Passport 12/Passport 8

Patient Monitor

Operator's Manual

CE 0123

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

WARNING

- **Only skilled/trained clinical professionals should operate this equipment.**
- **It is important for the hospital or organization that uses this equipment to perform a recommended service/maintenance plan. Neglect of this may result in machine breakdown or personal injury.**

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Mindray warrants that components within its products will be free from defects in workmanship and materials for a period of one year from the date of purchase except that disposable or one-time use products are warranted to be free from defects in workmanship and materials up to a date one year from the date of purchase or the date of first use, whichever is sooner.

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- Malfunction of the instrument or part whose serial number is not legible.
- Others not caused by instrument or part itself.

Service

Mindray maintains a network of service representatives and factory-trained distributors. Prior to requesting service, perform a complete operational check of the instrument to verify proper control settings. If operational problems continue to exist,
In North America contact the Service Department at (800) 288-2121, ext: 8116 for Technical Support or (201) 995-8000 for assistance in determining the nearest field service location.

Please include the instrument model number, the serial number, and a description of the problem with all requests for service.

Any questions regarding the warranty should be directed to your local sales or service representative.

NOTE

- **Upon request, Mindray provides circuit diagrams, component part lists, descriptions, calibration instructions, or other information which assist the user's appropriately qualified technical personnel to repair those parts of the equipment which are designated by Mindray DS USA, Inc. as repairable.**

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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 questions, please contact Mindray.

This manual is an integral part of the product. It should always be kept close to the equipment so that it can be conveniently referenced when needed.

Intended Audience

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

Illustrations

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

Manual Conventions

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

FOR YOUR NOTES

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1 Safety

1.1 Safety Information

WARNING

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

CAUTION

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

NOTE

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

1.1.1 Warnings

WARNINGS

- **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 a properly grounded power outlet is not available, operate the monitor on battery power.**
- **The equipment is not intended to be used within the Magnetic Resonance (MR) environment.**
- **To avoid an explosion hazard, do not use the equipment in the presence of oxygen-rich atmospheres, flammable anesthetics, or other flammable agents (such as gasoline).**
- **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.**
- **Do not open the equipment housings. All servicing or future upgrades must be carried out by Mindray trained and authorized personnel.**
- **Do not come into contact with patients during defibrillation. Otherwise serious injury or death could result.**
- **Do not rely exclusively on the audible alarm system for patient monitoring. Adjustment of alarm volume to a low level or off may result in a hazard to the patient. Remember that alarm settings should be customized according to different patient situations and always keeping the patient under close surveillance is the most reliable way for safe patient monitoring.**
- **The physiological data and alarm messages displayed on the equipment should be reviewed by a clinician before being used for diagnostic interpretation and treatment.**

WARNINGS

- **To avoid inadvertent disconnection, route all cables in a way to prevent a stumbling hazard. Wrap and secure excess cabling to reduce risk of entanglement by patients or personnel.**
- **Do not touch the equipment's metal parts or connectors when in contact with the patient; otherwise patient injury may result.**
- **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.**
- **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.**
- **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.**

1.1.2 Cautions

CAUTIONS

- **Only use parts and accessories specified 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.**
- **Ensure that the patient monitor is supplied with continuous electric power during work. Sudden power failure may lead to data loss.**
- **This equipment is intended for single patient use.**
- **Store and use the equipment in specified environmental condition. The monitor and accessories may not meet the performance specification due to aging, stored or used outside the specified temperature and humidity range.**

1.1.3 Notes

NOTES

- **Put the equipment in a location where you can easily view and operate the equipment.**
- **During normal use, the operator is expected to face the front of the equipment.**
- **The equipment uses a mains plug as a means of isolation to the mains power supply. Do not position the equipment in a place difficult to operate the mains plug.**
- **Keep this manual in the vicinity of the equipment so that it can be conveniently referenced when needed.**
- **The software was developed in compliance with IEC60601-1-4. The possibility of hazards arising from software errors is minimized.**

NOTES

- **This manual describes all features and options. Your equipment may not have all of them.**
- **At the end of its service life, the equipment, as well as its accessories, must be disposed of in compliance with the guidelines regulating the disposal of such products. If you have any questions concerning disposal of the equipment, please contact Mindray.**
- **When disposing of the packaging material, be sure to observe the applicable waste control regulations and keep it out of children's reach.**

1.2 Equipment Symbols

Some symbols may not appear on your equipment.

	Caution		
	Power ON/OFF (for a part of the equipment)		Battery indicator
	Alternating current		VGA output
	Equipotentiality		Graphical record
	USB connector		Network connector
	Zero key		Input/Output
	Check sensor		Calibrate key
	Measure/standby		Inserted direction
	Gas outlet	SN	Serial number
	DATE OF MANUAFACTURE	REF	Catalog number
	Electrostatic sensitive devices		
	DEFIBRILLATION-PROOF TYPE CF APPLIED PART		
	DEFIBRILLATION-PROOF TYPE BF APPLIED PART		

ETL CLASSIFIED C US Intertek 3191955	The presence of this label indicates the machine was certified by ETL with the statement: Conforms to AAMI Std ES 60601-1, IEC Std 60601-1-6, IEC Std 60601-1-8, IEC Std 60601-2-25, IEC Std 60601-2-26, IEC Std 60601-2-27, IEC Std 60601-2-34, IEC Std 60601-2-49, IEC Std 80601-2-30, ISO Std 80601-2-55, ISO Std 80601-2-56, ISO Std 80601-2-61 Certified to CSA Std C22.2 NO. 60601-1, NO. 60601-6, NO. 60601-1-8, NO. 60601-2-25, NO. 60601-2-26,NO. 60601-2-27, NO. 60601-2-34, NO. 60601-2-49, NO. 80601-2-30, NO. 80601-2-55, NO. 80601-2-56, NO. 80601-2-61

2 The Basics

2.1 Intended Use

The Passport Series Patient Monitors, including Passport 8 and Passport 12, are intended to be used for monitoring, displaying, reviewing, storing and alarming of multiple physiological parameters including ECG (3-lead, or 5-lead selectable), arrhythmia detection and ST Segment analysis, heart rate (HR), respiration (Resp), temperature (Temp), pulse oxygen saturation (SpO_2), pulse rate (PR), non-invasive blood pressure (NIBP), invasive blood pressure (IBP), cardiac output (C.O.), carbon dioxide (CO_2), and anesthetic gas (AG).

