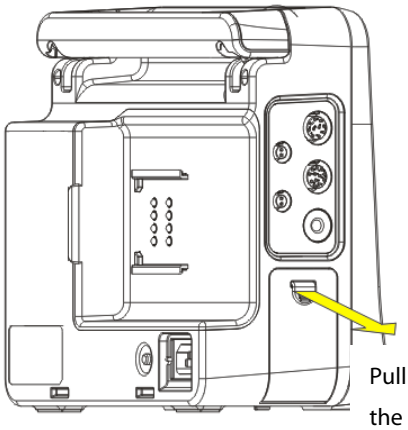
When the iPM 10/iPM 6 or iPM 8/iPM 5 patient monitor operates on battery power, make sure the patient monitor is power off before replacing a battery.

To replace a battery, follow this procedure:

1. Open the battery door.



iPM 12/iPM 7



iPM 10/iPM 8/iPM 6/iPM 5

2. Push aside the latch fixing the battery to be replaced and remove the battery.
3. Insert a battery into the slot with its contact point inward.
4. Close the battery door.

26.3 Battery Guidelines

Life expectancy of a battery depends on how frequent and how long it is used. For a properly maintained and stored lithium ion battery, its life expectancy is about 3 years. For more aggressive use models, life expectancy can be less. We recommend replacing lithium ion batteries every 3 years.

To get the most out of the battery, observe the following guidelines:

- The battery performance test must be performed every two years, before monitor repairs, or whenever the battery is suspected as being the source of the problems.
- Condition a battery once when it is used or stored for 3 months, or when its operating time becomes noticeably shorter.
- Take out the battery before the monitor is transported or will not be used for more than 3 months.
- Remove the battery from the monitor if it is not being used regularly. (Leaving the battery in a monitor that is not in regular use will shorten the life of the battery).
- The shelf life of a Lithium Ion battery is about 6 months when the battery is stored with the battery power being 50% of the total power. In 6 months the battery power must be depleted before the Lithium Ion battery is fully charged. Then run the monitor on this fully charged battery .When its battery power becomes 50% of the total power, take out the battery from the monitor and store it.

⚠WARNING

- **Keep the battery out of the reach of children.**
- **Use only the battery specified by the manufacturer.**
- **If the battery shows signs of damage or signs of leakage, replace it immediately. Do not use a faulty battery in the monitor.**

26.4 Battery Maintenance

Conditioning a Battery

A battery should be conditioned before it is used for the first time. A battery conditioning cycle is one uninterrupted charge of the battery, followed by an uninterrupted battery discharge and charge. Batteries should be conditioned regularly to maintain their useful life.

NOTE

- **The actual battery capacity will decrease over time with use of batteries. When a monitor operates on batteries that have been used before, the full capacity battery symbol does not indicate the capacity and operating time of this battery can still fulfill battery specifications in the operator's manual. When conditioning a battery, please replace the battery if its operating time is significantly lower than the specified time.**

To condition a battery, follow this procedure:

1. Disconnect the monitor from the patient and stop all monitoring or measuring.
2. Insert the battery in need of conditioning in the battery slot of the monitor.
3. Apply AC/DC power to the monitor and allow the battery to charge uninterrupted for 10 hours.
4. Remove AC/DC power and allow the monitor to run from the battery until it shuts off.
5. Apply AC/DC power again to the monitor and allow the battery to charge uninterrupted for 10 hours.
6. This battery is now conditioned and the monitor can be returned to service.

Checking a Battery

The battery performance test must be performed every two years, before monitor repairs, or whenever the battery is suspected as being the source of the problems. The performance of a rechargeable battery may deteriorate over time. To check the performance of a battery, follow this procedure:

1. Disconnect the monitor from the patient and stop all monitoring or measuring.
2. Apply AC/DC power to the monitor and allow the battery to charge uninterrupted for 10 hours.
3. Remove AC/DC power and allow the monitor to run from the battery until it shuts off.
4. The operating time of battery reflects its performance directly.

Please replace the battery or contact with the maintenance personnel if its operating time is significantly lower than the specified time.

NOTE

- **The battery might be damaged or malfunctioned if its operating time is too short after being fully charged. The operating time depends on the configuration and operation. For example, measuring NIBP more frequently will also shorten the operating time.**
- **When a battery has visual signs of damage, or no longer holds a charge, it should be replaced. Remove the old battery from the monitor and recycle it properly.**

26.5 Battery Recycling

When a battery has visual signs of damage, or no longer holds a charge, it should be replaced. Remove the old battery from the monitor and recycle it properly. To dispose of the batteries, follow local laws for proper disposal.

⚠WARNING

- **Do not disassemble batteries, or dispose of them in fire, or cause them to short circuit. They may ignite, explode, leak or heat up, causing personal injury.**

27 Care and Cleaning

Use only the substances approved by us and methods listed in this chapter to clean or disinfect your equipment. Warranty does not cover damage caused by unapproved substances or methods.
We make no claims regarding the efficacy of the listed chemicals or methods as a means for controlling infection. For the method to control infection, consult your hospital's Infection Control Officer or Epidemiologist.

In this chapter we only describe cleaning and disinfection of the main unit. For the cleaning and disinfection of other reusable accessories, refer to instructions for use of corresponding accessories.

27.1 General Points

Keep you equipment and accessories free of dust and dirt. To avoid damage to the equipment, follow these rules:

- Always dilute according the manufacturer's instructions or use lowest possible concentration.
- Do not immerse part of the equipment into liquid.
- Do not pour liquid onto the equipment or accessories.
- Do not allow liquid to enter the case.
- Never use abrasive materials (such as steel wool or silver polish), or erosive cleaners (such as acetone or acetone-based cleaners).

⚠ WARNING

- **The responsible hospital or institution shall carry out all cleaning and disinfection procedure specified in this chapter.**
- **Be sure to 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.**
- **Avoid the external connectors and thermovent during cleaning or disinfection procedures.**

27.2 Cleaning

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

Recommended cleaning agents are:

- Water
- Sodium hypochlorite bleach (10%, Sodium hypochlorite)
- Hydrogen peroxide (3%)
- Ethanol (70%)
- Isopropyl alcohol (70%)
- 1-Propanol (50%)
- Virkon
- Descosept forte
- Descosept AF
- Dismozon® plus
- Mikrozid® AF liquid
- Terralin Liquid
- Perform® classic concentrateOXY ($KHSO_4$ solution)

To clean your equipment, follow these rules:

1. Clean the display screen using a soft, clean cloth dampened with a glass cleaner, making sure that no cleanser is dripping from the cloth.
2. Clean the exterior surface of the equipment using a soft cloth dampened with the cleaner, making sure that no cleanser is dripping from the cloth.
3. Wipe off all the cleaning solution with a dry cloth after cleaning if necessary.
4. Dry your equipment in a ventilated, cool place.

27.3 Disinfection

Disinfect the equipment as required in your hospital's servicing schedule. Cleaning equipment before disinfecting is recommended.

27.4 Sterilization

Sterilization is not recommended for this monitor, related products, accessories, or supplies unless otherwise indicated in the Instructions for Use that accompany the products, accessories or supplies.

28 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.**
- **Do not open the equipment housings. All servicing and future upgrades must be carried out by the service personnel.**
- **No modification of this equipment is allowed.**
- **If you discover a problem with any of the equipment, contact your service personnel or us.**
- **The service personnel must be properly qualified and thoroughly familiar with the operation of the equipment.**

28.1 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 recorder functions correctly and the recorder paper meets the requirements.
- 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.

28.2 Maintenance and Testing Schedule

The following maintenance and tests, except for visual inspection, power on test, touchscreen calibration, battery check, and recorder check, shall be carried out by the service personnel only. Contact your service personnel if any maintenance is required. Make sure to clean and disinfect the equipment before any test and maintenance.

Check/Maintenance Item		Recommended Frequency
Preventative Maintenance Tests		
Visual inspection		When first installed or reinstalled.
NIBP test	Pressure check	1. If the user suspects that the measurement is incorrect. 2. Following any repairs or replacement of relevant module. 3. At least once a year. 4. AG leakage test should be performed before AG measurement.
	Leakage test	
Sidestream and Microstream CO_2 tests	Leakage test	
	Performance test	
	Calibration	
AG tests	Leakage test	
	Performance test	
	Calibration	
Performance Tests		
ECG test and calibration	Performance test	1. If the user suspects that the measurement is incorrect. 2. Following any repairs or replacement of relevant module. 3. At least once every two years. At least once a year is recommended for NIBP, CO_2, and AG. 4. AG leakage test should be performed before AG measurement.
	Calibration	
Resp performance test		
SpO_2 test		
NIBP test	Pressure check	
	Leakage test	
Temp test		
IBP test and calibration	Performance test	
	Pressure calibration	
C.O. test		
Mainstream CO_2 test and calibration		
Sidestream and Microstream CO_2 tests and calibration	Leakage test	
	Performance test	
	Calibration	
AG test	Leakage test	
	Performance test	
	Calibration	
BIS test		
Nurse call relay performance test		If the user suspects that the analog output does not work well.
Analog output performance test		
Electrical Safety Tests		
Electrical safety tests		At least once every two years.
Other Tests		
Power on test		1. When first installed or reinstalled. 2. Following any maintenance or the replacement of any main unit parts.
Touchscreen calibration		1. When the touchscreen appears abnormal.

Check/Maintenance Item		Recommended Frequency
		2. After the touchscreen is replaced.
Recorder check		Following any repair or replacement of the recorder.
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.

28.3 Checking Monitor and Module Information

To view the information about system start time, selftest, etc., select [**Main Menu**]→[**Maintenance >>**]→[**Monitor Information >>**]. You can print out the information for the convenience of troubleshooting. The information will not be saved during shut down.

You can also view the information about the monitor configuration and system software version by selecting [**Main Menu**]→[**Maintenance >>**]→[**Software Version >>**].

28.4 Calibrating ECG

The ECG signal may be inaccurate due to hardware or software problems. As a result, the ECG wave amplitude becomes greater or smaller. In that case, you need to calibrate the ECG module.

1. Select the ECG parameter window or waveform area→[**Filter**]→[**Diagnostic**].
2. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→ [**Module Maintenance >>**]→[**Calibrate ECG**]. A square wave appears on the screen and the message [**ECG Calibrating**] is displayed.
3. Compare the amplitude of the square wave with the wave scale. The difference should be within 5%.
4. After the calibration is completed, select [**Stop Calibrating ECG**]

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

28.5 NIBP Tests

28.5.1 NIBP Leakage Test

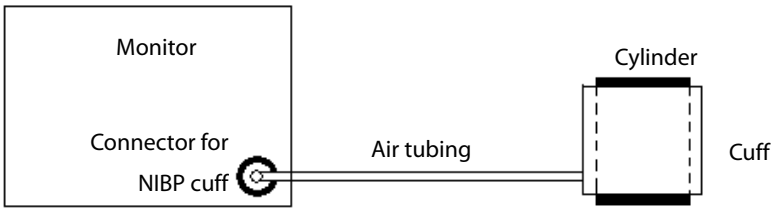
The NIBP leakage test checks the integrity of the system and of the valve. It is required at least once a year or when you doubt the measured NIBP. If the test failed, corresponding prompt messages will be given. If no message is displayed, it means no leakage is detected.

Tools required:

- An adult cuff
- An air tubing
- A correct sized cylinder

Follow this procedure to perform the leakage test:

1. Set the patient category to [**Adu**].
2. Connect the cuff to the NIBP connector on the monitor.
3. Wrap the cuff around the cylinder as shown below.



4. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]. Enter the required password and then select [**OK**].
5. Select [**Module Maintenance >>**]→[**NIBP Leakage Test**]. The NIBP display shows [**Leakage Testing…**].

After about 20 seconds, the monitor will automatically deflate. This means the test is completed.
If the message [**NIBP Pneumatic Leak**] is displayed, it indicates that the NIBP airway may have leakages. Check the tubing and connections for leakages. If you ensure that the tubing and connections are all correct, perform a leakage test again.

If the problem persists, contact your service personnel.

28.5.2 NIBP Accuracy Test

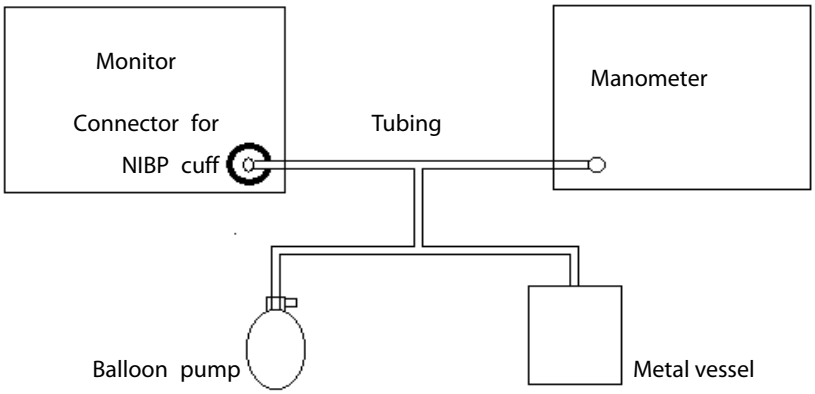
The NIBP accuracy test is required at least once a year or when you doubt the measured NIBP.

Tools required:

- T-piece connector
- Approprating tubing
- Balloon pump
- Metal Vessel (volume 500±25 ml)
- Reference manometer (calibrated with accuracy higher than 0.75 mmHg)

Follow this procedure to perform the accuracy test:

1. Connect the equipment as shown.



2. Before inflation, check that the reading of the manometer should be 0. If not, open the valve of the balloon pump to let the whole airway open to the atmosphere. Close the valve of the balloon pump after the reading is 0.
3. Select [**Main Menu**] →[**Maintenance >>**]→[**User Maintenance >>**]. Enter the required password and then select [**OK**].
4. Select [**Module Maintenance >>**]→[**NIBP Accuracy Test**].
5. Check the manometer values and the monitor values. Both should be 0mmHg.
6. Raise the pressure in the rigid vessel to 50 mmHg with the balloon pump. Then, wait for 10 seconds until the measured values become stable.
7. Compare the manometer values with the monitor values. The difference should be 3 mmHg. If it is greater than 3 mmHg, contact your service personnel.
8. Raise the pressure in the rigid vessel to 200 mmHg with the balloon pump. Then, wait for 10 seconds until the measured values become stable and repeat step 6.

28.6 CO_2 Tests

28.6.1 CO_2 Leakage Test

For sidestream and microstream CO_2 modules, leakage test is needed every year or when you suspect the measurement.

Follow this procedure to perform the test:

1. Connect the CO_2 module with the patient module.
2. Wait until CO_2 warmup is finished and then use your hand or other objects to completely block the gas inlet of the module or watertrap. The sidestream and microstream CO_2 modules will behave as follows:
   - Sidestream: The alarm message [**CO2 FilterLine Err**] is displayed on the screen after certain time. Block the gas inlet for another 30 s. If the alarm message does not disappear, it indicates that the module does not leak.
   - Microstream: The alarm message [**CO2 Purging**] is displayed on the screen after certain time. Block the gas inlet for another 30s. If alarm message [**CO2 FilterLine Err**] is shown, it indicates that the module does not leak.

28.6.2 CO_2 Accuracy Test

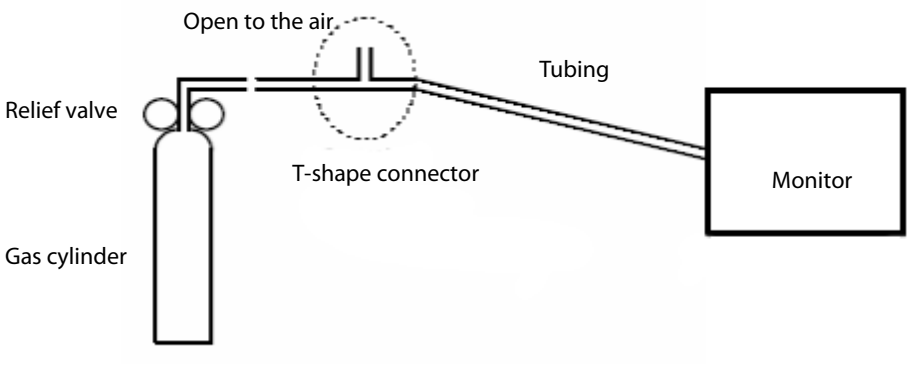
For sidestream and microstream CO_2 modules, leakage test is needed every year or when you suspect the measurement.

Tools required:

- A steel gas cylinder with 6±0.05% CO_2 and balance gas N_2
- T-shape connector
- Tubing

Follow this procedure to perform the test:

1. Connect the CO_2 module with the patient module.
2. Wait until the CO_2 module warmup is finished, and check the airway for leakage and perform a leakage test as well to make sure the airway has no leakage.
3. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Module Maintenance >>**]→[**Maintain CO2 >>**]→[**Calibrate CO2 >>**].
4. Connect the test system as follows:



5. Open the relief valve to vent standard CO_2 and make sure that there is an excess gas flow through the T-shape connector to air.
6. Check the realtime CO_2 value is within 6.0±0.3% in the [**Calibrate CO2**] menu.