All the parameters can be applied to single adult, pediatric or neonatal patients with the exception of the following:

- C.O. monitoring is restricted to adult patients only;
- PAWP monitoring is not intended for neonatal patients;
- The Mortara ECG Algorithm arrhythmia detection and ST Segment analysis is intended for adult and pediatric patients. The Mindray ECG Algorithm arrhythmia detection (currently unavailable in the US and Canada) is intended for adult and pediatric patients, and the Mindray ECG Algorithm ST Segment analysis (currently unavailable in the US and Canada) is intended for adult patients only.
- Arrhythmia detection, ST Segment analysis and AG monitoring are available for Passport 12 Patient Monitors only.

The monitors are to be used in healthcare facilities by clinical physicians or appropriate medical staff under the direction of physicians.

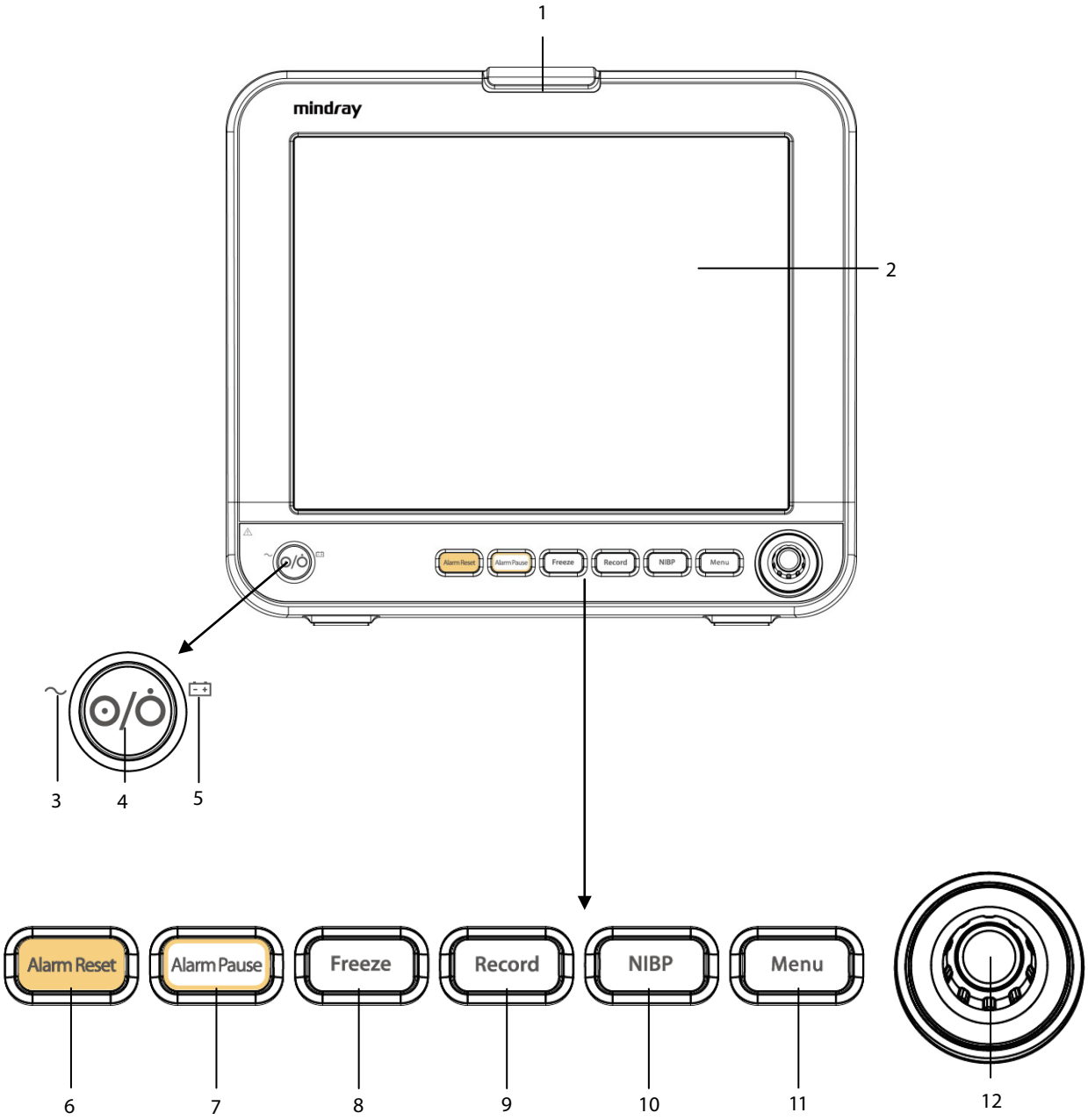
2.2 Applied Parts

The applied parts of the Passport 8/12 patient monitors are:

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

2.3 Main Unit

2.3.1 Front View



1. Alarm lamp

   When a physiological alarm or technical alarm occurs, this lamp flashes 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

4. Power On/Off Switch

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

   An indicator is built into this switch. It turns on when the monitor is on and turns off when the 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 malfunctioning, or no AC source is connected when the monitor is powered off.
   - Flashing: when the monitor operates on battery power.