28.6.3 Calibrating CO_2

For sidestream and microstream CO_2 modules, a calibration is needed every year or when the measured values have a great deviation. For maintream CO_2 module, no calibration is needed. Calibration for sidestream CO_2 module can be performed only when the sidestream module enters the full accuracy mode.

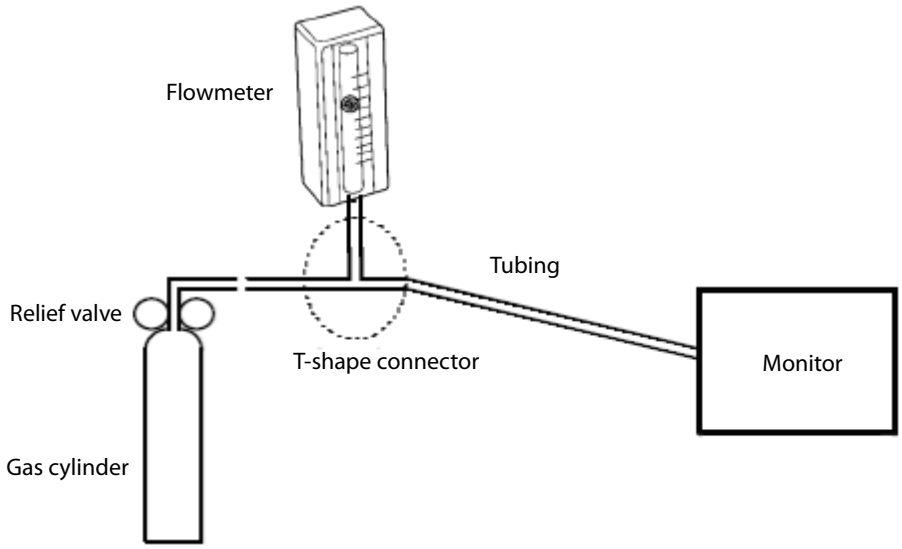
Tools required:

- A steel gas cylinder with 6±0.05% CO_2 and balance gas N_2
- T-shape connector
- Tubing

Follow this procedure to perform a calibration:

1. Make sure that the sidestream or microstream CO_2 module has been warmed up or started up.
2. Check the airway for leakage and perform a leakage test as well to make sure the airway has no leakage.

3. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Module Maintenance >>**]→[**Maintain CO2 >>**]→[**Calibrate CO2 >>**].
4. In the [**Calibrate CO2**] menu, select [**Zero**].
5. After the zero calibration is finished successfully, connect the equipment as follows:



6. Turn on and adjust the relief valve to make the flowmeter reads within 10-50 mL/min and keeps stable as well.
7. In the [**Calibrate CO2**] menu, enter the vented CO_2 concentration in the [**CO2**] field.
8. In the [**Calibrate CO2**] menu, the measured CO_2 concentration is displayed. After the measured CO_2 concentration becomes stable, select [**Calibrate CO2**] to calibrate the CO_2 module.
9. If the calibration is finished successfully, the message [**Calibration Completed!**] is displayed in the [**Calibrate CO2**] menu. If the calibration failed, the message [**Calibration Failed!**] is displayed. In this case, perform another calibration.

⚠WARNING

- **Connect an exhaust tube to the gas outlet connector of the monitor to remove the calibration gases to a scavenging system.**

28.7 AG Tests

28.7.1 AG Leakage Test

The AG leakage test is required every time before the AG measurement. Follow this procedure to perform the test:

1. Plug the AG module into the module rack.
2. Wait for more than10mins until the AG module warmup is finished and then use your hand or other objects to completely block the gas inlet of the AG module. An alarm message [**AG Airway Occluded**] will appear on the screen.
3. Block the gas inlet for another 30 s. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Module Maintenance >>**]→[**Calibrate AG >>**].

Check that the current flow rate is less than 10ml/min, and the alarm message [**AG Airway Occluded**] does not disappear. This indicates that the module does not leak.

If the alarm message disappears, or the flow rate is equal to or greater, it indicates that the module leaks. Perform the leakage test again. If the problem remains, contact your service personnel for help.

28.7.2 AG Accuracy Test

Tools required:

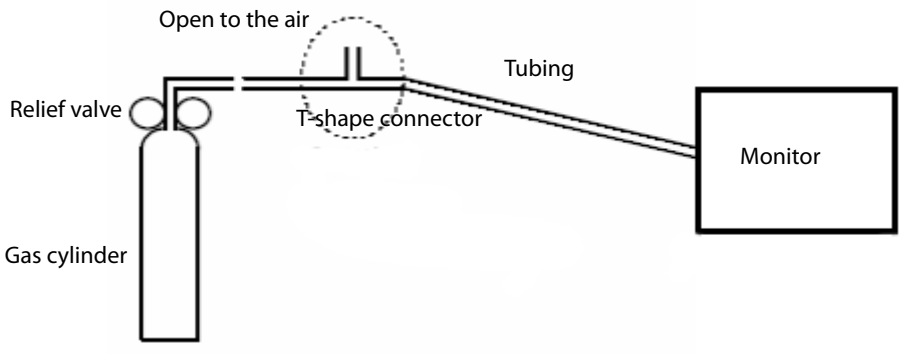
- Gas cylinder with 100% O_2 and/or a certain standard gas (such as 6±0.05% CO_2, Bal N_2), or standard gas mixture (such as 5±0.03% CO_2, 1.5±0.15% ISO, 45±0.23% O_2 bal N_2O).
- Gas concentration should meet the following requirements respectively: AA≥1.5%, CO_2≥1.5%, N_2O≥40%, O_2≥40%, of which AA represents an anaesthetic agent. The gas concentration accuracy should have a tolerance as follows: AA±0.15%, CO_2±0.1%, N_2O±1%, O_2±1%.
- T-shape connector
- Tubing

NOTE

- **When testing a particular gas in a mixture, only the concentration of the gas to be tested needs to meet the requirements.**
- **Handle the gas cylinder by following the instructions on the gas cylinder.**

Follow this procedure to perform the test:

1. Plug the AG module into the module rack.
2. Wait at least 10 min and then perform a leakage test to make sure the airway has no leakage.
3. Check if the fan inside the AG module works correctly.
4. Connect the test system as follows:



5. Open the relief valve and vent a standard gas and make sure that there is an excess gas flow through the T-shape connector to air. And wait for at least 30 seconds until the gas reading stable.
6. Check that the concentration of each composition meets the specification stated in the Operator's Manual.

⚠ WARNING

- **When performing AG accuracy test, be sure to dispose of exhaust gas properly.**

28.7.3 AG Calibration

Calibrate the AG module every year or when the measured value is outside the specification.

Tools required:

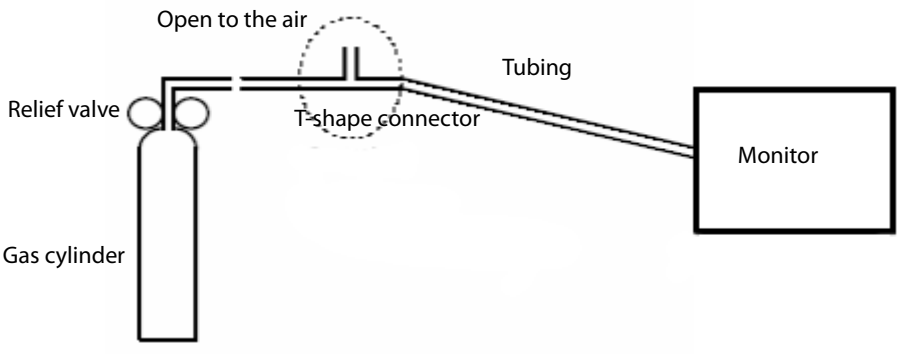
- Gas cylinder with a certain standard gas or standard gas mixture. Gas concentration should meet the following requirements respectively: AA≥1.5%, CO_2≥1.5%, N_2O≥40%, O_2≥40%, of which AA represents an anaesthetic agent. The gas concentration accuracy should have a tolerance as follows: AA±0.15%, CO_2±0.1%, N_2O±1%, O_2±1%.
- T-shape connector
- Tubing

NOTE

- **When calibrating a particular gas in a mixture, only the concentration of the gas to be calibrated needs to meet the requirements.**
- **Handle the gas cylinder by following the instructions on the gas cylinder(s).**

Follow this procedure to perform the AG calibration:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Module Maintenance >>**]→[**Calibrate AG >>**].
2. Check the airway and make sure that there are no occlusions or leaks.
   - ◆ Vent the sampling tubing to the air and check if the [**Current FlowRate**] and [**SetFlowRate**] are approximately the same. If the deviation is great, it indicates that there is an occlusion in the tubing. Check the tubing for an occlusion.
   - ◆ Perform a leakage test to make sure that the airway has no leakage.
3. Connect the test system as follows:



4. Open the relief valve and vent a certain standard gas or gas mixture and make sure that there is an excess gas flow through the T-shape connector to air. And wait for at least 30 seconds until the gas reading stable.

5. In the [**Calibrate AG**] menu, the concentration of each measured gas and flow rate are displayed.
   - If the difference between the measured gas concentration and the actual one is within the tolerances in the user manual, a calibration is not needed.
   - If the difference for one gas composition or more gas compositions is outside of the stated tolerances, a calibration for one gas composition or more gas compositions should be performed. Select [**Calibrate >>**] to enter the calibrate menu.
6. Enter the vented gas concentration(s) for one gas composition or more gas compositions which needs calibration. If only one gas composition in gas mixture is to be calibrated i.e. CO_2 only, set the concentration of the other gases to 0.
7. Select [**Start**] to start a calibration.
8. If the calibration is finished successfully, the message [**Calibration Completed!**] is displayed. If the calibration failed, the message [**Calibration Failed!**] is displayed. Perform another calibration.

After the calibration finished, an accuracy test should be performed according to the Accuracy Test chapter. If one gas composition of the gas mixture is outside of the stated tolerances, please perform the calibration for the gas which reading is out of stated tolerances by using the calibration gas cylinder or another calibration gas cylinder following the instruction of Calibration chapter again.

⚠ WARNING

- **When performing AG calibration, be sure to dispose of exhaust gas properly.**

⚠ CAUTION

- **Calibrate the AG module, if it has been transported for a long distance or not used for a prolonged period of time.**
- **Calibrate the AG module, if the module was subject to physical impact damage i.e. dropped etc. or when the measured value(s) has a great deviation.**
- **It is not recommended to calibrate the anaesthetic agents (Halothane, Isoflurane, Enflurane, Sevoflurane and Desflurane) for AG user calibration. If the gas measurement reading for anaesthetic agents is outside the specification please contact Mindray Medical for advice.**

NOTE

- **For measurement of O_2 concentration more than 80%, it recommends to use gas cylinder with 100% O_2 to do the O_2 calibration again.**

28.8 Calibrating the Touchscreen

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Cal. Touchscreen**].
2.  will, in turn, appear at different positions of the screen.
3. Select each  as it appears on the screen.
4. After the calibration is completed, the message [**Screen Calibration Completed!**] is displayed. Select [**Ok**] to confirm the completion of the calibration.

28.9 Electrical Safety Tests

Refer to ***E Electrical Safety Inspection***.

FOR YOUR NOTES

29 Accessories

The accessory material that contacts the patients has undertaken the bio-compatibility test and is verified to be in compliance with ISO 10993-1. For details about the accessories, refer to the instructions for use provided with the accessory.

⚠ WARNING

- **Use accessories specified in this chapter. Using other accessories may cause damage to the patient monitor or not meet the claimed specifications.**
- **Single-use accessories are not designed to be reused. Reuse may cause a risk of contamination and affect the measurement accuracy.**
- **Check the accessories and their packages for any sign of damage. Do not use them if any damage is detected.**
- **Use the accessories before the expiry date if their expiry date is indicated.**
- **The disposable accessories shall be disposed of according to hospital's regulations.**

29.1 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

12-Pin Integrative Trunk Cables

Leadwire supported	Compatible with	Type	Patient Category	Model	Part No.
5-leadwire	AHA	Snap, Defibrillation-proof	Adult, pediatric	EA6251B	040-000961-00
5-leadwire	IEC			EA6252B	040-000963-00
3-leadwire	AHA			EA6231B	040-000965-00
3-leadwire	IEC			EA6232B	040-000967-00
5-leadwire	AHA	Clip, Defibrillation-proof		EA6251A	040-000960-00
5-leadwire	IEC			EA6252A	040-000962-00
3-leadwire	AHA			EA6231A	040-000964-00
3-leadwire	IEC			EA6232A	040-000966-00

12-Pin Separable Trunk Cables

Leadwire supported	Compatible with	Type	Patient Category	Part No.
3-leadwire	AHA, IEC	Defibrillation-proof	Infant, neonate	0010-30-42720
3-leadwire	AHA, IEC	ESU-proof		0010-30-42724
3-leadwire	/	Defibrillation-proof		040-000754-00
3/5-leadwire	AHA, IEC	Defibrillation-proof	Adult, pediatric	0010-30-42719
3/5-leadwire	AHA, IEC	Defibrillation-proof		009-004728-00
3/5-leadwire	AHA, IEC	ESU-proof		0010-30-42723
12-leadwire	AHA	Defibrillation-proof	Adult	0010-30-42721
12-leadwire	IEC	Defibrillation-proof		0010-30-42722

Cable Sets

3-Electrode Cable Sets						
Type	**Compatible with**	**Model**	**Patient Category**	**Part No.**	**Length**	**Remark**
Clip	IEC	EL6304A	Adult, pediatric	0010-30-42732	1m	Long
		EL6302A		0010-30-42725	0.6m	/
		EL6308A	Pediatric	0010-30-42899	0.6m	/
		EL6306A	Infant, neonate	0010-30-42897	1m	Long
		EL6312A		040-000149-00	1m	Long
	AHA	EL6303A	Adult, pediatric	0010-30-42731	1m	Long
		EL6301A		0010-30-42726	0.6m	/
		EL6307A	Pediatric	0010-30-42898	0.6m	/
		EL6305A	Infant, neonate	0010-30-42896	1m	Long
		EL6311A		040-000148-00	1m	Long
Snap	IEC	EL6302B	Adult, pediatric	0010-30-42733	1m	Long
		EL6308B	Pediatric	0010-30-42901	0.6m	/
		EL6312B	Infant, neonate	040-000147-00	1m	Long
	AHA	EL6301B	Adult, pediatric	0010-30-42734	1m	Long
		EL6307B	Pediatric	0010-30-42900	0.6m	/
		EL6311B	Infant, neonate	040-000146-00	1m	Long

5-Electrode Cable Sets						
Type	**Compatible with**	**Model**	**Patient Category**	**Part No.**	**Length**	**Remark**
Clip	IEC	EL6502A	Adult, pediatric	0010-30-42728	0.6m	/
		EL6504A		0010-30-42730	1m to 1.4m	Long
	AHA	EL6501A		0010-30-42727	0.6m	/
		EL6503A		0010-30-42729	1m to 1.4m	Long
Snap	IEC	EL6502B		0010-30-42736	1.4m for F and N; 1m for others	Long
				009-004730-00		
	AHA	EL6501B		0010-30-42735	1.4m for RL and LL; 1m for others	Long
				009-004729-00		

12-Electrode Cable Sets(for iPM 12/iPM 7 and iPM 10/iPM 6 only)						
Type	**Compatible with**	**Model**	**Patient Category**	**Part No.**	**Length**	**Remark**
Clip	IEC	EL6802A	Adult	0010-30-42903	0.8m	Limb
		EL6804A		0010-30-42905	0.6m	Chest
	AHA	EL6801A		0010-30-42902	0.8m	Limb
		EL6803A		0010-30-42904	0.6m	Chest
Snap	IEC	EL6802B	Adult	0010-30-42907	0.8m	Limb
		EL6804B		0010-30-42909	0.6m	Chest
	AHA	EL6801B		0010-30-42906	0.8m	Limb
		EL6803B		0010-30-42908	0.6m	Chest

29.2 SpO_2 Accessories

Extension Cable

Module type	Remarks	Part No.
Mindray	/	0010-20-42710
	7 pins	009-004600-00
Masimo	8 pins, purple connector	040-000332-00
Nellcor	8 pins	0010-20-42712

SpO_2 Sensors

The SpO_2 sensor material that patients or other staff will come into contact with have 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.**	**Application Site**
Disposable	MAXAI	Adult (>30Kg)	0010-10-12202	Finger
	MAXPI	Pediatric (10 to 50Kg)	0010-10-12203	Finger
	MAXII	Infant (3 to 20Kg)	0010-10-12204	Toe
	MAXNI	Neonate (<3Kg), Adult (>40Kg)	0010-10-12205	Foot Finger
	520A	Adult	520A-30-64101	Finger
	520A		009-005087-00	
	521A		009-005091-00	
	520P	Pediatric	520P-30-64201	Finger
	520P		009-005088-00	
	521P		009-005092-00	
	520I	Infant	520I-30-64301	Toe
	520I		009-005089-00	
	521I		009-005093-00	
	520N	Neonate	520N-30-64401	Foot
	520N		009-005090-00	
	521N		009-005094-00	

Mindray SpO_2 Module				
Type	**Model**	**Patient Category**	**Part No.**	**Application Site**
Reusable	DS-100A	Adult	9000-10-05161	Finger
	OXI-P/I	Pediatric, Infant	9000-10-07308	Finger
	OXI-A/N	Adult Neonate	9000-10-07336	Finger Foot
	ES-3212-9	Adult	0010-10-12392	Finger Finger Foot
	518B	Neonate (Multi-sites)	518B-30-72107	/
	518C	Neonate (Multi-sites)	040-000330-00	/
	512E	Adult (Finger type)	512E-30-90390	Finger
	512E		115-027653-00	
	512F		512F-30-28263	
	512G	Pediatric (Finger type)	512G-30-90607	Finger
	512H		512H-30-79061	

Masimo SpO_2 Module				
Type	**Model**	**Patient Category**	**Part No.**	**Application Site**
Disposable	LNCS NeoPt-L	Pediatric Neonate	0010-10-42626	Finger Foot
	LNCS Neo-L	Neonate	0010-10-42627	Foot
	LNCS Inf-L	Infant	0010-10-42628	Toe
	LNCS Pdtx	Pediatric	0010-10-42629	Finger
	LNCS Adtx	Adult	0010-10-42630	Finger
Reusable	LNCS DCI	Adult	0010-10-42600	Finger
	LNCS DCIP	Pediatric	0010-10-42634	Finger
	LNCS YI	Adult Pediatric Neonate	0010-10-43016	Finger Finger Foot
Nellcor SpO_2 Module				
Type	**Model**	**Patient Category**	**Part No.**	**Application Site**
Disposable	MAXAI	Adult (>30Kg)	0010-10-12202	Finger
	MAXPI	Pediatric (10 to 50Kg)	0010-10-12203	Finger
	MAXII	Infant (3 to 20Kg)	0010-10-12204	Toe
	MAXNI	Neonate (<3Kg) Adult (>40Kg)	0010-10-12205	Foot Finger
Reusable	DS-100A	Adult	9000-10-05161	Finger
	OXI-P/I	Pediatric Infant	9000-10-07308	Finger Toe
	OXI-A/N	Adult Neonate	9000-10-07336	Finger Foot
	D-YS	Adult, Pediatric, Infant, Neonate	0010-10-12476	/

- Wavelength emitted by the sensors is between 600 nm and 1000 nm.
- The maximum photic output consumption of the sensor is less than 18 mW.

The information about the wavelength range and maximum photic output consumption can be especially useful to clinicians (for example, when photodynamic therapy is performed).

29.3 NIBP Accessories

Tubing

Type	Patient Category	Part No.
Reusable	Adult, pediatric, infant	6200-30-09688
	Neonate	6200-30-11560

Reusable Cuff

Model	Patient Category	Measurement Site	Limb Circumference (cm)	Bladder Width (cm)	Part No.
CM1200	Small infant	Arm	7 to 13	5.8	115-002480-00
CM1201	Infant		10 to 19	9.2	0010-30-12157
CM1202	Pediatric		18 to 26	12.2	0010-30-12158
CM1203	Adult		24 to 35	15.1	0010-30-12159
CM1204	Large adult		33 to 47	18.3	0010-30-12160
CM1205	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	46 to 66	22.5	040-000993-00
CM1306	Adult	Arm	24 to 35	15.1	115-015930-00
CM1307	Large adult	Arm	33 to 47	18.3	115-015931-00

Disposable Cuff

Model	Patient Category	Measurement Site	Limb Circumference (cm)	Bladder Width (cm)	Part No.
CM1500A	Neonate	Arm	3.1 to 5.7	2.2	001B-30-70677
CM1500B			4.3 to 8.0	2.9	001B-30-70678
CM1500C			5.8 to 10.9	3.8	001B-30-70679
CM1500D			7.1 to 13.1	4.8	001B-30-70680
CM1500E			8 to 15	/	001B-30-70681
CM1501	Infant		10 to 19	7.2	001B-30-70682
CM1502	Pediatric		18 to 26	9.8	001B-30-70683
CM1503	Adult		25 to 35	13.1	001B-30-70684
CM1504	Large adult		33 to 47	16.5	001B-30-70685

CM1505	Adult	Thigh	46 to 66	20.5	001B-30-70686
CM1506	Adult	Arm	25 to 35	13.1	115-016969-00
CM1507	Adult	Arm	33 to 47	16.5	115-016709-00

29.4 Temp Accessories

Temp Cable

Type	Model	Remark	Part No.
Extension cable (reusable)	MR420B	Applicable to sensor MR411 and MR412	0011-30-37391
TEMP adapter cable (2-pin to audio)	MR421	/	0010-30-43056

Temp Probes

Type	Model	Patient Category	Measurement Site	Part No.
Reusable	MR401B	Adult	Esophageal/Rectal	0011-30-37392
	MR403B		Skin	0011-30-37393
	MR402B	Pediatric, infant	Esophageal/Rectal	0011-30-37394
	MR404B		Skin	0011-30-37395
Disposable	MR411	Adult, pediatric, infant	Esophageal/Rectal	0011-30-37398
	MR412		Skin	0011-30-37397

29.5 IBP/ICP Accessories

Material		Part No.
IBP adapter cable		0010-30-43055
IBP extended cable with dual-receptacle		040-001029-00
Accessories Kit No.	**Components**	**Part No.**
6800-30-50876 (Hospira)	IM2201 12Pin IBP Cable	001C-30-70759
	Disposable Transducer	0010-10-42638
	Steady Rest for IBP Transducer and Clamp	M90-000133---
	Steady Rest for IBP Transducer and Clamp	M90-000134---
6800-30-50877 (BD)	IM2202 12Pin IBP Cable	001C-30-70757
	Disposable Pressure Transducer	6000-10-02107
	Transducer/Manifold Mount	0010-10-12156
115-020884-00 (Mindray)	IBP accessory kit, 12 pin	/
ICP		
Model	**Material**	**Part No.**
Gaeltec TYPE.S13	12Pin ICP cable	0010-30-42742
Gaeltec ICT/B	Intracranial Pressure Transducer	0010-10-12151
82-6653	ICP sensor kit, disposable	040-002336-00

It is proved through tests that the following accessories are compatible with the patient monitor. Only the accessories proceeded by "*" are available from our company. If you want to purchase other accessories, contact respective manufacturers and make sure if these accessories are approved for sale in local.

Manufacturer	Accessories
Smith Medical (Medex)	MX961Z14 Logical Cable, to be used in connection with the Adapter Cable (0010-20-42795) MX960 Reusable Transducer Kit MX261 Logical Clamp For Transducer Bracket MX262 Logical Clamp For 2 Transducer Mount Plates MX960E6441 Logical Transducer Mounting Plate (More Logical Clamps are available from Medex. For detailed information, contact Medex.)
Braun	IBP Reusable Cable (REF: 5203511), to be used in connection with the Adapter Cable (0010-20-42795) Combitrans Monitoring Set (contact Braun for detailed information) Combitrans Attachment Plate Holder (REF:5215800) Combitrans Attachment Plate (contact Braun for detailed information)
Memscap	*Truck cable (0010-21-43082) SP844 Physiological Pressure Transducer 844-26 Monitoring Line Set 84X-49 Mounting Bracket
Utah	Reusable Blood Pressure Monitor Interface Cable (REF: 650-206) Deltran Disposable Pressure Transducer System (More Deltran sensors are available from Utah. For detailed information, contact Utah.) Pole Mount Unit (ERF: 650-150) Deltran Three Slot Organizer, Attaches to I.V. Pole Mount (REF: 650-100) Deltran Four Slot Organizer, Attaches to I.V. Pole Mount (REF: 650-105)
Edwards	* IBP Truwave Reusable Cable (0010-21-12179) Pressure Monitoring Kit With Truwave Disposable Pressure Transducer. (More Truwave sensors are available from Edwards. For detailed information, contact Edwards.) DTSC IV Pole Clamp for Model DTH4 Backplate Holder DTH4 Disposable Holder for DPT

29.6 C.O. Accessories

Model	Material	Part No.
CO7702	12Pin C.O. cable.	0010-30-42743
SP4042	TI Sensor	6000-10-02079
SP5045	TI Sensor Housing	6000-10-02080
MX387	12CC Control Syringe W/1CC Stop W/Rotator	6000-10-02081
131HF7	Thermodilution catheter	6000-10-02183
9850A	Cable kit with TI Sensor	0012-00-1519

29.7 CO_2 Accessories

Sidestream CO_2 module

Material	Patient Category	Remark	Part No.
DRYLINE Watertrap	Adult, pediatric	Reusable	9200-10-10530
DRYLINE Watertrap	Neonate		9200-10-10574
Sampling Line Adult 2.5m	Adult, pediatric	Disposable	9200-10-10533
Sampling Line, Neonate, 2.5m	Neonate		9200-10-10555
Adult Nasal CO_2 Sample Cannula	Adult		M02A-10-25937
Pediatric Nasal CO_2 Sample Cannula	Pediatric		M02A-10-25938
Infant Nasal CO2 Sample Cannula	Neonate		M02B-10-64509
DRYLINE Airway Adapter	Adult, pediatric	Straight, disposable	9000-10-07486

Microstream CO_2 Module

Disposable Airway Sampling Line			
Model	**Patient Category**	**Remark**	**Part No.**
XS-04620	Adult, pediatric	/	0010-10-42560
XS-04624		Humidified	0010-10-42561
007768		Long	0010-10-42563
007737		Long, humidified	0010-10-42564
006324	Infant, Neonate	Humidified	0010-10-42562
007738		Long, humidified	0010-10-42565

Disposable Nasal Sampling Line			
Model	**Patient Category**	**Remark**	**Part No.**
009818	Adult, intermediate	/	0010-10-42566
009822		Plus O_2	0010-10-42568
009826		Long, plus O_2	0010-10-42570
008174	Adult	/	0010-10-42577
008177		Humidified	0010-10-42572
008180		Humidified, plus O_2	0010-10-42575
007266	Pediatric	/	0010-10-42567
008175		/	0010-10-42578
008178		Humidified	0010-10-42573
008181		Humidified, plus O_2	0010-10-42576
007269		Plus O_2	0010-10-42569
007743		Long, plus O_2	0010-10-42571
008179	Infant, Neonate	Humidified	0010-10-42574

Mainstream CO_2 Module

Material	Model	Patient Category	Remark	Part No.
Airway adapter	6063	Adult, pediatric	Disposable	0010-10-42662
	6421		Disposable, with mouthpiece	0010-10-42663
	7007		Reusable	0010-10-42665
	6312	Neonate, pediatric	Disposable	0010-10-42664
	7053		Reusable	0010-10-42666
Mask	9960STD	Adult	/	0010-10-42670
	9960LGE		Adult large	0010-10-42669
	9960PED	Pediatric	/	0010-10-42671
Cable management straps	6934-00	/	/	0010-10-42667
Sensor holding clips	8751	/	/	0010-10-42668
Sensor	1022386	Adult, pediatric, neonate	Reusable	6800-30-50760

29.8 AG Accessories (for iPM 12/iPM 7 and iPM 10/iPM 6 only)

Material	Patient Category	Remark	Part No.
Watertrap	Adult, pediatric	Reusable	9200-10-10530
	Neonate		9200-10-10574
Sampling line	Adult, pediatric	Disposable	9200-10-10533
	Neonate		9200-10-10555
Airway adapter	Adult, pediatric, neonate	Disposable, straight	9000-10-07486
	Adult, pediatric, neonate	Disposable, elbow	9000-10-07487

29.9 BIS Accessories (for iPM 12/iPM 7 and iPM 10/iPM 6 only)

Material	Patient Category	Part No.
BIS Cable	Adult, pediatric	6800-30-50761
BISx4 Cable	Adult, pediatric	115-005707-00

*If you need to purchase BIS Quatro, Pediatric, SRS, and CLICK sensors, please contact Covidien.

29.10 Others

Material	Part No.
Lithium battery, LI23S002A	022-000008-00
Power cord	509B-10-05996
U.K. power cord	DA8K-10-14453
European power cord	DA8K-10-14454
U.S. power cord	DA8K-10-14452
Brazil power cord (250V, 10A, 3M)	009-001075-00
South Africa Power Cable (250V, 16A, 3M)	009-001791-00
India power cord	0000-10-10903
DC power line to vehicle (for iPM 8/iPM 5 only)	M03-010089-00
Grounding cable	1000-21-00122
Synchronization/Nurse call/ analog output cable	009-002492-00
BeneView T1 connecting cable	009-002234-00
Display, 17"	0000-10-11284
Display, 19"	023-001129-00
USB drive, 4G	023-000217-00
	023-000218-00
Recorder	TR6F-30-67306
Thermal paper	A30-000001---
Wall mount bracket for external display	0010-30-42956
Rolling bracket	045-000670-00
Wall mount	045-000672-00
Bedrail Hook subassembly (iPM 6/iPM 7/iPM 10/iPM 12)	115-012698-00
Bedrail Hook subassembly (iPM 5/iPM 8)	115-012697-00
Transition Plate Kit	115-012695-00
Beneview data output package (CD, Cable, User's Guide)	6800-30-51213
Cable protecting tube	009-003648-00
Accessories management tape	009-003903-00
Barcode scanner	023-001158-00

A Product Specifications

A.1 Monitor Safety Specifications

A.1.1 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 and AG monitoring. Type CF defibrillation proof for ECG, RESP, TEMP, SpO_2, NIBP, IBP and C.O..
Mode of operation	Continuous
Degree of protection against harmful ingress of water	IPX1

A.1.2 Environmental Specifications

WARNING

- **The equipment may not meet the performance specifications if stored or used outside the specified temperature and humidity ranges.**

Main unit		
Item	**Operating conditions**	**Storage conditions**
Temperature (°C)	0 to 40	iPM 8/iPM 5: -30 to 70 iPM 12/ iPM 10/iPM 7/iPM 6: -20 to 60
Relative humidity (noncondensing)	15% to 95%	10% to 95%
Barometric (kPa)	57.0 to 107.4	16.0 to 107.4

Microstream CO_2 module		
Item	**Operating conditions**	**Storage conditions**
Temperature (°C)	0 to 40	-20 to 60
Relative humidity (noncondensing)	15% to 95%	10% to 95%
Barometric (kPa)	57.3 to 105.3	57.3 to 105.3

Sidestream CO_2 module		
Item	**Operating conditions**	**Storage conditions**
Temperature (°C)	5 to 40	-20 to 60
Relative humidity (noncondensing)	15% to 95%	10% to 95%
Barometric (kPa)	57.3 to 105.3	57.3 to 105.3

Mainstream CO_2 module		
Item	**Operating conditions**	**Storage conditions**
Temperature (°C)	0 to 40	-20 to 60
Relative humidity (noncondensing)	15% to 90%	10% to 90%
Barometric (kPa)	57.0 to 107.4	53.3 to 107.4

AG module		
Item	**Operating conditions**	**Storage conditions**
Temperature (°C)	10 to 40	-20 to 60
Relative humidity (noncondensing)	15% to 95%	10% to 95%
Barometric (kPa)	70 to 107.4	70 to 107.4

NOTE

- **The environmental specifications of unspecified parameters are the same as those of the main unit of iPM 12/iPM 10/iPM 7/iPM 6.**

A.2 Power Supply Specifications

AC power		
Line voltage		100 to 240 VAC (±10%)
Current		1.3 to 0.5 A
Frequency		50/60 Hz (±3Hz)
DC power (available for iPM 8/iPM 5 only)		
Voltage		12 VDC (±10%)
Current		3.5 A
Battery		
Battery Type		Chargeable Lithium-Ion, 11.1DVC, 4.5 Ah
Run time	iPM 12/iPM 7	≥ 4 hours when powered by a new fully-charged battery (25°C, SpO_2, ECG, disconnected from Temp cable, Auto NIBP measurements at intervals of 15 minutes) ≥ 8 hours when powered by two new fully-charged batteries (25°C, SpO_2 sensor and ECG cable connected,, Temp cable not connected,, Auto NIBP measurements at an interval of 15 minutes)
	iPM 10/iPM 6	≥ 4 hours when powered by a new fully-charged battery (25°C, SpO_2 sensor and ECG cable connected,, Temp cable not connected,, Auto NIBP measurements at an interval of 15 minutes)
	iPM 8/iPM 5	≥ 6 hours when powered by a new fully-charged battery (25°C, SpO_2 sensor and ECG cable connected,, Temp cable not connected,, Auto NIBP measurements at an interval of 15 minutes
Charge time		Less than 3 hours to 90%, and less than 4 hours to 100% when the monitor is off. Less than 8 hours to 90%, and less than 12 hours to 100% when the monitor is on.
Shutdown delay		at least 20 min (after a low battery alarm first occurs)

A.3 Physical Specifications

Model	Size (Width × Height × Thickness)	Weight	Remark
iPM 12/iPM 7	318mm × 274mm × 128mm	≤4.5 kg	Standard parameters, including touchscreen and recorder, and battery (2 batteries for iPM 12/iPM 7)
iPM 10/iPM 6	282mm × 252mm × 128mm	≤4.0 kg	
iPM 8/iPM 5	238mm × 225mm × 128mm	≤3.5 kg	

A.4 Hardware Specifications

A.4.1 Display

Host display			
	Screen Size (diagonal)	**Screen type**	**Resolution**
iPM 12/iPM 7	12.1″	color LED	800×600 pixels
iPM 10/iPM 6	10.4″		
iPM 8/iPM 5	8.4″		
External display			
Screen type		Medical-grade LED	

A.4.2 Recorder

Method	Thermal dot array
Paper width	50 mm±1 mm
Paper speed	25 mm/s or 50 mm/s with accuracy within ±5%
Number of waveform channels	Maximum 3

A.4.3 LEDs

Alarm lamp	1 (two color coded: yellow and red)
Power on LED	1 (green)
AC power LED	1 (green)
Battery LED	1 (green)

A.4.4 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.4.5 Monitor Interface Specifications

Power	1 AC power input connector
	1 DC power input connector (for iPM 8/iPM 5 only)
Wired network	1 RJ45 connector, 100 Base-TX, IEEE 802.3
USB	2 connectors, USB 2.0
Equipotential Grounding Terminal	1
Multifunctional connector	1
VGA connector	1

A.4.6 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≥2.5V Pulse width: 10ms±5% Signal rising and falling time: ≤100μs
IBP Analog Output (For iPM 12/iPM 7 only)	
Bandwidth (-3dB; reference frequency:1Hz)	DC to 40 Hz
Max transmission delay	30 ms
Sensitivity	1 V/100 mmHg ±5%
Nurse Call Signal	
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.
Rising and falling time	≤1 ms
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 (Network connector)	
Alarm delay time from patient monitor to remote equipment	The alarm delay time from the patient monitor to remote equipment is ≤2 seconds, measured at the patient monitor's signal output connector.