6. **Alarm Reset**: Press to reset the alarms.
7. **Alarm Pause**: Press to pause or restore alarms.
8. **Freeze**: Press to freeze or unfreeze waveforms.
9. **Record**: Press to start or stop recordings.
10. **NIBP**: Press to start or stop NIBP measurements.
11. **Menu**:

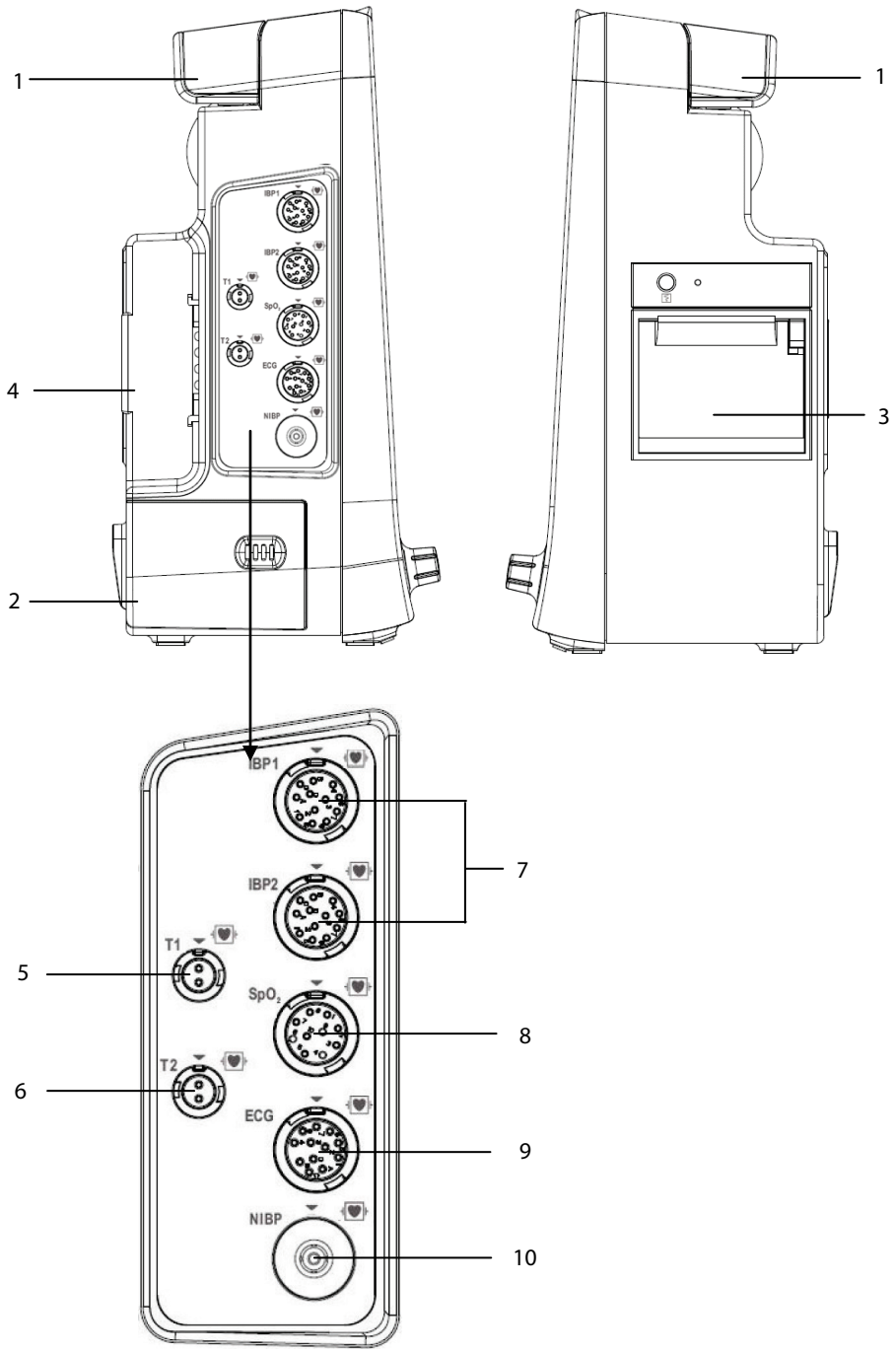
    If no menu is currently displayed on the screen, pressing it enters the main menu. If a menu is currently displayed on the screen, pressing it closes that menu.

12. Knob

    - Rotate the knob clockwise or counter-clockwise to move the cursor.
    - Press the knob to select one item, such as accessing a menu or confirming the selection.