A.5 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
Parameter alarms	100 physiological alarms and manual events and related parameter waveforms.
Arrh. events	100 arrhythmia events and relate waveforms and parameters.
NIBP measurements	1000 sets
Full-disclosure waveforms	48 hours at maximum. The specific storage time depends on the waveforms stored and the number of stored waveforms.

A.6 Wireless Network

Standards	WM1010BGN Wireless Module: IEEE 802.11b/g/n, support Wi-Fi MSD45N Wireless Module: IEEE 802.11a/b/g/n, support Wi-Fi

A.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 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 (for iPM 12/iPM 7 and iPM 10/iPM 6 only)	
ECG standard	AHA, IEC	
Display sensitivity	1.25 mm/mV (X0.125), 2.5 mm/mV (X0.25), 5 mm/mV (X0.5), 10 mm/mV (X1), 20 mm/mV (X2), 40 mm/mV (X4) Accuracy: ±5%	
Sweep speed	6.25 mm/s, 12.5 mm/s, 25 mm/s, 50 mm/s, Accuracy: ±10%	
Bandwidth (-3dB)	Diagnostic mode: Monitor mode: Surgical mode: ST mode:	0.05 to 150 Hz 0.5 to 40 Hz 1 to 20 Hz 0.05 to 40 Hz
Common mode rejection ratio	Diagnostic mode: Monitor mode: Surgical mode: ST mode:	>90 dB >105 dB >105 dB >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	Based on IEC 60601-2-25 to determine frequency response.	

Electrode offset potential tolerance	±500 mV
Lead-off detection current	Measuring electrode: <0.1 μA Drive electrode: <1 μA
Input offset current	Measuring electrode: ≤0.1 μA Drive electrode: ≤1 μA
Defibrillation protectionBaseline recovery time	Enduring 5000V (360 J) charge without data loss or corruption Baseline recovery time: <5 s (after defibrillation) Polarization recovery time: <10 s Defibrillation energy absorption: <10% (100Ω load)
Patient leakage current	<10 uA
Calibration signal	1mV (peak-to-peak value) Accuracy: ±5%
ESU protection	Cut mode: 300 W Coagulate mode: 100 W Recovery time: ≤10 s In compliance with the requirements in clause 202.6.2.101 of IEC 60601-2-27
Pace Pulse	
Pace pulse markers	Pace pulses meeting the following conditions are labelled with a PACE marker: Amplitude: ±2 to ±700 mV Width: 0.1 to 2 ms Rise time: 10 to 100 μs
Pace pulse rejection	When tested in accordance with the IEC60601-2-27: 201.12.1.101.13, the heart rate meter rejects all pulses meeting the following conditions. Amplitude: ±2 to ±700 mV Width: 0.1 to 2 ms Rise time: 10 to 100 μs
Sampling rate	500 samples/s (A/D) 500 samples/s (ECG algorithm)
Accuracy	2.44μV/LSB

Mindray algorithm

HR		
Measurement range	Neonate: Pediatric: Adult:	15 to 350 bpm 15 to 350 bpm 15 to 300 bpm
Resolution	1 bpm	
Accuracy	±1 bpm or ±1%, whichever is greater.	
Sensitivity	200μV (lead II)	
HR averaging method	In compliance with the requirements in Clause 201.7.9.2.9.101 b) 3) of IEC60601-2-27, the following method is used: If the last 3 consecutive RR intervals are greater than 1200 ms, the 4 most recent RR intervals are averaged to compute the HR. Otherwise, heart rate is computed by subtracting the maximum and minimum ones from the most recent 12 RR intervals and then averaging them. The HR value displayed on the monitor screen is updated every second.	

Response to irregular rhythm	In compliance with the requirements in Clause 201.7.9.2.9.101 b) 4) of IEC60601-2-27, the heart rate after 20 seconds of stabilization is displayed as follows: Ventricular bigeminy (3a): 80±1 bpm Slow alternating ventricular bigeminy (3b): 60±1 bpm Rapid alternating ventricular bigeminy (3c): 120±1 bpm Bidirectional systoles (3d): 90±2 bpm	
Response time to heart rate change	Meets the requirements of IEC60601-2-27: Clause 201.7.9.2.9.101 b) 5 From 80 to 120 bpm: less than 11 s From 80 to 40 bpm: less than 11 s	
Time to alarm for tachycardia	Meets the requirements of IEC60601-2-27: Clause 201.7.9.2.9.101 b) 6. Waveform 4ah - range: < 11 s 4a - range: < 11 s 4ad - range: < 11 s Waveform 4bh - range: < 11 s 4b - range: < 11 s 4bd - range: < 11 s	
Tall T-wave rejection capability	When the test is performed based on Clause 201.7.9.2.9.101 b) 2)of IEC60601-2-27, the heart rate meter will reject all 100 ms QRS complexes with less than 1.2 mV of amplitude, and T waves with T-wave interval of 180 ms and those with Q-T interval of 350 ms.	
Arrhythmia Analysis Classifications	Asystole, VFib/VTac, Vtac, Vent. Brady, Extreme Tachy, Extreme Brady, PVC, Couplet, Bigeminy, Trigeminy, R on T, Run PVCs, PVCs, Tachy, Brady, Missed Beats, Vent. Rhythm, PNP, PNC, Multif. PVC, Nonsus. Vtac, Pause, Irr. Rhythm, Afib	
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	
Resolution	0.01 mV	
QT/QTc Analysis		
Measurement range	QT: 200 to 800 ms QTc: 200 to800 ms QT-HR: 15 to 150 bpm for adult, 15 to 180 bpm for pediatric and neonate	
QT Accuracy	±30 ms ±30 ms	
Resolution	QT: 4 ms QTc: 1 ms	
Alarm limit	**Range**	**Step**
HR High	(low limit + 2) to 300 bpm	1bpm
HR Low	15 to (high limit – 2) bpm	
ST High	(low limit +0.2) to 2.0 mV	0.1mV
ST Low	-2.0 to (high limit – 0.2) mV	
QTc High	200 to 800 ms	10 ms
∆ QTc High	30 to 200 ms	

Mortara algorithm

Only the differences from the Mindray algorithm are listed.

HR	
HR averaging method	In compliance with the requirements in Clause 201.7.9.2.9.101 b) 3)of IEC60601-2-27, the following method is used: Heart rate is computed by averaging the most recent 16 RR intervals, unless the HR by averaging the most recent 4 heart beats is less than or equals to 48. The HR value displayed on the monitor screen is updated every second.
Time to alarm for tachycardia	Meets the requirements of 201.7.9.2.9.101 b) 6). 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
Arrhythmia Analysis Classifications	Asystole, Vfib, Vtac, Vent. Rhythm, Couplet, Run PVCs, Bigeminy, Trigeminy, R on T, Multif. PVC, Irr. Rhythm, Tachy, Brady, Missed Beats, PNP, PNC
ST Segment Analysis	
Refreshing rate	per 16 heartbeats

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 2500Ω (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	0 to 200 rpm	
Resolution	1 rpm	
Accuracy	0 to 120 rpm: ±1 rpm 121 to 200 rpm: ±2 rpm	
Apnea alarm time	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s	
Alarm limit	**Range (rpm)**	**Step (rpm)**
RR High	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 (%)
SpO_2 High	(low limit + 2) to 100	1
SpO_2 Low	Mindray, Masimo: Desat to (high limit – 2) Nellcor: Desat or 20 (whichever is greater) to (high limit – 2)	
Desat	0 to (high limit – 2)	

Mindray SpO_2 Module

Standards	Meet standards of ISO80601-2-61
*Measurement accuracy verification: The SpO_2 accuracy has been verified in human experiments by comparing with arterial blood sample reference measured with a CO-oximeter. Pulse oximeter measurement are statistically distributed and about two-thirds of the measurements are expected to come within the specified accuracy range compared to CO-oximeter measurements.	
SpO_2 measurement range	0 to 100%
Resolution	1%
Response time	≤ 30 s (PI > 0.3, no disturbance, SpO_2 value sudden change within 70% - 100%) ,
Accuracy	70 to 100%: ±2% (adult/pediatric 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	≤ 2 s
PI measurement range	0.05% to 20%

Masimo SpO_2 Module

Standards	Meet standards of ISO80601-2-61
SpO_2 measurement range	1 to 100%
Resolution	1%
Response time	≤ 20 s (PR 75 bpm, average time 8 s, SpO_2 value rises from 60% to 95%)
Accuracy[1]	70 to 100%: ±2% (measured without motion in adult/pediatric mode) 70 to 100%: ±3% (measured without motion in neonate mode) 70 to 100%: ±3% (measured with motion) 1% to 69%: Not specified.
Refreshing rate	≤ 2 s
SpO_2 averaging time	2-4 s, 4-6 s, 8 s, 10 s, 12 s, 14 s, 16 s
Low perfusion conditions	Pulse amplitude: >0.02% Light penetration: >5%

Low perfusion SpO_2 accuracy[2]	±2%

[1] The Masimo pulse oximeter with sensors have been validated for no motion accuracy in human blood studies on healthy adult volunteers in induced hypoxia studies in the range of 70% to 100% SpO_2 against a laboratory co-oximeter and ECG monitor. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population. One percent was added to the accuracies for neonatal sensors to account for accuracy variation due to properties of fetal hemoglobin.
The Masimo pulse oximeter with sensors has been validated for motion accuracy in human blood studies on healthy adult volunteers in induced hypoxia studies while performing rubbing and tapping motions at 2 to 4 Hz. At an amplitude of 1 to 2 cm and non-repetitive motion between 1 to 5 Hz. At an amplitude of 2 to 3 cm in induced hypoxia studies in the range of 70% to 100% SpO_2 against a laboratory co-oximeter and ECG monitor. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

[2] The Masimo pulse oximeter has been validated for low perfusion accuracy in bench top testing against a Biotek Index 2 simulator and Masimo's simulator with signal strengths of greater than 0.02% and a % transmission of greater than 5% for saturations ranging from 70 to 100%. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

Nellcor SpO_2 Module

Standards	Meet standards of ISO80601-2-61
Measurement range	0 to 100%
Resolution	1%
Response time	≤ 30 s (PI > 0.3, no disturbance, SpO_2 value sudden change within 70% - 100%)
Accuracy	70 to 100%: ±2% (adult/pediatric) 70 to 100%: ±3% (neonate) 0% to 69%: Not specified.
*: When the SpO_2 sensor is applied for neonatal patients as indicated, the specified accuracy range is increased by ±1%, to compensate for the theoretical effect on oximeter measurements of fetal hemoglobin in neonatal blood.	

Information of the Test Subjects of the Clinical Study Report:

Skin color	Gender	Number	Age (years)	Health
Black	Male	1	28.2±9.19	Healthy
	Female	1		
Yellow	Male	3		
	Female	9		

A.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 300 bpm
Resolution	1 bpm
Response time	≤ 30 s (PI > 0.3, no disturbance, PR value sudden change within 25 – 250 bpm)
Accuracy	±3 bpm
Refreshing rate	1 s

PR from Masimo SpO_2 Module

Measurement range	25 to 240 bpm
Resolution	1 bpm
Response time	≤ 30 s (PI > 0.3, no disturbance, PR value sudden change within 25 – 240 bpm)
Accuracy	±3 bpm (measured without motion) ±5 bpm (measured with motion)
Refreshing rate	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 PR accuracy	±3 bpm

PR from Nellcor SpO_2 Module

Measurement range	20 to 300 bpm
Resolution	1 bpm
Response time	≤ 30 s (PI > 0.3, no disturbance, PR value sudden change within 25 – 250 bpm)
Accuracy	20 to 250 bpm: ±3 bpm 251 to 300 bpm, not specified
Refreshing rate	1 s

PR from NIBP Module

Measurement range	30 to 300 bpm
Resolution	1 bpm
Accuracy	±3bpm or ±3%, whichever is greater

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

A.7.5 NIBP

Standards	Meet standards of IEC60601-2-30			
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			
STAT mode cycle time	5 min			
Max measurement time	Adult, pediatric: 180 s Neonate: 90 s			
Measurement ranges (mmHg)		Adult	Pediatric	Neonate
	Systolic:	25 to 290	25 to 240	25 to 140
	Diastolic:	10 to 250	10 to 200	10 to 115
	Mean:	15 to 260	15 to 215	15 to 125
Accuracy	Max mean error: ±5 mmHg Max standard deviation: 8 mmHg			
Resolution	1mmHg			
Initial cuff inflation pressure range (mmHg)	Adult: 80 to 280 Pediatric: 80 to 210 Neonate: 60 to 140			
Default initial cuff inflation pressure (mmHg)	Adult: 160 Pediatric: 140 Neonate: 90			
Software overpressure protection	Adult: 297±3 mmHg Pediatric: 297±3 mmHg Neonate: 147±3 mmHg			
Hardware overpressure protection	Adult: ≤330 mmHg Pediatric: ≤330 mmHg Neonate: ≤165 mmHg			
Static pressure measurement range	0 mmHg to 300 mmHg			
Static pressure measurement accuracy	±3 mmHg			

Alarm limit	Range (mmHg)	Step (mmHg)
Sys High	Adult: (low limit+5) to 270 Pediatric: (low limit+5) to 200 Neonate: (low limit+5) to 135	NIBP ≤ 50: 1 NIBP > 50: 5
Sys Low	40 to (high limit-5)	
Mean High	Adult: (low limit+5) to 230 Pediatric: (low limit+5) to 165 Neonate: (low limit+5) to 110	
Mean Low	20 to (high limit-5)	
Dia High	Adult: (low limit+5) to 210 Pediatric: (low limit+5) to 150 Neonate: (low limit+5) to 100	
Dia Low	10 to (high limit-5)	

**Measurement accuracy verification: In adult and pediatric modes, the blood pressure measurements measured with this device are in compliance with the Standard for Non-invasive sphygmomanometers (ISO 81060-2)in terms of mean error and stardard deviation by comparing with intra-arterial or auscultatory measurements (depending on the configuration) in a typical patient population. For auscultatory reference, the 5th Korotkoff sound was used to determine the diastolic pressure. In neonatal mode, the blood pressure measurements measured with this device are in compliance with the American National Standard for Non-invasive sphygmomanometers (ISO 81060-2) in terms of mean error and stardard deviation by comparing with intra-arterial measurements (depending on the configuration) in a typical patient population.

A.7.6 Temp

Standards	Meet standard of ISO 80601-2-56
Technique	Thermal resistance
Operating mode	Direct mode
Measurement range	0 to 50℃ (32 to 122℉)
Resolution	0.1℃
Accuracy	±0.1℃ (without probe)
Refreshing rate	1 s
Minimum time for accurate measurement	Body surface: <100 s Body cavity: <80 s
Minimum time between measurements	Body surface probe: <100 s Body cavity probe: <80 s

Alarm limit	Range	Step
T1/T2 High	(low limit +1) to 50℃	0.1℃
T1/T2 Low	0.1 to (high limit -1)℃	
TD High	0.1 to 50℃	

A.7.7 IBP

Standards	Meet standard of IEC60601-2-34.
Technique	Direct invasive measurement
IBP	
Measurement range	-50 to 360 mmHg
Resolution	1 mmHg
Accuracy	±2% or ±1 mmHg, whichever is greater (without sensor)
Refreshing rate	1 s
Pressure transducer	
Excitement voltage	5 VDC, ±2%
Sensitivity	5 μV/V/mmHg
Zero adjustment range	±200 mmHg
Impedance range	300 to 3000Ω

Alarm limit	Range (mmHg)	Step (mmHg)
Sys High	(low limit + 2) to 360	1
Mean High		
Dia High		
Sys Low	-50 to (high limit – 2)	
Mean Low		
Dia Low		

A.7.8 C.O.

Measurement method	Thermodilution method	
Measurement range	C.O.:	0.1 to 20 L/min
	TB:	23 to 43°C
	TI:	0 to 27°C
Resolution	C.O.:	0.1 L/min
	TB, TI:	0.1°C
Accuracy	C.O.:	±5% or ±0.1 L /min, whichever is greater
	TB, TI:	±0.1°C (without sensor)
Repeatability	C.O.:	±2% or ±0.1 L/min, whichever is greater
Alarm range	TB:	23 to 43°C

Alarm limit	Range	Step
TB High	(low limit + 1) to 43°C	0.1°C
TB Low	23 to (high limit - 1) °C	

A.7.9 CO_2

Measurement mode	Sidestream, microstream, mainstream
Technique	Infrared absorption

Sidestream CO_2 Module

Standard	Meet standard of ISO 80601-2-55
CO_2 Measurement range	0 to 99 mmHg
Accuracy*	0 to 40 mmHg: ±2 mmHg 41 to 76 mmHg: ±5% of the reading 77 to 99 mmHg: ±10% of the reading
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	Iso accuracy mode: ≤45s Full accuracy mode: ≤10 min
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

Note: The response time is the sum of the rise time and the delay time.

Effect of interference gases on CO_2 measurements		
Gas	**Concentration (%)**	**Quantitive effect***
N_2O	≤60	±1 mmHg
Hal	≤4	
Sev	≤5	
Iso	≤5	
Enf	≤5	
Des	≤15	±2 mmHg

*: means an extra error should be added in case of gas interference when CO_2 measurements are performed between 0-40mmHg.

Inaccuracy specifications are affected by the breath rate and I:E change. The end-tidal gas reading is within specification for breath rate below 15BPM and I:E ratio smaller than 1:1 relative to the gas readings without breath.

Alarm limit	Range	Step
$EtCO_2$ High	(low limit + 2) to 99 mmHg	1 mmHg
$EtCO_2$ Low	1 to (high limit - 2)mmHg	
$FiCO_2$ High	1 to 99 mmHg	
awRR High	Adult, pediatric: (low limit + 2) to 100 rpm Neonate: (low limit + 2) to 150 rpm	1 rpm
awRR Low	0 to (high limit - 2) rpm	

Microstream CO_2 Module

Standard	Meet standard of ISO 80601-2-55
CO_2 Measurement range	0 to 99 mmHg
Accuracy*	0 to 38 mmHg: ±2 mmHg 39 to 99 mmHg: ±5% of the reading+0.08% of (the reading-38)
Accuracy drift	Meet the requirement for measurement accuracy within 6 hours
* This accuracy is applied to respiration rate no greater than 80 rpm. For respiration rate greater than 80 rpm and $EtCO_2$ value greater than 18 mmHg, the accuracy is 4 mmHg or ±12% of the reading, whichever is greater. For respiration rate greater than 60 rpm, the above accuracy can be achieved by using the CapnoLine H Set for Infant/Neonatal. In the presence of interfering gases, the accuracy specification deteriorates by 4% of the above accuracy.	
Resolution	1 mmHg
Sample flow rate	$50^{-7.5}_{+15}$ ml/min
Initialization time	30 s (typical)
Response time	Measured with a FilterLine of standard length: 2.9 s (typical), 4.5 s (Maximum) The response time is the sum of the rise time and the delay time Rise time: <190 ms (10% to 90%) Delay time: 2.7 s (typical)
awRR measurement range	0 to 150 rpm
awRR measurement accuracy	0 to 70 rpm: ±1 rpm 71 to 120 rpm: ±2 rpm

	121 to 150 rpm: ±3 rpm	
Apnea alarm time	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s	
Alarm limit	**Range**	**Step**
$EtCO_2$ High	(low limit + 2) to 99 mmHg	1 mmHg
$EtCO_2$ Low	1 to (high limit – 2)mmHg	
$FiCO_2$ High	1 to 99 mmHg	
awRR High	Adult, pediatric: (low limit + 2) to 100 rpm Neonate: (low limit + 2) to 150 rpm	1 rpm
awRR Low	0 to (high limit – 2) rpm	

Mainstream CO_2 Module

Standard	Meet standard of ISO 80601-2-55	
CO_2 Measurement range	0 to 150 mmHg	
Accuracy	0 to 40 mmHg: ±2 mmHg 41 to 70 mmHg: ±5% of the reading 71 to 100 mmHg: ±8% of the reading 101 to 150 mmHg: ±10% of the reading	
Accuracy drift	Meet the requirement for measurement accuracy within 6 hours	
Resolution	1 mmHg	
Rise time	<60 ms	
awRR measurement range	0 to 150 rpm	
awRR measurement accuracy	±1 rpm	
Apnea alarm time	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s	
Alarm limit	**Range**	**Step**
$EtCO_2$ High	(low limit + 2) to 99 mmHg	1 mmHg
$EtCO_2$ Low	1 to (high limit - 2)mmHg	
$FiCO_2$ High	1 to 99 mmHg	
awRR High	Adult, pediatric: (low limit + 2) to 100 rpm Neonate: (low limit + 2) to 150 rpm	1 rpm
awRR Low	0 to (high limit - 2) rpm	
Accuracy (of the measured CO2 partial pressure) applies for breath rates of up to 80 bpm. For breath rates above 80 bpm, accuracy is 4 mmHg or ±12 % of reading whichever is greater for EtCO2 values exceeding 18 mmHg.		

A.7.10 AG (For iPM 12/ iPM 10/iPM 7/iPM 6 only)

Standards	Meet standard of ISO 80601-2-55	
Technique	Infrared absorption	
Warm-up time	Iso accuracy mode: ≤ 45 s Full accuracy mode: ≤ 10 min	
Sample flow rate	Adult, pediatric: 120, 150, 200 ml/min Neonate: 70, 90, 120 ml/min Accuracy: ±10 ml/min or ±10%, whichever is greater	
Measurement range	CO_2: 0 to 30%	

	O_2:	0 to 100%	
	N_2O:	0 to 100%	
	Des:	0 to 30%	
	Sev:	0 to 30%	
	Enf:	0 to 30%	
	Iso:	0 to 30%	
	Hal:	0 to 30%	
	awRR:	2 to 100 rpm	
Resolution	CO_2:	1 mmHg	
	awRR:	1 rpm	
Full accuracy	Gases	Range ($\%_{REL}$))[1]	Accuracy ($\%_{ABS}$)
	CO_2	0 to 1	±0.1
		1 to 5	±0.2
		5 to 7	±0.3
		7 to 10	±0.5
		>10	Not specified
	N_2O	0 to 20	±2
		20 to 100	±3
	O_2	0 to 25	±1
		25 to 80	±2
		80 to 100	±3
	Des	0 to 1	±0.15
		1 to 5	±0.2
		5 to 10	±0.4
		10 to 15	±0.6
		15 to 18	±1
		>18	Not specified
	Sev	0 to 1	±0.15
		1 to 5	±0.2
		5 to 8	±0.4
		>8	Not specified
	Enf, Iso, Hal	0 to 1	±0.15
		1 to 5	±0.2
		>5	Not specified
	awRR	2 to 60 rpm	±1 rpm
		>60 rpm	Not specified
	Note [1]: The highest GAS LEVEL for a single halogenated anaesthetic gas in a gas mixture that is concealed when the anaesthetic concentration falls is 0.15/0.3% (Full/ISO accuracy).		

Accuracy drift	Meet the requirement for measurement accuracy within 6 hours			
Apnea alarm time	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s			
Refreshing rate	1 s			
Response time	Using the DRYLINE™ water trap and neonatal DRYLINE™ sampling line (2.5m):			
		120 ml/min	90 ml/min	70 ml/min
	CO_2	≤4S s	≤ 4.5 s	≤5 s

	N_2O	≤4.2 s	≤5 s	≤5.5 s
	O_2	≤4 s	≤5 s	≤6 s
	Hal, Iso, Sev, Enf	≤4.4 s	≤5.2 s	≤6 s
	Des	≤4.4 s	≤5 s	≤6 s
	Using the DRYLINE™ water trap and adult DRYLINE™ sampling line (2.5m)			
		200 ml/min	150 ml/min	120 ml/min
	CO_2	≤4.2 s	≤4.8 s	≤5.5 s
	N_2O	≤4.3 s	≤5 s	≤5.8 s
	O_2	≤4 s	≤4.6 s	≤5.5 s
	Hal, Iso, Sev, Enf, Des	≤4.5 s	≤5.2 s	≤6 s
Anesthetic agent limit	Primary anesthetic agent In full accuracy mode: 0.15%,			
	Second anesthetic agent: In full accuracy mode: 0.3% or 5% REL (10% REL for Isoflurane) of primary agent if primary agent is greater than 10%			
Inaccuracy specifications are affected by the breath rate and I:E change. The end-tidal gas reading is within specification for breath rate below 15BPM and I:E ratio smaller than 1:1 relative to the gas readings without breath; Add ±6%REL to inaccuracy for HAL and O_2 for breath rate larger than 15 BPM; Add ±6%REL to inaccuracy for all gases for breath rate larger than 30 BPM (inaccuracy for HAL and O_2 are unspecified in this case); inaccuracy is unspecified for breath rate larger than 60 BPM.				

Effect of interference gases on AG measurements					
Gas	**Concentration(%)**	**Quantitive effect(%ABS)[3)]**			
		CO_2	**N_2O**	**Agent [1)]**	**O_2**
CO_2	/	/	0.1	0	0.2
N_2O	/	0.1	/	0.1	0.2
Agent [1) 2)]	/	0.1	0.1[5)]	0.1[4)]	1.0
Xenon	<100%	0.1	0	0	/
Helium	<50%	0.1	0	0	/
Ethanol	<0.1%	0	0	0	/
Acetone	<1%	0.1	0.1	0	/
Methane	<1%	0.1	0.1	0	/
Saturated Isopropanol vapour	/	0.1	0	0	/
O_2	/	0.1	0.1	0.1	/

1) Agent represents one of Des, Iso, Enf, Sev, and Hal.

2) Multiple agent interference on CO_2, N_2O and O_2 is typically the same as single agent interference.

3) For CO_2, N_2O and Agents, maximum interference from each gas at concentrations within specified accuracy ranges for each gas. The total interference of all gases is never larger than $5\%_{REL}$.

4) Applicable to type A AG module, representing the interference effect of secondary anesthetic agents on primary anesthetic agent.

5) Measurement interference to type M AG module originates from the applied anesthetic agent that is configured manually.

Alarm limit	Range		Step
$EtCO_2$ High	(low limit + 2) to 99 mmHg		1 mmHg
$EtCO_2$ Low	1to (high limit - 2)mmHg		
$FiCO_2$ High	1 to 99 mmHg		
awRR High	Adult, pediatric: Neonate:	(low limit + 2) to 100 rpm (low limit + 2) to 150 rpm	1 rpm
awRR Low	0 to (high limit - 2)rpm		
EtO_2 High	(low limit + 2) to 100 %		0.1%
EtO_2 Low	18 to (high limit - 2)%		
FiO_2 High	(low limit + 2) to 100 %		
FiO_2 Low	18 to (high limit - 2)%		
EtN_2O High	(low limit + 2) to 100 %		1%
EtN_2O Low	0 to (high limit - 2)%		
FiN_2O High	(low limit + 2) to 100 %		
FiN_2O Low	0 to (high limit - 2)%		
EtHal/Enf/Iso High	(low limit + 0.2) to 5.0 %		0.1%
EtHal/Enf/Iso Low	0 to (high limit - 0.2)%		
FiHal/Enf/Iso High	(low limit + 0.2) to 5.0 %		
FiHal/Enf/Iso Low	0 to (high limit - 0.2)%		
EtSev High	(low limit + 0.2) to 8.0 %		0.1%
EtSev Low	0 to (high limit - 0.2)%		
FiSev High	(low limit + 0.2) to 8.0 %		
FiSev Low	0 to (high limit - 0.2)%		
EtDes High	(low limit + 0.2) to 18.0 %		0.1%
EtDes Low	0 to (high limit - 0.2)%		
FiDes High	(low limit + 0.2) to 18.0 %		
FiDes Low	0 to (high limit - 0.2)%		

A.7.11 BIS (For iPM 12/ iPM 10/iPM 7/iPM 6 only)

Standards	Meet standard of IEC 60601-2-26	
Technique	Bispectral index	
Measured parameters	EEG BIS, BIS L, BIS R：0 to 100	
Calculated parameters	SQI, SQI L, SQI R:0 to 100% EMG, EMG L, EMG R:0 to 100 dB SR, SR L, SR R:0 to 100% SEF, SEF L, SEF R:0.5 to 30.0 Hz TP, TP L, TP R:40 to 100 dB BC, BC L, BC R:0 to 30 sBIS L, sBIS R:0 to 10.0 sEMG L, sEMG R:0 to 10.0 ASYM:0 to 100%	
Impedance range	0 to 999 kΩ	
Sweep speed	6.25 mm/s, 12.5 mm/s, 25 mm/s or 50 mm/s	
Input impedance	>5 MΩ	
Noise (RTI)	<0.3 μV (0.25 to 50 Hz)	
Input signal range	±1 mV	
EEG bandwidth	0.25 to 100 Hz	
Patient leakage current	<10 μA	
Alarm limit	**Range**	**Step**
BIS High	(low limit + 2) to 100	1
BIS Low	0 to (high limit – 2)	

FOR YOUR NOTES

B EMC and Radio Regulatory Compliance

B.1 EMC

The device meets the requirements of IEC 60601-1-2: 2014.

⚠WARNING

- **Use of accessories, transducers and cables other than those specified or provided by the manufacturer of this device could result in increased electromagnetic emissions or decreased electromagnetic immunity of this device and result in improper operation.**
- **Use of this device adjacent to or stacked with other device should be avoided because it could result in improper operation. If such use is necessary, this device and the other device should be observed to verify that they are operating normally.**
- **Portable RF communications equipment (including peripherals such as antenna cables and external antennas) should be used no closer than 30 cm (12 inches) to any part of the this device, including cables specified by the manufacturer. Otherwise, degradation of the performance of this device could result.**
- **The non-ME EQUIPMENT (e.g. ITE) that is a part of an ME SYSTEM may be disrupted by the electromagnetic interference of nearby equipment. It may be necessary to take mitigation measures, such as re-orienting or relocating the non-ME EQUIPMENT or shielding the location.**
- **This device is intended for use in professional healthcare facility EMC environment. If it is used in special environment, such as magnetic resonance imaging environment, the equipment/system may be disrupted by the operation of nearby equipment.**

Guidance and Declaration - Electromagnetic Emissions		
The device is intended for use in the electromagnetic environment specified below. The customer or the user of the device should assure that it is used in such an environment.		
Emission test	**Compliance**	**Electromagnetic environment - guidance**
Conducted and radiated RF EMISSIONS CISPR 11	Group 1	The device uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic device.
Conducted and radiated RF EMISSIONS CISPR 11	Class A	The device is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic distortion IEC 61000-3-2	Class A	The device is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Voltage fluctuations and flicker IEC 61000-3-3	Complies	

NOTE

- **The device needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided in appendix B.**
- **Other devices may affect this device even though they meet the requirements of CISPR.**
- **When the inputted signal is below the minimum amplitude provided in technical specifications, erroneous measurements could result.**
- **The EMISSIONS characteristics of this device make it suitable for use in industrial areas and hospitals (CISPR 11 class A). If it is used in a residential environment (for which CISPR 11 class B is normally required) this device might not offer adequate protection to radio-frequency communication services. The user might need to take mitigation measures, such as relocating or re-orienting the device.**
- **If the essential performance is lost or degraded, it may be necessary to take mitigation measures, such as re-orienting or relocating the ME EQUIPMENT or ME SYSTEM or shielding the location or stopping using the monitor and contact the service personnel.**

If the device is operated within the electromagnetic environment listed in Table **Guidance and Declaration —Electromagnetic Immunity**, the system will remain safe and provide the following essential performance:

- **Operating mode**
- **Accuracy**
- **Function**
- **Accessories identification**
- **Data stored**
- **Alarm**

- **Detect for connection**

Guidance and Declaration - Electromagnetic Immunity			
The device is intended for use in the electromagnetic environment specified below. The customer or the user of the device should assure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	±8 kV contact ±15kV air	±8 kV contact ±15kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	±2 kV for power supply lines ±1 kV for input/output lines (length greater than 3 m)	±2 kV for power supply lines ±1 kV for input/output lines (length greater than 3 m)	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1 kV line(s) to line(s) ±2 kV line(s) to earth	±1 kV line(s) to line(s) ±2 kV line(s) to earth	
Voltage dips and Voltage interruptions IEC 61000-4-11	0 % U_T for 0,5 cycle 0 % U_T for 1 cycle and 70 % U_T for 25/30 cycles 0 % U_T for 250/300 cycle	0 % U_T for 0,5 cycle 0 % U_T for 1 cycle and 70 % U_T for 25/30 cycles 0 % U_T for 250/300 cycle	Mains power quality should be that of a typical commercial or hospital environment. If the user of our product requires continued operation during power mains interruptions, it is recommended that our product be powered from an uninterruptible power supply or a battery.
RATED power frequency magnetic fields IEC 61000-4-8	30 A/m 50 Hz / 60 Hz	30 A/m 50 Hz / 60 Hz	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Note: U_T is the A.C. mains voltage prior to application of the test level.			