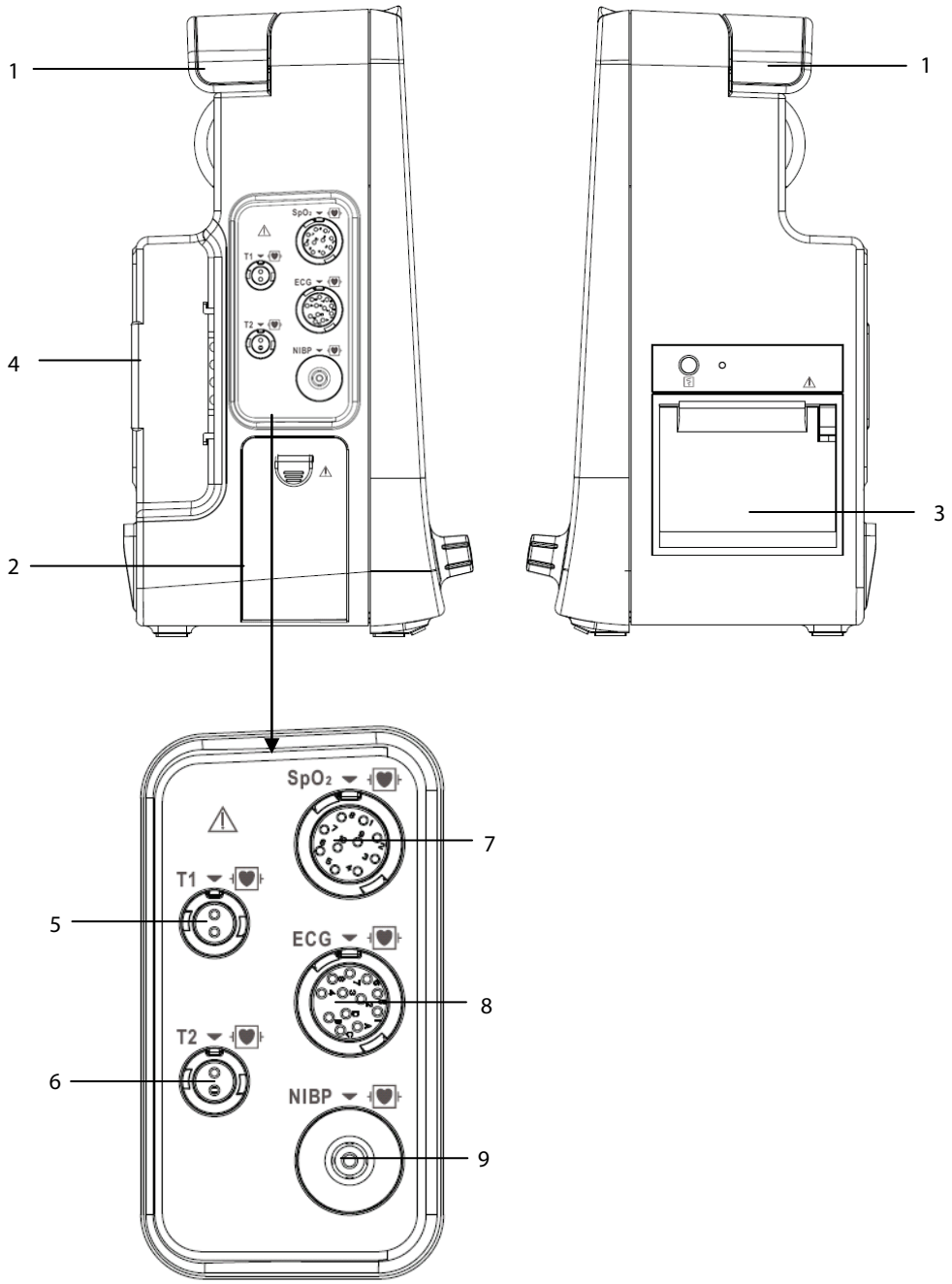
2.3.2 Side View

Passport 12



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

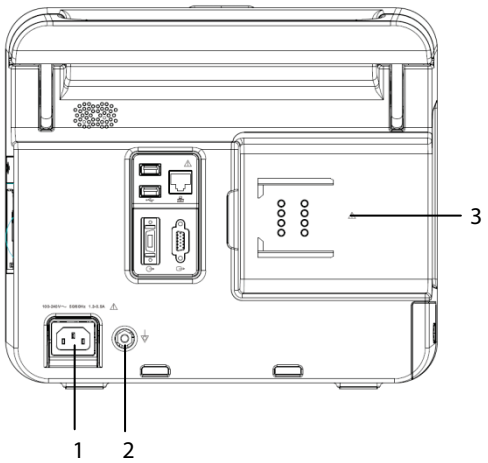
Passport 8

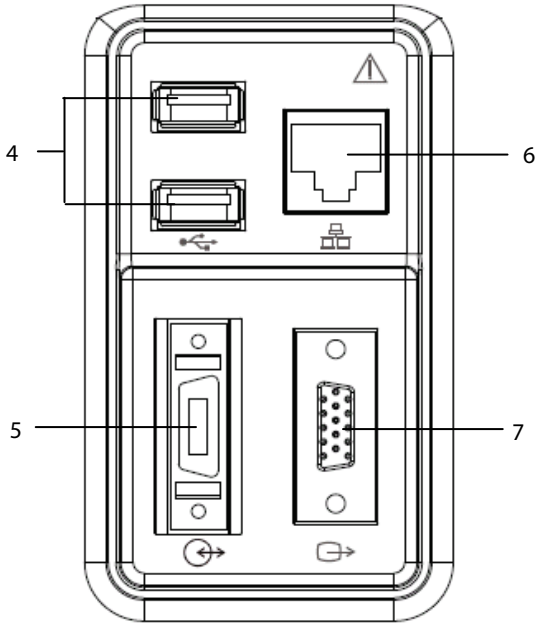


1. Handle
2. Battery compartment
3. Recorder
4. Parameter module slot
5. Temp probe 1 connector
6. Temp probe 2 connector
7. SpO_2 cable connector for
8. ECG cable connector
9. NIBP cuff connector

2.3.3 Rear View

Passport 12





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

   Connects a USB drive for data or configuration transfer.
5. Multifunctional Connector:

   Outputs defibrillator synchronization signals, nurse call signals and analogy output signals.

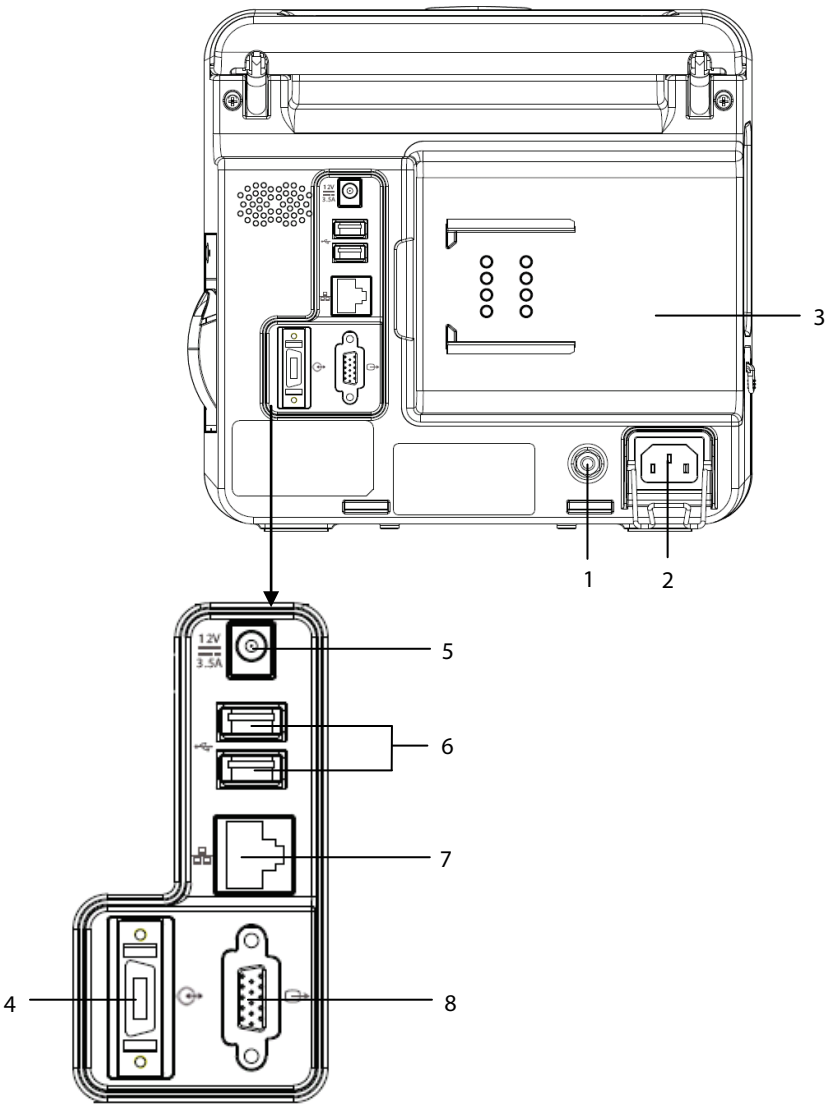
6. Network Connector

   A standard RJ45 connector which connects the monitor to the central station (CMS) or other monitor for remote viewing. It also connects the monitor to a PC for a system upgrade.

7. VGA Connector

   Connects a secondary display, which extends the display capability of your monitor. The contents displayed on the secondary display screen matches what displays on the monitor screen.

Passport 8



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

   Outputs defibrillator synchronization signals, nurse call signals and analogy output signals.

5. Reserved for future use

6. USB Connectors

   Connects a USB disk for data or configuration transfer.

7. Network Connector

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

8. VGA Connector

   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.

2.4 Modules

1 2 3 4 5 6

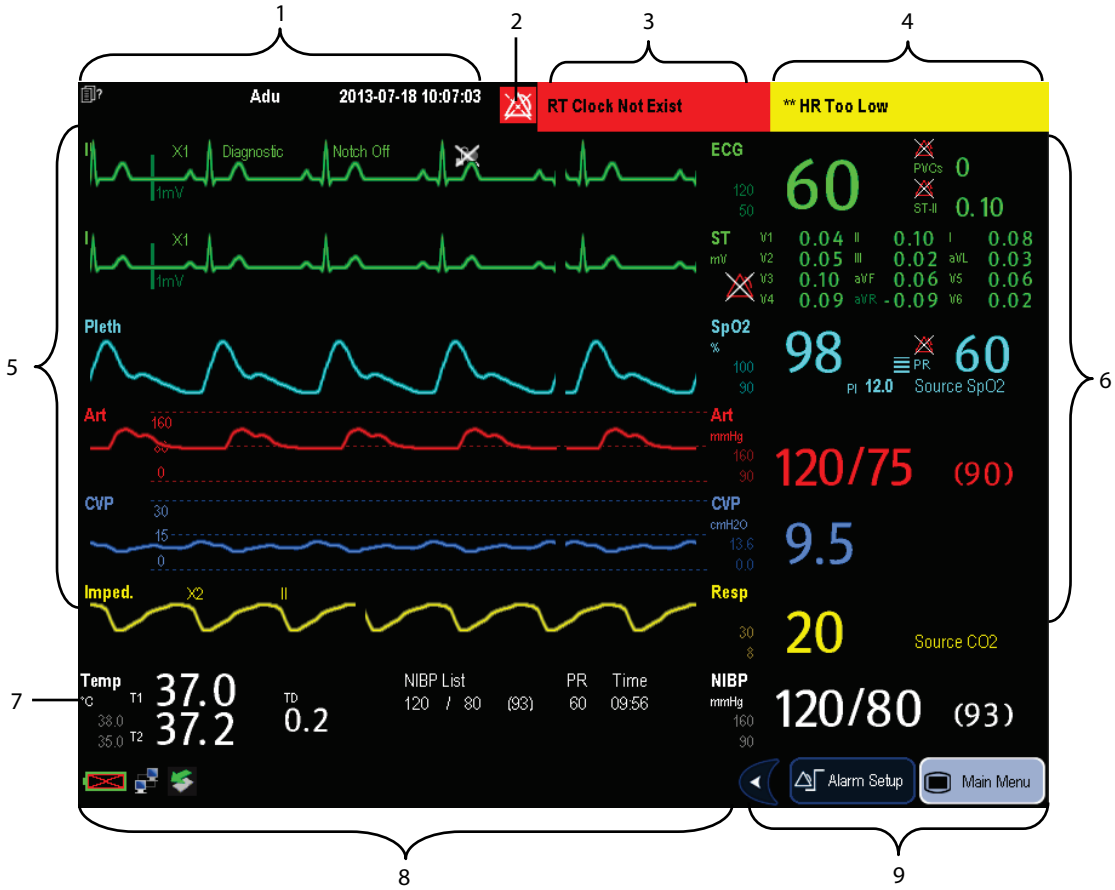
1.	IBP module:	contains IBP cable connector
2.	Sidestream CO_2 module:	contains CO_2 watertrap connector, and CO_2 gas outlet.
3.	IBP+C.O. module:	contains IBP cable connector and C.O. cable connector.
4.	IBP+C.O. + sidestream CO_2 module:	contains IBP cable connector, C.O. cable connector, CO_2 watertrap connector, and CO_2 gas outlet.
5.	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.
6.	IBP+C.O.+AG module (with O_2):	contains IBP cable connector, C.O. cable connector, AG watertrap slot, and AG gas outlet. This module is for Passport 12 only.