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	IEC 60601 Test level	Compliance level	Electromagnetic environment - guidance
Conducted disturbances induced by RF fields IEC61000-4-6	3 Vrms 150 kHz to 80 MHz	3 Vrms	Portable and mobile RF communications equipment should be used no closer to any part of the device, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance: $d = \left[\frac{3.5}{V}\right]\sqrt{P}$ 150k to 80 MHz $d = \left[\frac{3.5}{E}\right]\sqrt{P}$ 80 MHz to 800 MHz $d = \left[\frac{7}{E}\right]\sqrt{P}$ 800 MHz to 2.7 GHz where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey[b], should be less than the compliance level in each frequency range[c]. Interference may occur in the vicinity of equipment marked with the following symbol:  .
	6 Vrms in ISM bands[a] between 0,15 MHz and 80 MHz	6 Vrms	
	6 Vrms in ISM bands and amateur radio bands[a] between 0,15 MHz and 80 MHz	6 Vrms (only iPM 8 /iPM 5)	
Radiated RF EM fields IEC61000-4-3	3V/m 80 MHz to 2.7 GHz	3V/m	
	10V/m 80 MHz to 2.7 GHz	10V/m (only iPM 8 /iPM 5)	
	20V/m 80 MHz to 2.5 GHz (IEC80601-2-30, ISO80601-2-56, ISO80601-2-61)	20 V/m (only iPM 8 /iPM 5)	
Proximity fields from RF wireless communications equipment IEC61000-4-3	27 V/m 380–390 MHz	27 V/m	
	28 V/m 430–470 MHz, 800–960 MHz, 1700–1990 MHz, 2400–2570 MHz	28 V/m	
	9 V/m 704–787 MHz, 5100–5800 MHz	9 V/m	

Note 1: At 80 MHz and 800 MHz, the higher frequency range applies.

Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

[a] The ISM (industrial, scientific, and medical) bands between 150 kHz and 80 MHz are 6.765 MHz to 6.795 MHz; 13.553 MHz to 13.567 MHz; 26.957 MHz to 27.283 MHz; and 40.66 MHz to 40.70 MHz. The

amateur radio bands between 0,15 MHz and 80 MHz are 1,8 MHz to 2,0 MHz, 3,5 MHz to 4,0 MHz, 5,3 MHz to 5,4 MHz, 7 MHz to 7,3 MHz, 10,1 MHz to 10,15 MHz, 14 MHz to 14,2 MHz, 18,07 MHz to 18,17 MHz, 21,0 MHz to 21,4 MHz, 24,89 MHz to

24,99 MHz, 28,0 MHz to 29,7 MHz and 50,0 MHz to 54,0 MHz.

[b] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the device is used exceeds the applicable RF compliance level above, the device should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the device.

[c] Over the frequency ranges 150 kHz to 80 MHz, field strengths should be less than 3V/m.

Recommended Separation Distances between Portable and Mobile RF, Communications Equipment and This Equipment

The equipment is intended for use in an electromagnetic environment in which radiated RF disturbance are controlled. The customer or the user of the device can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the device as recommended below, according to the maximum output power of the communication equipment.

Rated Maximum Output power of Transmitter Watts (W)	**Separation Distance According to Frequency of Transmitter (m)**		
	150 kHz to 80 MHz $d = \left[\frac{3.5}{V}\right]\sqrt{P}$	80 MHz to 800 MHz $d = \left[\frac{3.5}{E}\right]\sqrt{P}$	800 MHz to 2.7 GHz $d = \left[\frac{7}{E}\right]\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

For transmitters at a maximum output power not listed above, the recommended separation distanced in meters (m) can be determined using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

Note 1: At 80 MHz and 800 MHz, the higher frequency range applies.

Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

B.2 Radio Regulatory Compliance

RF parameters (WM1010BGN Module)

Type of Radio	IEEE 802.11b/g/n (2.4G)
Operating frequency	2412 - 2462 MHz
Modulation mode	DSSS and OFDM
Output power	< 30 dBm (peak power) < 20 dBm (average power)

RF parameters (MSD45N Module)

Type of Radio	IEEE 802.11b/g/n (2.4G)	IEEE 802.11a/n (5G)
Modulation mode	DSSS and OFDM	OFDM
Operating frequency	ETSI: 2.4 GHz - 2.483 GHz FCC: 2.4 GHz - 2.483 GHz MIC: 2.4 GHz - 2.495 GHz KC: 2.4 GHz - 2.483 GHz	ETSI: 5.15 GHz - 5.35 GHz, 5.47 GHz - 5.725 GHz FCC: 5.15 GHz - 5.35 GHz, 5.47~5.725 GHz， 5.725 GHz - 5.825 GHz MIC: 5.15 GHz - 5.35GH, 5.47~5.725 GHz KC: 5.15 GHz - 5.35 GHz, 5.47~5.725 GHz, 5.725 GHz - 5.825 GHz
Output power	< 30 dBm (peak power) < 20 dBm (average power)	

CE

The radio device used in this product is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EU.

This device complies with part 15 of the FCC Rules and with RSS-210 of Industry Canada. Operation is subject to the condition that this device does not cause harmful interference.

This device must accept any interference received, including interference that may cause undesired operation.

⚠ WARNING

- **Changes or modifications not expressly approved by the party responsible compliance could void the user's authority to operate the equipment.**

FOR YOUR NOTES

C Default Configurations

This chapter lists some of the most important factory default settings for each department 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. The last column of the following tables is for your notes and review.

Note: In this chapter, O.M means the monitor's operating mode. Column C refers to the settings that can be changed in configuration management. Column M refers to the settings that can be changed in monitoring mode.

C.1 Parameters Configuration

C.1.1 ECG

ECG Setup

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
Lead Set		*	*	Auto					
Alm Source		*	*	HR					
Alarm		*	*	On					
Alm Lev		*	*	Med					
HR/PR High	Adu	*	*	120					
	Ped			160					
	Neo			200					
HR/PR Low	Adu	*	*	50					
	Ped			75					
	Neo			100					
Sweep		*	*	25 mm/s					
Beat Vol		*	*	2		1			
Paced			*	No					
Notch Filter		*	*	Weak					
Gain		*	*	X1					
Filter		*	*	Monitor	Surgery	Monitor		Diagnostic	
ECG Display		*	*	Normal					
Pacemaker Rate			*	60					
Minimum QRS Threshold			*	0.16 mV					

ST Analysis

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
ST Analysis	*	*	Off				On	
Alarm	*	*	Off					
Alm Lev	*	*	Med					
ST-X High	*	*	when ST Unit is mV: 0.20 when ST Unit is mm: 2.0					
ST-X Low	*	*	when ST Unit is mV: -0.20 when ST Unit is mm: -2.0					
ISO	*	*	-80 ms					
J			48 ms					
ST			J + 60 ms					

X represents I, II, III, aVR, aVL, aVF, V, V1, V2, V3, V4, V5 or V6.

QT/QTc Analysis

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
QT Analysis	*	*	Off					
QTc Formula	*	*	Hodges					
Analysis Lead	*	*	All					

Arrh. Analysis

Item Name	Algorithm	O.M		Genral	OR	ICU	NICU	CCU	User Defaults
		C	M						
Arrhythmia Threshold Settings									
PVCs High	Mindray	*	*	Adu, Ped: 10 Neo: N/A					
Tachy		*	*	Adu: 120 Ped: 160 Neo: N/A					
Brady		*	*	Adu: 50 Ped: 75 Neo: N/A					
Asys. Delay		*	*	Adu, Ped: 5 Neo: N/A					
Vtac Rate		*	*	Adu, Ped: 130 Neo: N/A					
Vtac PVCs		*	*	Adu, Ped: 6 Neo: N/A					
Multif. PVC's Window		*	*	Adu, Ped: 15 Neo: N/A					

Item Name	Algorithm	O.M		Genral	OR	ICU	NICU	CCU	User Defaults
		C	M						
Extreme Tachy		*	*	Adu: Ped: Neo:	160 180 N/A				
Extreme Brady		*	*	Adu: Ped: Neo:	35 50 N/A				
Vbrd Rate		*	*	Adu, Ped: Neo:	40 N/A				
Vbrd PVCs		*	*	Adu, Ped: Neo:	5 N/A				
Pause Time		*	*	Ad, Ped: Neo:	2 N/A				
PVCs High	Mortara	*	*	Adu, Ped: Neo:	10 N/A				
Asys. Delay		*	*	Adu, Ped: Neo:	5 N/A				
Vtac Rate		*	*	Adu, Ped: Neo:	130 N/A				
Vtac PVCs		*	*	Adu, Ped: Neo:	6 N/A				
Multif. PVC's Window		*	*	Adu, Ped: Neo:	15 N/A				
Tachy		*	*	Adu: Ped: Neo:	120 160 N/A				
Brady		*	*	Adu: Ped: Neo:	50 75 N/A				
Arrhythmia Alarm Settings									
PVCs/min Alarm	Mindray	*	*	Off				On	
R on T Alarm		*	*	Off				On	
Nonsus. Vtac Alarm		*	*	Off				On	
Vent. Rhythm Alarm		*	*	Off				On	
Bigeminy Alarm		*	*	Off				On	
Trigeminy Alarm		*	*	Off				On	
Afib Alarm		*	*	Off				On	
Asystole Alarm		*	*	On					
VFib/VTac Alarm		*	*	On					
Vtac Alarm		*	*	On					

Item Name	Algorithm	O.M		Genral	OR	ICU	NICU	CCU	User Defaults
		C	M						
Vent. Brady Alarm		*	*	On					
Extreme Tachy Alarm		*	*	On					
Extreme Brady Alarm		*	*	On					
X Alarm		*	*	Off					
Asystole Alm Lev		*	*	High					
VFib/VTac Alm Lev		*	*	High					
Vtac Alm Lev		*	*	High					
Vent. Brady Alm Lev		*	*	High					
Extreme Tachy Alm Lev		*	*	High					
Extreme Brady Alm Lev		*	*	High					
Run PVCs Alm Lev		*	*	Low					
Pause Alm Lev		*	*	Low					
Couplet Alm Lev		*	*	Prompt					
PVC Alm Lev		*	*	Prompt					
Irr. Rhythm Alm Lev		*	*	Prompt					
PNP Alm Lev		*	*	Prompt					
PNC Alm Lev		*	*	Prompt					
Missed Beats Alm Lev		*	*	Prompt					
Afib Alm Lev		*	*	Prompt					
X Alm Lev		*	*	Med					
X Alm Rec		*	*	Off					
PVCs/min Alarm	Mortara	*	*	Off				On	
R on T Alarm		*	*	Off				On	
Vent. Rhythm Alarm		*	*	Off				On	
Bigeminy Alarm		*	*	Off				On	
Trigeminy Alarm		*	*	Off				On	
Asystole Alarm				On					
VFib Alarm				On					
VTac Alarm				On					
X Alarm		*	*	On					
Asystole Alm Lev		*	*	High					
VFib Alm Lev		*	*	High					

Item Name	Algorithm	O.M		Genral	OR	ICU	NICU	CCU	User Defaults
		C	M						
VTac Alm Lev		*	*	High					
Run PVCs Alm Lev		*	*	Low					
Couplet Alm Lev		*	*	Prompt					
PVC Alm Lev		*	*	Prompt					
Irr. Rhythm Alm Lev		*	*	Prompt					
PNP Alm Lev		*	*	Prompt					
PNC Alm Lev		*	*	Prompt					
Missed Beats Alm Lev		*	*	Prompt					
X Alm Lev		*	*	Med					
X Alm Rec		*	*	Off					

X represents a certain arrhythmia event. Refer to the chapter ***A Product Specifications*** for details. The X in "X Alm Lev" refers to all arrhythmia events except for those specially marked ones.

C.1.2 RESP

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Alarm	*	*	On					
Alm Lev	*	*	Med					
Sweep	*	*	6.25 mm/s					
Lead	*	*	II					
Gain	*	*	X2					
RR High	*	*	Adu, Ped: 30 Neo: 100					
RR Low	*	*	Adu, Ped: 8 Neo: 30					
Apnea Delay	*	*	Adu, Ped: 20 Neo: 15					
Detection Mode	*	*	Auto					
RR Source		*	Auto					

C.1.3 PR

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
Alarm		*	*	On					
Alm Lev		*	*	Med					
HR/PR High	Adu	*	*	120					
	Ped			160					
	Neo			200					
HR/PR Low	Adu	*	*	50					
	Ped			75					
	Neo			100					
PR Source		*	*	SpO_2					
Beat Vol		*	*	2		1			

C.1.4 SpO_2

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Alarm	*	*	On					
Alm Lev	*	*	Med					
SpO_2 High	*	*	Adu, Ped: 100 Neo: 95					
SpO_2 Low	*	*	90					
Desat Limit	*	*	80					
Sweep	*	*	25 mm/s					
NIBP Simul		*	Off					
Sensivity (Mindray)	*	*	Med					
Sensivity (Masimo)	*	*	Normal					
Averaging (Masimo)	*	*	8 s					
Sat-Seconds (Nellcor)	*	*	0 s					
PI Zoom	*	*	No					

C.1.5 Temp

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Alarm	*	*	On					
Alm Lev	*	*	Med					
T1/T2 High (°C)	*	*	38.0					
T1/T2 Low (°C)	*	*	35.0					
TD High (°C)	*	*	2.0					

C.1.6 NIBP

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
Alarm		*	*	On					
Alm Lev		*	*	Med					
Interval		*	*	15 min	5 min	15 min	30 min	15 min	
NIBP End Tone		*	*	Off					
Clock		*	*	On					
Cuff Press. (mmHg)	Adu	*	*	80					
	Ped			60					
	Neo			40					
Initial Pressure (mmHg)	Adu	*	*	160					
	Ped			140					
	Neo			90					
Alarm Limits									
NIBP-S High (mmHg)	Adu	*	*	160					
	Ped			120					
	Neo			90					
NIBP-S Low (mmHg)	Adu	*	*	90					
	Ped			70					
	Neo			40					
NIBP-M High (mmHg)	Adu	*	*	110					
	Ped			90					
	Neo			70					
NIBP-M Low (mmHg)	Adu	*	*	60					
	Ped			50					
	Neo			25					
NIBP-D High (mmHg)	Adu	*	*	90					
	Ped			70					
	Neo			60					
NIBP-D Low (mmHg)	Adu	*	*	50					
	Ped			40					
	Neo			20					

C.1.7 IBP

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
IBP 1 Label		*	*	Art					
IBP 2 Label		*	*	CVP					
Alarm		*	*	On					
Alm Lev		*	*	Med					
Alm Rec			*	Off					
P1 Measure		*	*	All					
P2 Measure		*	*	All					
P3 Measure		*	*	Mean					
P4 Measure		*	*	Mean					
PPV Measurement		*	*	Off					
PPV Source		*	*	Auto					
Sensitivity		*	*	Med					
Sweep		*	*	25 mm/s					
Sweep (PAWP measurement window)		*	*	12.5 mm/s					
Filter		*		12.5 Hz					
Gridlines		*	*	Off					
IBP Label Order Setup		*	*	Art, pArt, CVP, pCVP, ICP, PA, Ao, UAP, FAP, BAP, LV, L AP, RAP, UVP, P1, P2, P3, P4					
Art, Ao, UAP, BAP, FAP, LV, P1-P2 Arterial Pressure Alarm Limits									
IBP-S High (mmHg)	Adu	*	*	160					
	Ped			120					
	Neo			90					
IBP-S Low (mmHg)	Adu	*	*	90					
	Ped			70					
	Neo			55					
IBP-M High (mmHg)	Adu	*	*	110					
	Ped			90					
	Neo			70					
IBP-M Low (mmHg)	Adu	*	*	70					
	Ped			50					
	Neo			35					
IBP-D High (mmHg)	Adu	*	*	90					
	Ped			70					
	Neo			60					
IBP-D Low (mmHg)	Adu	*	*	50					
	Ped			40					
	Neo			20					
PA Alarm Limits									
PA-S High (mmHg)	Adu	*	*	35					
	Ped			60					
	Neo			60					

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
PA-S Low (mmHg)	Adu	*	*	10					
	Ped			24					
	Neo			24					
PA-M High (mmHg)	Adu	*	*	20					
	Ped			26					
	Neo			26					
PA-M Low (mmHg)	Adu	*	*	0					
	Ped			12					
	Neo			12					
PA-D High (mmHg)	Adu	*	*	16					
	Ped			4					
	Neo			4					
PA-D Low (mmHg)	Adu	*	*	0					
	Ped			-4					
	Neo			-4					
CVP, LAP, RAP, ICP, UVP, P3-P4 Venous Pressure Alarm Limits									
IBP-M High (mmHg)	Adu	*	*	10					
	Ped			4					
	Neo			4					
IBP-M Low (mmHg)	Adu	*	*	0					
	Ped			0					
	Neo			0					
CPP Alarm Limits									
CPP High (mmHg)	Adu	*	*	130					
	Ped			100					
	Neo			90					
CPP Low (mmHg)	Adu	*	*	50					
	Ped			40					
	Neo			30					
Art, Ao, BAP, FAP, LV, P1-P2 Arterial Pressure Scale									
Scale (mmHg)		*	*	0-160					
PA Scale									
Scale (mmHg)		*	*	0-30					
CVP, LAP, RAP, ICP, UVP Scale									
Scale (mmHg)		*	*	0-20					
UAP, P3-P4 Venous Pressure Scale									
Scale (mmHg)		*	*	0-80					
IBP Overlapping Left Scale									
Scale (mmHg)		*	*	0-160					
IBP Overlapping Right Scale									
Scale (mmHg)		*	*	0-20					

C.1.8 C.O.