NOTE

- **The above modules with IBP connectors support two invasive blood pressures through an IBP extended cable (PN: 040-001029-00).**

2.5 Display Screen

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



1. Patient Information Area

   - This area shows date, time, and the patient information such as department, bed 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 enters the [**Patient Setup**] menu. For admitted patients, selecting this area enters 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 occur, the messages scroll. Select this area and the technical alarm list displays.

4. Physiological Alarm Area

   This area shows physiological alarm messages. When multiple alarms occur, the messages scroll. Select this area and the physiological alarm list displays.

5. Waveform Area

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

6. Parameter Area A

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

7. Parameter Area B

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

8. Prompt Message Area

   This area shows the prompt messages, network status icons, and battery status icons, etc. For details about battery status symbols, refer to chapter ***24 Batteries.***

   - indicates the monitor is successfully connected to a wired network.
   - indicates the monitor has failed to connect to a wired network.
   - indicates the wireless function (optional) is working.
   - indicates the wireless function (optional) is not working.
   - indicates a USB drive is inserted.

9. QuickKeys Area

   This area contains QuickKeys that provide quick access to functions.

2.6 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 your monitor configuration.

The following QuickKeys are available:

Display more QuickKeys

Hide the QuickKeys

[**Main Menu**] QuickKey
Enter the [**Main Menu**]

[**Standby**] QuickKey
Enter Standby mode

[**Alarm Setup**] QuickKey
Change alarm settings

[**Review**] QuickKey
Review the patient's data

[**NIBP Measure**] QuickKey
Enter the [**NIBP Measurement**] menu

[**Stop All**] QuickKey
Stop all NIBP Measurements

[**Zero IBP**] QuickKey
Zero IBP

[**Realtime Print**] QuickKey
Start the realtime print

[**Print Setup**] QuickKey
Print Setup

[**Alarm Reset**] QuickKey
Reset the alarms

[**Alarm Pause**] QuickKey
Pause or restore alarms

[**Screens**]
Change screen

[**Patient Setup**] QuickKey
Enter the [**Patient Setup**] menu

[**Manual Event**] QuickKey
Trigger a manual event

[**Minitrends**] QuickKey
Have a split-screen view of minitrends

[**Volume Setup**] QuickKey
Enter the [**Volume Setup**] menu

[**Load Config.**] QuickKey

Default configurations

[**Start C.O.**] QuickKey

Start cardiac output procedure

[**Calculations**] QuickKey

Perform calculations

[**Others**] QuickKey

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

[**OxyCRG**] QuickKey

Have a split-screen view of OxyCRG trends

[**7-Lead ECG**] QuickKey

Enter the full-screen 7-lead ECG screen

[**Parameters**] QuickKey

Enter the [Parameters] menu

[**NIBP STAT**] QuickKey

Start NIBP STAT measurement

[**Unit Setup**] QuickKey

Enter the [Unit Setup] menu

[**PAWP**] QuickKey

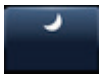
Enter the PAWP measurement screen

[**CPB Mode**] QuickKey

Enter the CPB mode

[**Privacy Mode**] QuickKey

Enter the Privacy mode



[**Night Mode**] QuickKey

Enter the Night mode

You can configure up to four QuickKeys on the screen. To select your desired QuickKeys:

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. Select the [**Select QuickKeys**] tab, and then configure your desired QuickKeys and the order of them.

3 Basic Operations

3.1 Installation

WARNING

- **Connect only approved devices to this equipment. Devices connected to the equipment must meet the requirements of the applicable IEC standards (e.g. IEC 60950 safety standards for information technology equipment and IEC 60601-1 safety standards for medical electrical equipment). The system configuration must meet the requirements of the IEC 60601-1 medical electrical systems standard. Any personnel who connect devices to the equipment's signal input/output port 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 questions, please contact Mindray.**
- **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.**

CAUTION

- **The equipment should be installed by authorized Mindray personnel.**

NOTE

- **The software equipment copyright is solely owned by Mindray. No organization or individual shall resort to modifying, copying, or exchanging it or to any other infringement on it in any form or by any means without due permission.**

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 Mindray.

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 Mindray in case of any problem.

CAUTION

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

NOTE

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

3.1.2 Environmental Requirements

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

The equipment operating environment should be reasonably free from noises, vibration, dust, corrosive, flammable and explosive substances. To maintain good ventilation, the equipment should be at least 2 inches (5 cm) away from surrounding objects.

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.

CAUTION

- **Make sure that the equipment operating environment meets the specific requirements. Otherwise unexpected consequences, e.g. damage to the equipment, could result.**
- **Put the equipment in a location where you can easily see the screen, access the operating controls, and disconnect the equipment from AC power.**

3.2 Getting Started

3.2.1 Connecting to Power Source

Using AC Power Source

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

WARNING

- **Always use the accompanying power cord with the monitor.**
- **Use the battery if the integrity of the protective earth conductor or the protective earthing system in the installation is in doubt.**

Using a Battery

This monitor can be equipped with rechargeable lithium-ion battery. If a battery is installed, the monitor system automatically switches to the battery for power if AC power is interrupted.

NOTE

- **When a battery has been stored for a long time, or the battery is depleted, recharge the battery at once. Otherwise, the low battery may not be sufficient to power the monitor if the AC power is unavailable.**

Refer to Chapter ***24 Batteries*** for detail.

Connecting Accessories

Insert the connector of accessory cables necessary for the measurements to be performed by your monitor to the corresponding connector on the monitor. For details about the parameter connectors, refer to ***2.3.2 Side View***

3.2.2 Turning Power On

Once the monitor is installed, before beginning measurements:

1. Check the monitor and plug-in modules for any mechanical damage, and make sure that all external cables, plug-ins and accessories are properly connected.
2. Check the power supply specification is met if mains power is used. Only use a power outlet that is properly grounded.
3. Plug the power cord into the AC power source. If you run the monitor on battery power, ensure that the battery is sufficiently charged.
4. Press the power on/off switch on the monitor's front panel.

The monitor will perform alarm system self-test during start-up. After pressing the power on/off button, the system shows a "**Loading…**" screen, sounds a beep and the alarm lamp simultaneously turns yellow, then red, and then turns off, followed by the start-up screen being shown. Then the start-up screen disappears. The alarm system self-test succeeds. The monitor enters the normal monitoring screen.

NOTE

- **Carefully check if the system performs the self-test as described above. Contact your service personnel or Mindray if the self-test is abnormal.**

WARNING

- **Do not use the monitor on a patient if you suspect it is not working properly, or if it is mechanically damaged. Contact your service personnel or Mindray.**

3.2.3 Starting Monitoring

1. Decide which measurements you want to take.
2. Connect the required modules, patient cables and sensors.
3. Make sure that the patient cables and sensors are correctly connected.
4. Make sure that the patient settings, such as [**Patient Cat.**], [**Paced**], etc, are appropriate for your patient.
5. Refer to the appropriate measurement section for details of how to perform the measurements you require.

3.3 Turning Off the Monitor

Before turning off the monitor,:

1. Ensure that the monitoring of the patient has been completed. .
2. Disconnect the cables and sensors from the patient.
3. Make sure to save or clear the patient monitoring data as required.
4. Press and hold the power on/off switch for more than 2seconds to turn off the monitor. "Shutting down…" is displayed on the screen and then the monitor shuts down.

CAUTION

- **Press and hold the power on/off switch for 10 seconds to forcibly shut down the monitor if it could not be shut down normally. This may cause loss of patient data.**
- **The monitor restores the latest configuration if it restarts within 60 seconds after a power failure. The monitor restores the default configuration, rather than the latest configuration, if it restarts 120 seconds after a power failure. The monitor may load either the latest configuration or the default configuration if it restarts from 60-120 seconds after a power failure.**
- **Power failure may cause data corruption on the SD card. It is recommended to turn off the monitor according to the normal procedures. Do not directly unplug the power cord, unless a charged battery is installed, or remove the battery before shutting down the monitor.**

NOTE

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

3.4 Using the Knob

Using the knob on the front panel of the monitor can do the following operations:

- Rotate the knob clockwise or counterclockwise to move the cursor.
- Press the knob to select one item, such as accessing a menu or confirming the selection.

3.5 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 or waveform area.
  - QuickKeys: QuickKeys are configurable graphical keys, located at the bottom of the main screen. For details, refer to the section ***2.6 QuickKeys***.
- Hardkeys: A hardkey is a physical key on a monitoring device, such as the [**Main Menu**] hardkey on the monitor's front panel.

- Pop-up Keys: Pop-up keys are task-related keys that appear automatically on the monitor screen when needed. For example, the Confirm pop-up key appears only when you need to confirm a change.

3.6 Using the Touchscreen

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

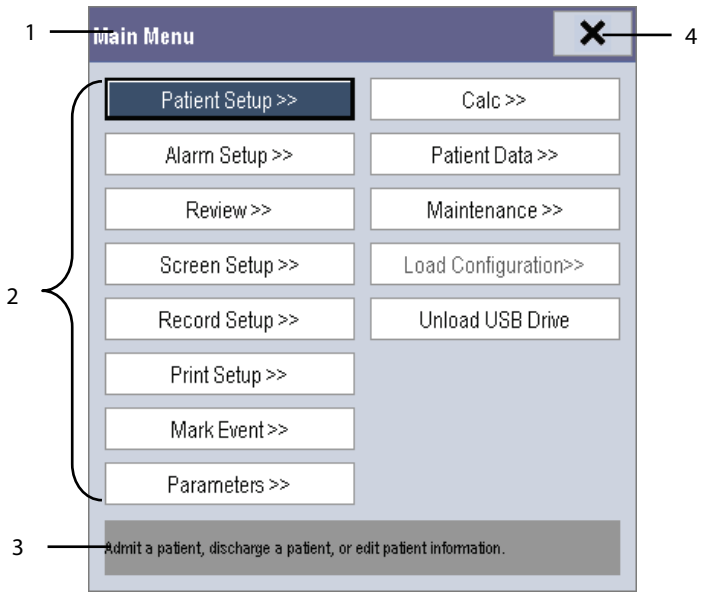
3.7 Using the On-screen Keyboard

The on-screen keyboard enables you to enter information.