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Alarm	*	*	On					
Alm Lev	*	*	Med					
TB High (ºC)	*	*	39.0					
TB Low (ºC)	*	*	36.0					
Comp. Const	*	*	0.542					
Auto TI	*	*	Auto					
Manual TI (ºC)	*	*	2.0					
Measuring mode	*	*	Manual					

C.1.9 CO_2

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Alarm	*	*	On					
Alm Lev	*	*	Med					
Operating Mode	*	*	Measure					
Sweep	*	*	6.25 mm/s					
Scale (mmHg)	*	*	50					
Apnea Delay	*	*	Adu, Ped: 20 Neo: 15					
RR Source		*	Auto					
Sidestream CO_2 Setup								
Flow Rate	*	*	Adu:, 120 ml/min Ped: 100 ml/min Neo: 70 ml/min					
BTPS Compen	*	*	Off					
N_2O Compen	*	*	0					
O_2 Compen	*	*	21	50	21			
Des Compen	*	*	0					
Microstream CO_2 Setup								
BTPS Compen		*	Off					
Max Hold	*	*	20 s					
Auto Standby (min)	*	*	0					
Mainstream CO_2 Setup								
Max Hold	*	*	10 s					
O_2 Compen	*	*	Off					
Balance Gas	*	*	Room Air					
AG Compen	*	*	0					

Alarm Limits				
$EtCO_2$ High (mmHg)	*	*	Adu, Ped: 50 Neo: 45	
$EtCO_2$ Low (mmHg)	*	*	Adu, Ped: 25 Neo: 30	
$FiCO_2$ High (mmHg)	*	*	Adu, Ped, Neo: 4	
RR High	*	*	Adu, Ped: 30 Neo: 100	
RR Low	*	*	Adu, Ped: 8 Neo: 30	

C.1.10 AG

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Alarm	*	*	On					
Alm Lev	*	*	Med					
Sweep	*	*	6.25 mm/s					
O_2 Compen	*	*	Off	On	Off			
Operating Mode	*	*	Measure					
Flow Rate	*	*	Adu, Ped: 120 ml/min Neo: 70 ml/min					
Auto Standby	*	*	Off					
Apnea Time	*	*	20 s					
RR Source		*	Auto					
CO_2 Setup								
Wave Type	*	*	Draw					
Scale	*	*	when unit is mmHg: 50 when unit is % or KPa: 7.0					
$EtCO_2$ High (mmHg)	*	*	Adu, Ped: 50 Neo: 45					
$EtCO_2$ Low (mmHg)	*	*	Adu, Ped: 25 Neo: 30					
$FiCO_2$ High (mmHg)	*	*	4					
RR High	*	*	Adu, Ped: 30 Neo: 100					
RR Low	*	*	Adu, Ped: 8 Neo: 30					
Gas Setup								
Agent	*	*	AA					
N_2O Scale	*	*	50					
O_2 Scale	*	*	when unit is mmHg: 400 when unit is % or KPa: 50					
AA Scale	*	*	9.0					
Hal/Enf/Iso Scale	*	*	2.5					
Des Scale	*	*	9.0					

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Sev Scale	*	*	4.0					
EtO_2 High	*	*	88					
EtO_2 Low	*	*	18					
FiO_2 High	*	*	Adu, Ped: 100 Neo: 90					
FiO_2 Low	*	*	18					
EtN_2O High	*	*	55					
EtN_2O Low	*	*	0					
FiN_2O High	*	*	53					
FiN_2O Low	*	*	0					
EtHal/Enf/Iso High	*	*	3.0					
EtHal/Enf/Iso Low	*	*	0.0					
FiHal/Enf/Iso High	*	*	2.0					
FiHal/Enf/Iso Low	*	*	0.0					
EtSev High	*	*	6.0					
EtSev Low	*	*	0.0					
FiSev High	*	*	5.0					
FiSev Low	*	*	0.0					
EtDes High	*	*	8.0					
EtDes Low	*	*	0.0					
FiDes High	*	*	6.0					
FiDes Low	*	*	0.0					

C.1.11 BIS

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Alarm	*	*	On					
Alm Lev	*	*	Med					
Smoothing Rate	*	*	15 s			Adu: 15s Ped: 15s Neo: N/A	15 s	
Display	*	*	EEG			Adu: EEG Ped: EEG Neo: N/A	EEG	
Filters	*	*	On			Adu: On Ped: On Neo: N/A	On	
Scale	*	*	100 μ V			Adu: 100 μ V Ped: 100 μ V Neo: N/A	100 μ V	
Sweep	*	*	25mm/s			Adu: 25mm/s Ped: 25mm/s Neo: N/A	25mm/s	

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Trend Length	*	*	60 min			Adu: 60 min Ped: 60 min Neo: N/A	60 min	
Secondary Parameters	*	*	SR, SEF			Adu, Ped: SR, SEF Neo: N/A	SR,SEF	
Display	*	*	BIS Trend			Adu:BIS Trend Ped:BIS Trend Neo:N/A	BIS Trend	
EEG Waveforms	*	*	All			Adu: All Ped: All Neo: N/A	All	
Parameter 1	*	*	BIS L			Adu: BIS L Ped: BIS L Neo: N/A	BIS L	
Parameter 2	*	*	EMG			Adu: EMG Ped: EMG Neo: N/A	EMG	
BIS High	*	*	70					
BIS Low	*	*	70					

C.2 Routine Configuration

C.2.1 Alarm

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Alm Volume	*	*	2	1	2			
Reminder Vol	*	*	Low					
Recording Length	*	*	16 s					
Apnea Delay	*	*	Adu, Ped: 20 s Neo: 15 s					
Alarm Delay	*	*	6 s					
ST Alarm Delay	*	*	30 s					

C.2.2 Screens

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
Choose Screen		*	*	Normal Screen					
Display the ST segments on ECG screen		*	*	Unselected					
Select QuickKeys		*		NIBP Measure→Stop All→Review→Standby					
Select Wave Sequence for Normal Screen	1	*	*	ECG1					
	2			ECG2					

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
	3			SpO_2+PR					
	4			Any IBP					
	5			Any IBP					
	6			CO_2					
	7			BIS					
	8			Resp					
Select Parameters for Big Numerics Screen	Parameter 1	*	*	ECG					
	Parameter 2			SpO_2+PR					
	Parameter 3			Resp					
	Parameter 4			NIBP					

C.2.3 Parameter/Wave Color

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
Parameter/ Wave Colour	ECG		*	Green					
	NIBP			White					
	SpO_2			Cyan					
	PR			Cyan					
	TEMP			White					
	Art/Ao/UAP/FAP/BAP/LV/P1~P4 (arterial pressure)			Red					
	PA			Yellow					
	CVP/ICP/P1~P4 (venous pressure)			Blue					
	LAP			Purple					
	RAP			Orange					
	UVP			Cyan					
	CO_2			Yellow					
	RESP			Yellow					
	AA			Yellow					
	N_2O			Blue					
	O_2			Green					
	Hal			Red					
	Enf			Orange					
	Iso			Purple					
	Des			Cyan					
	Sev			Yellow					
	C.O.			White					
	EEG L/BIS L Trend			Yellow					
	EEG R/BIS R Trend			Blue					

X represents a waveform label, such as ECG, RESP, CO_2 and so forth. The ECG waveform cannot be set off.

C.2.4 Review

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
Tabular Trends	Interval	*	*	30 min	5min	30 min			
	Trend Group	*	*	Standard					
Graphic Trends	Trend Group	*	*	Standard					
Minitrend Length			*	2 h					
Full Disclosure	Save Waves	*	*	Save ECG1 by default.					

C.2.5 Event

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Waveform 1		*	II					
Waveform 2		*	I			Pleth	I	
Waveform 3		*	Pleth			Resp	Pleth	

C.2.6 Record

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
Length			*	8 s					
Interval			*	Off					
Paper Speed			*	25 mm/s					
Alm Rec	X		*	Off					

X represents a parameter label.

C.2.7 Print

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
Paper Size			*	A4					
ECG Reports	Amplitude		*	10 mm/mV					
	Sweep		*	25 mm/s					
	Auto Interval		*	Off					
	12-Lead Format		*	12X1					
Tabular Trends Reports	Set as End Case Report		*	Unselected					
	Back		*	Auto					
	Spacing		*	Auto					
	Report Layout		*	Parameter Oriented					
	Currently Displayed Trended Parameters		*	Selected					
	Standard Parameter Group		*	Unselected					
	Custom		*	Unselected					

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
Graphic Trends Reports	Set as End Case Report		*	Unselected					
	Back		*	Auto					
	Zoom		*	Auto					
Realtime Report	Set as End Case Report		*	Unselected					
	Sweep		*	Auto					
	Select Wave		*	Current					

C.2.8 Others

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
Brightness			*	5					
Key Volume			*	2					
View Other Patient	Auto Alarm		*	On					

C.3 User Maintenance Items

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Changing Bed No.		*	Protected					
Atmospheric Pressure		*	760 mmHg					
Height Unit		*	cm					
Weight Unit		*	kg					
ST Unit		*	mV					
Press. Unit		*	mmHg					
CVP Unit		*	cmH_2O					
CO_2 Unit		*	mmHg					
O_2 Unit		*	%					
Temp Unit		*	℃					
Network Type		*	LAN					
Latching Alarms	*	*	No					
Alarm Pause Time	*	*	2 min					
High Alarm Interval (s)		*	10					
Med Alarm Interval (s)		*	20					
Low Alarm Interval (s)		*	20					
Alarm Light on Alarm Reset		*	On					
Reset Other Bed's Alarms		*	Off					
Alarm Reset By Other Bed		*	On					
Minimum Alarm Volume	*	*	2	1	2			
Reminder Tone		*	On					
Reminder Interval		*	3 min					

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
Max. Alarm Pause 15min			*	A. Disable					
ECGLeadOff Lev.			*	Low					
SpO_2SensorOff Lev.			*	Low					
IBPSensorOff Lev.			*	Med					
Lethal Arrh. OFF			*	Disable					
Silence Other Bed			*	On					
Extended Arrh.			*	Enable					
Alarm Delay			*	6 s					
ST Alarm Delay			*	30 s					
Intubation Mode Period			*	2min					
Wave Line			*	Mediate					
ECG Standard			*	AHA					
Notch Freq.			*	50 Hz					
Data Transfer Method			*	Module					
Transferred Data Length			*	4 h					
Data Transfer Strategy			*	Always Ask					
Para Switch Authority			*	Unprotected					
Parameter Switch		*	*	When [Para Switch Authority] is set to [Protected]: Unselected When [Para Switch Authority] is set to [Unprotected]: Selected					
SpO_2 Tone			*	Mode 1					
Nurse Call	Signal Type		**	Continuous					
	Contact Type		*	Normally Closed					
	Alm Lev	*	*	High, Med, Low					
	Alarm Cat.	*	*	Phys., Tech.					

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 ***7.8 Resetting Alarms*** for details.
- The "L" field indicates the alarm level: H means high, M means medium and L means low. "*" means the alarm level is user-adjustable.
- XX represents a measurement or parameter label, such as ECG, NIBP, HR, ST-I, PVCs, RR, SpO_2, PR, etc.

In the "Cause and Solution" column, corresponding solutions are given instructing you to troubleshoot problems. If the problem persists, contact your service personnel.

D.1 Physiological Alarm Messages

Measurement	Alarm messages	L	Cause and solution
XX	XX Too High	M*	XX value has risen above the high alarm limit or fallen below the low alarm limit. Check the patient's condition and check if the patient category and alarm limit settings are correct.
	XX Too Low	M*	
ECG	ECG Weak Signal	H	The ECG signal is so weak that the monitor can't perform ECG analysis. Check the patient's condition and the ECG connections.
	Asystole	H	Arrhythmia has occurred to the patient. Check the patient's condition and the ECG connections.
	VFib/VTac	H	
	Vtac	H	
	Vent. Brady	H	
	Extreme Tachy	H	
	Extreme Brady	H	
	R on T	M*	
	Run PVCs	L*	
	PVCs/min	M*	
	Bigeminy	M*	
	Trigeminy	M*	
	Tachy	M*	
	Brady	M*	
	Vent. Rhythm	M*	
	Multif. PVC	M*	

Measurement	Alarm messages	L	Cause and solution
	Nonsus. Vtac	M*	
	Pause	L*	
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 SpO_2 value has fallen below the desaturation alarm limit. Check the patient's condition and check if the alarm limit settings are correct.
	No Pulse	H	The pulse signal was so weak that the monitor cannot perform pulse analysis. Check the patient's condition, SpO_2 sensor and measurement site.
CO_2	CO_2 Apnea	H	The patient stops breathing, or the respiration signal was so weak that the monitor cannot perform respiration analysis. Check the patient's condition and the RM connections.
AG	AG Apnea	H	
	FiO_2 Too Low	H	Check the patient's condition, the ventilated O_2 content and the AG connections.

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. Re-plug the module and restart the monitor, or plug the module into another monitor.
	XX Init Err	H	A	
	XX Init Err N	H	A	
	N is within 1 to 8			
	XX Comm Err	H	A	
	XX Comm Stop	H	C	
	XX Limit Err	L	C	XX parameter limit is accidentally changed. Contact your service personnel.
	XX Overrange	L	C	The measured XX value is not within the specified range for XX measurement. Contact your service personnel.
ECG	ECG Lead Off	L*	B	The electrode has become detached from the patient or the lead wire has become disconnected from the adapter cable. Check the connections of the electrodes and leadwires.
	ECG YY Lead Off	L*	B	
	Note: YY represents the leadwires, V (V1, V2, V3, V4, V5, V6,), LL, LA, RA, as per AHA standard, or C (C1, C2, C3, C4, C5, C6), F, L and R as per IEC standard.			
	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.

Measurement	Alarm message	L	I	Cause and solution
	ECG Artifact	L	A	Artifacts are detected on the ECG analysis lead and as a result heart rate cannot be calculated and Asystole, Vfib and Vtac cannot be analyzed. Check the connections of the electrodes and leadwires and check for any possible source of interference around the cable and electrode. Check the patient's condition and check the patient for great motion.
	ECG Low Freq. Noise	L	A	Low frequency signals are detected on the ECG analysis lead. Check for any possible source of interference around the cable and electrode.
	ECG Amplitude Too Small	L	C	The ECG amplitude didn't reach the detected threshold. Check for any possible source of interference around the cable and electrode.
	ECG Config. Err	L	C	ECG configuration is wrongly downloaded. Check the downloaded configuration and re-download the correct configuration.
Temp	Temp Cal. Err	H	C	A calibration failed. Restart the monitor.
	YY Sensor Off	L	A	The Temp sensor has become detached from the patient or the module. Check the sensor connections.
	YY represents a temperature label.			
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 if the sensor is 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 SpO_2 signal has been interfered. Check for any possible sources of signal noise around the sensor and check the patient for great motion.
	SpO_2 Board Fault	L	C	There is a problem with the SpO_2 measurement board. Do not use the module and contact your service personnel.
NIBP	NIBP Loose Cuff	L	A	The NIBP cuff is not properly connected, or there is a leak in the airway.
	NIBP Air Leak	L	A	
	NIBP Pneumatic Leak	L	A	Check the NIBP cuff and pump for leakages.
	NIBP Cuff Type Wrong	L	A	The cuff type applied mismatches the patient category. Verify the patient category and replace the cuff.

Measurement	Alarm message	L	I	Cause and solution
	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 exceeds the module measurement range.
	NIBP-XX Over Upper Limit	L	A	The measured pressure is greater than the specified NIBP measurement upper limit.
	NIBP-XX Over Lower Limit	L	A	The measured pressure is lower than the specified NIBP measurement lower limit.
	XX represents diastolic pressure, mean pressure, or systolic pressure.			
	NIBP Excessive Motion	L	A	Check the patient's condition and reduce the patient motion.
	NIBP Cuff Overpress.	L	A	The NIBP airway may be occluded. Check the airway and measure again.
	NIBP Equip Err	H	A	An error occurred during NIBP measurement and therefore the monitor cannot perform analysis correctly. Check the patient's condition and NIBP connections, or replace the cuff.
	NIBP Timeout	L	A	
	NIBP Measure Failed	L	A	
	NIBP Illegally Reset	L	A	An illegal reset occurred during NIBP measurement. Check if the airway is occluded.
IBP	YY Sensor Off	M*	A	Check the sensor connection and reconnect the sensor.
	YY Disconnected	H	C	The liquid way is 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 Sensor Fault	M	C	Replace the sensor.
	YY Non-Pulsatile	L	A	The catheter may be occluded. Please flush the catheter.
	YY represents an IBP label.			
C.O.	TB Sensor Off	L	A	Check the sensor connection and reconnect the sensor.
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	

Measurement	Alarm message	L	I	Cause and solution
	CO_2 High Barometric Press.	L	C	Check the CO2 connections, make sure that the monitor application site meets the requirements, and check for special sources that affect the ambient pressure. Restart the monitor.
	CO_2 Low Barometric Press.	L	C	
	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	
AG	AG No Watertrap	L	B	Check the connections of the watertrap and re-connect it.
	AG Change Watertrap	L	A	Wait until the change is completed.
	AG Watertrap Type Wrong	L	A	Make sure that a correct watertrap has been used.
	O_2 Accuracy Unspecified	L	A	The measured value has exceeded the specified accuracy range.
	N_2O Accuracy Unspecified	L	A	
	CO_2 Accuracy Unspecified	L	A	
	Enf Accuracy Unspecified	L	A	
	Iso Accuracy Unspecified	L	A	
	Sev Accuracy Unspecified	L	A	
	Hal Accuracy Unspecified	L	A	
	Des Accuracy Unspecified	L	A	
	awRR Accuracy Unspecified	L	A	
	AG Hardware Err	H	A	Remove the AG module. Stop using the module and contact your service personnel.
	AG Airway Occluded	L	A	Check the airway and remove the occlusion.
	AG Zero Failed	L	A	Re-plug the module or restart the monitor, and then perform a zero calibration again.
BIS	BIS High Imped.	L	A	Check and reconnect the BIS sensor.
	BIS Sensor Off	L	A	

Measurement	Alarm message	L	I	Cause and solution
	BIS DSC Err	L	C	An error occurred to the DSC during receiving signals. Check the DSC.
	BIS DSC Malf	L	C	The DSC automatically shuts down as a result of malfunction. Check the DSC.
	BIS No Cable	L	A	Check the BIS cables.
	BISx Disconnected	L	A	Check the BISx module.
	BIS No Sensor	L	A	Check the BIS sensor.
	BIS Wrong Sensor Type	L	A	Check or replace the sensor.
	BIS Sensor Too Many Uses	L	A	Replace the sensor.
	SQI<50%	L	A	The SQI value is too low. Check the patient's condition and the sensor connections.
	SQI<15%	L	A	
	BIS Sensor Expired	L	A	Replace the sensor.
	BIS Sensor Fault	L	C	Re-attach or Replace BIS Sensor
	Disconnect/Reconnect BIS	L	C	Re-plug the BIS Module
Power	12V Too High	H	C	There is a problem with the system power supply. Restart the monitor.
	12V Too Low	H	C	
	5V Too High	H	C	
	5V Too Low	H	C	
	3.3V Too High	H	C	
	3.3V Too Low	H	C	
	Battery Too Low	H	C	Connect the monitor to an AC power source and allow the batteries to charge.
	Different Battery Voltages	M	C	The two batteries have different charge capacity, or the batteries unspecified have been used, or there is a problem with the batteries. Make sure that correct batteries are used and the batteries are not damaged, or replace the batteries.
	Battery Power Overload	H	C	The power consumption of the equipment is too high. Power the monitor using an AC power source.
	RT Clock Not Exist	H	C	Contact your service personnel.
Recorder	Recorder Init Err N	L	A	Restart the monitor.
	N is within 1 to 8.			
	Recorder SelfTest Err	L	A	Stop the recording and restart the monitor.
	Recorder Comm Err	L	A	
	Recorder S. Comm Err	L	A	
	Recorder Unavailable	L	A	
	Recorder Vlt High	L	C	An error occurred to the system power supply. Restart the monitor.
	Recorder Vlt Low	L	C	
	Recorder Head Hot	L	C	The recorder has been working for too long time. Stop the recording and resume the recording till the recorder's printhead cools down.
	Rec Paper Wrong Pos.	L	A	Re-load the recorder paper.
System	System Watchdog Err	H	C	An error occurred to the system. Restart the monitor.
	System Software Err	H	C	

Measurement	Alarm message	L	I	Cause and solution
	System CMOS Full	H	C	
	System CMOS Err	H	C	
	System FPGA Err	H	C	
	System Err N	H	C	
	N is within 2 to 12.			
	PWR interrupted. Check meas. state	L	A	Power supply failed accidently. Check the measurements when the monitor restarts.
	Other Bed Disconnected	L	A	Check network connection.
	No CMS	L	A	The monitor is disconnected from the CMS. Check network connection.
T1	T1 battery aged. Replace the battery	L	C	Replace the battery.

FOR YOUR NOTES

E Electrical Safety Inspection

The following electrical safety tests are recommended as part of a comprehensive preventive maintenance program. They are a proven means of detecting abnormalities that, if undetected, could prove dangerous to either the patient or the operator. Additional tests may be required according to local regulations.

All tests can be performed by using commercially available safety analyzer test equipment. These procedures assume the use of a 601PROXL International Safety Analyzer or equivalent safety analyzer. Other popular testers complying with IEC 60601-1 used in Europe, such as Fluke, Metron, or Gerb, may require modifications to the procedure. Please follow the instructions of the analyzer manufacturer.

The electrical safety inspection should be periodically performed every two years .The safety analyzer also proves to be an excellent troubleshooting tool to detect abnormalities of line voltage and grounding, as well as total current loads.

E.1 Power Cord Plug

Test Item		Acceptance Criteria
The power plug	The power plug pins	No broken or bent pin. No discolored pins.
	The plug body	No physical damage to the plug body.
	The strain relief	No physical damage to the strain relief. No plug warmth for device in use.
	The power plug	No loose connections.
The power cord		No physical damage to the cord. No deterioration to the cord.
		For devices with detachable power cords, inspect the connection at the device.
		For devices with non-detachable power cords, inspect the strain relief at the device.

E.2 Device Enclosure and Accessories

E.2.1 Visual Inspection

Test Item	Acceptance Criteria
The enclosure and accessories	No physical damage to the enclosure and accessories.
	No physical damage to meters, switches, connectors, etc.
	No residue of fluid spillage (e.g., water, coffee, chemicals, etc.).
	No loose or missing parts (e.g., knobs, dials, terminals, etc.).

E.2.2 Contextual Inspection

Test Item	Acceptance Criteria
The enclosure and accessories	No unusual noises (e.g., a rattle inside the case).
	No unusual smells (e.g., burning or smoky smells, particularly from ventilation holes).
	No taped notes that may suggest device deficiencies or operator concerns.

E.3 Device Labelling

Check the labels provided by the manufacturer or the healthcare facilities are present and legible.

- Main unit label
- Integrated warning labels

E.4 Protective Earth Resistance

1. Plug the probes of the analyzer into the device's protective earth terminal and protective earth terminal of the AC power cord.
2. Test the earth resistance with a current of 25 A.
3. Verify the resistance is less than limits.

LIMITS

For all countries, R = 0.2 Ω Maximum

E.5 Earth Leakage Test

Run an Earth Leakage test on the device being tested before performing any other leakage tests.

The following outlet conditions apply when performing the Earth Leakage test:

- normal polarity(Normal Condition),
- reverse polarity(Normal Condition),
- normal polarity with open neutral(Single Fault Condition),
- reverse polarity with open neutral(Single Fault Condition)

LIMITS

For UL60601-1,

- 300 µA in Normal Condition
- 1000 µA in Single Fault Condition

For IEC60601-1,

- 500 µA in Normal Condition
- 1000 µA in Single Fault Condition

E.6 Patient Leakage Current

Patient leakage currents are measured between a selected applied part and mains earth. All measurements have a true RMS only

The following outlet conditions apply when performing the Patient Leakage Current test.

- normal polarity(Normal Condition);
- reverse polarity(Normal Condition),
- normal polarity with open neutral(Single Fault Condition);
- reverse polarity with open neutral(Single Fault Condition).
- normal polarity with open earth(Single Fault Condition);
- reverse polarity with open earth(Single Fault Condition).

LIMITS

For CF applied parts

- 10μA in Normal Condition
- 50μA in Single Fault Condition

For BF applied parts

- 100μA in Normal Condition
- 500μA in Single Fault Condition

E.7 Mains on Applied Part Leakage

The Mains on Applied Part test applies a test voltage, which is 110% of the mains voltage, through a limiting resistance, to selected applied part terminals. Current measurements are then taken between the selected applied part and earth. Measurements are taken with the test voltage (110% of mains) to applied parts in the normal and reverse polarity conditions

The following outlet conditions apply when performing the Mains on Applied Part test.

- Normal Polarity;
- Reversed Polarity

LIMITS

- For CF applied parts: 50 μA
- For BF applied parts: 5000 μA

E.8 Patient Auxiliary Current

Patient Auxiliary currents are measured between any selected Applied Part connector and the remaining Applied Part connector s. All measurements may have a true RMS only response.

The following outlet conditions apply when performing the Patient Auxiliary Current test.

- normal polarity(Normal Condition);
- reverse polarity(Normal Condition),
- normal polarity with open neutral(Single Fault Condition);
- reverse polarity with open neutral(Single Fault Condition).
- normal polarity with open earth(Single Fault Condition);
- reverse polarity with open earth(Single Fault Condition).

LIMITS

For CF applied parts,

- 10μA in Normal Condition
- 50μA in Single Fault Condition

For BF applied parts,

- 100μA in Normal Condition
- 500μA in Single Fault Condition

NOTE

- **Make sure the safety analyzer is authorized comply with requirement of 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
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
mcg	microgram
mEq	milli-equivalents
mg	milligram
min	minute
ml	milliliter
mm	millimeter
mmHg	millimeters of mercury
cmH2O	centimeters of water
ms	millisecond
mV	millivolt
mW	milliwatt
MΩ	megaohm
nm	nanometer

rpm	breath per minute
s	second
V	volt
VA	volt ampere
Ω	ohm
W	watt
–	minus, negative
%	percent
/	per; divide; or
+	plus
=	equal to
<	less than
>	greater than
≤	less than or equal to
≥	greater than or equal to
±	plus or minus
×	multiply

F.2 Abbreviations

$AaDO_2$	alveolar-arterial oxygen gradient
AAMI	Association for Advancement of Medical Instrumentation
AC	alternating current
ACI	acceleration index
Adu	adult
AG	anaesthesia gas
AHA	American Heart Association
ANSI	American National Standard Institute
Ao	aortic pressure
Art	arterial
aVF	left foot augmented lead
aVL	left arm augmented lead
AVPU	Alert, Reacting to Voice, Reacting to Pain, Unresponsive
aVR	right arm augmented lead
awRR	airway respiratory rate
BAP	brachial arterial pressure
BC	burst count
BIS	bispectral index
BP	blood pressure
BPSK	binary phase shift keying
BSA	body surface area
BT	blood temperature
BTPS	body temperature and pressure, saturated
C.I.	cardiac index
CCI	Continuous Cardiac Index

C.O.	cardiac output
CCO	Continuous Cardiac Output
CaO_2	arterial oxygen content
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
CO_2	carbon dioxide
COHb	carboxyhemoglobin
CP	cardiopulmonary
CPI	cardiac power index
CPO	Cardiac Power Output
CVP	central venous pressure
DC	direct current
Des	desflurane
Dia	diastolic
DPI	dot per inch
dPmx	left ventricular contractility
DVI	digital video interface
DO_2	oxygen delivery
DO_2I	oxygen delivery index
ECG	electrocardiograph
EDV	end-diastolic volume
EEC	European Economic Community
EEG	electroencephalogram
EMC	electromagnetic compatibility
EMG	electromyography
EMI	electromagnetic interference
Enf	enflurane
ESU	electrosurgical unit
Et	end-tidal
$EtCO_2$	end-tidal carbon dioxide
EtN_2O	end-tidal nitrous oxide
EtO	ethylene oxide
EtO_2	end-tidal oxygen
EVLW	extravascular lung water
ELWI	extravascular lung water index
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
$FiCO_2$	fraction of inspired carbon dioxide

FiN_2O	fraction of inspired nitrous oxide
FiO_2	fraction of inspired oxygen
FPGA	field programmable gate array
FV	flow-volume
GCS	Glasgow Coma Scale
GEDV	global end diastolic volume
GEDI	global end diastolic volume index
GEF	global ejection fraction
Hal	halothane
Hct	haematocrit
Hb	hemoglobin
Hb-CO	carbon mono-oxide hemoglobin
HbO_2	oxyhemoglobin
HR	heart rate
I:E	inspiratory-expiratory ratio
IBP	invasive brood pressure
ICG	impedance cardiography
ICP	intracranial pressure
ICT/B	intracranial catheter tip pressure transducer
ICU	intensive care unit
ID	identification
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
Ins	inspired minimum
IP	internet protocol
IPS	Individual Parameter Score
Iso	isoflurane
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
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
MEWS	Modified Early Warning Score
MRI	magnetic resonance imaging
MVe	expiratory minute volume
MVi	inspiratory minute volume
N/A	not applied
N_2	nitrogen
N_2O	nitrous oxide
Neo	neonate
NEWS	National Early Warning Score
NIBP	noninvasive blood pressure
O_2	oxygen
O_2CI	oxygen consumption index
O_2R	oxygen extraction ratio
OR	operating room
OxyCRG	oxygen cardio-respirogram
PA	pulmonary artery
pArt-D	diastolic artery pressure
pArt-M	mean artery pressure
pArt-S	systolic artery pressure
Paw	airway pressure
PAWP	pulmonary artery wedge pressure
PD	photodetector
Ped	pediatric
PEEP	positive end expiratory pressure
PEF	peak expiratory flow
PEP	pre-ejection period
PIF	peak inspiratory flow
PIP	peak inspiratory pressure
Pleth	plethysmogram
Pmean	mean pressure
Pplat	plateau pressure
PPV	Pulse Pressure Variation
PR	pulse rate
PVC	premature ventricular contraction
PVR	pulmonary vascular resistance
PVRI	pulmonary vascular resistance index
PVPI	pulmonary vascular permeability index
pArt	artery pressure
pCVP	central venous pressure
R	right
RA	right arm
RAM	random access memory
RAP	right atrial pressure
Rec	record, recording
Resp	respiration

RHb	reduced hemoglobin
RL	right leg
RM	respiratory mechanics
RR	respiration rate
RSBI	rapid shallow breathing index
SaO_2	arterial oxygen saturation
SEF	spectral edge frequency
Sev	sevoflurane
SFM	self-maintenance
SI	stroke index
SMR	satellite module rack
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
SvO_2	mixed venous oxygen saturation
$ScvO_2$	central venous oxygen saturation
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
Toral	oral temperature
TP	total power
Trect	rectal temperature
TVe	expiratory tidal volume
TVi	inspiratory tidal volume
UAP	umbilical arterial pressure
UPS	uninterruptible power supply
USB	universal serial bus
UVP	umbilical venous pressure
VAC	volts alternating current
VEPT	volume of electrically participating tissue
VI	velocity index
VO_2	oxygen consumption
VO_2I	oxygen consumption index
WLAN	wireless local area network

G Declaration of Conformity

Declaration of Conformity V1.0

CE

Declaration of Conformity

Manufacturer:	Shenzhen Mindray Bio-Medical Electronics Co., Ltd. Mindray Building, Keji 12th Road South, Hi-tech Industrial Park, Nanshan, Shenzhen, 518057, P. R. China
EC-Representative:	Shanghai International Holding Corp. GmbH (Europe) Eiffestraße 80 20537 Hamburg, Germany
Product:	**Patient Monitor (Including Accessories)**
Model:	iPM 5/iPM 6/iPM 7/iPM 8/iPM 10/iPM 12

We herewith declare that the above mentioned products meet the provisions of the Council Directive 2014/53/EU concerning radio equipment. All supporting documentations is retained under the premises of the manufacturer.

Standards Applied:

☒ EN 60601-1:2006+A1:2013	☒ EN 60601-1-2:2007/AC:2010
☒ EN 62311:2008	☒ EN 50385:2002
☒ ETSI EN 301 489-1 V2.2.0	☒ ETSI EN 301 489-17 V3.1.1
☒ EN 300 328 V2.1.1	☒ ETSI EN 301 893 V2.1.1

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Place, Date of Issue:	Shenzhen, 2017.6.13
Signature:	
Name of Authorized Signatory:	Wang Xinbing
Position Held in Company:	Manager, Technical Regulation

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