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

3.8 Using the Main Menu

To enter the [**Main Menu**], select the [**Main Menu**] on-screen QuickKey or the [**Menu**] hardkey on the monitor's front panel. Most of monitor operations and settings can be performed through this [**Main Menu**].



Other menus are similar to the [**Main Menu**] and contain the following parts:

1. Heading: displays the title for the current menu.
2. Main body: displays options, buttons, prompt messages, etc. The menu buttons with ">>" open 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. If changes are made in the menu, they take effect after selecting this button.

3.9 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 arrange the positions of the parameters and waveforms. Unselected parameters or waveforms will not display.

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 parameter windows and their waveforms (if one exists). Each parameter and the associated waveform are displayed in the same row.
- In Area B, you can choose to display the parameter windows. But if all parameters in area C are set to [**Off**], both the parameter and waveform selected in the first row of area B will be displayed.
- In Area C, you can choose to display the timer and any parameters without associated waveforms.

The screen automatically adjusts to ensure the best view based on your screen setup.
If no corresponding parameter or waveform displays after the module is inserted, 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 by selecting [**Main Menu**] → [**Screen Setup**] → [**Screen Layout >>**].
- Check that the parameter is turned on in [**Parameters Switch**] window.

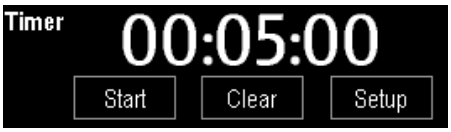
CAUTION

- **Unallocated parameters in the [Screen Setup] window will not display. However, the monitor still sounds alarms for these parameters.**

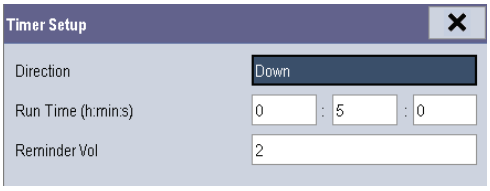
3.10 Displaying the Timer

To display the timer in the main screen:

1. Select [**Main Menu**]→[**Screen Setup>>**]→[**Screen Layout >>**] to access the [**Screens**] window.
2. Select [**Screen Setup**] tab.
3. In Area C, select [**Timer**] from the drop-down list of the desired parameter area. Refer to section ***3.9 Setting the Screen***.
4. Select ✕ to exit the window. The main screen will display the timer.



- Select [**Start**] or [**Pause**] to start or pause 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.



3.11 Changing General Settings

This chapter covers only general settings such as language, brightness, date and time, etc. Refer to measurement and other settings in their respective sections.

3.11.1 Setting up a Monitor

To install a monitor or change its location:

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

3.11.2 Changing Language

To change the 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 monitor.

NOTE

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

3.11.3 Adjusting the Screen Brightness

To adjust 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 dimmest.

If the monitor operates on battery power, setting a dimmer screen brightness will prolong the battery operating time. When the monitor enters Standby mode, the screen automatically changes to the dimmest setting.

3.11.4 Showing/Hiding Help Text

The monitor provides online help information. The user can display or hide the help text as needed.

1. Select [**Main Menu**]→[**Screen Setup >>**].
2. Select [**Help**] and select either [**On**] or [**Off**].

3.11.5 Setting the Date and Time

To set the date and time:

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

If your monitor is connected to a central station (CMS), the date and time are automatically synchronized to that CMS. In that case, you cannot change the date and time settings on your monitor.

CAUTION

- **Changing date and time affects the storage of trends and events and may cause data loss. Save or record any needed data prior to changing the date and time.**

3.11.6 Adjusting Volume

Alarm Volume

To adjust the 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 Alarm), and 10 is the maximum volume.

Key Volume

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

To adjust the key volume:

1. Select the [**Volume Setup**] QuickKey, or [**Main Menu**]→[**Screen Setup >>**].
2. Select [**Key Volume**] and then select the appropriate volume. 0 means off, and 10 is 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 tone pitch rises as the saturation level increases and falls as the saturation level decreases. The tone volume is user adjustable.

To adjust the QRS volume

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 is the maximum volume.

3.12 Setting Parameters

3.12.1 Switching the Parameters On/Off

To switch the parameters on or off, select [**Main Menu**]→[**Screen Setup >>**]→[**Screen Layout >>**]→[**Parameters Switch**]. 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 can not switch it off.**

3.12.2 Accessing the Parameters Menu

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

3.13 Operating Modes

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

3.13.1 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.

3.13.2 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 measurements 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 pop-up.

CAUTION

- **Before entering Night mode, confirm the brightness settings, alarm volume, QRS volume, and key volume. Consider the potential risk when the setting value is low.**

3.13.3 Privacy Mode

Privacy mode is only available when an admitted patient at a monitor is also monitored by the CMS.

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

The monitor does the following after activating Privacy mode:

- The screen turns blank and the message [**Under monitoring. Press any key to exit the privacy mode.**] displays.
- Monitoring and data storing continue but patient data is only visible at the CMS.
- Alarms can still be triggered. But all audible alarms are suppressed and the alarm light is deactivated at the 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 monitor exits the Privacy mode automatically in any of the following situations:

- The monitor disconnects from the CMS.
- 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 monitor. Alarms sound only at the CMS.**

3.13.4 Demo Mode

Demo mode is password protected, and it is used for demonstration purposes only.

To enter Demo mode:

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

To exit Demo mode:

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

WARNING

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

3.13.5 Standby Mode

In Standby mode, you can temporarily stop patient monitoring without turning off the monitor. To enter the Standby mode, select the [**Standby**] QuickKey .

FOR YOUR NOTES

4 Managing Patients

4.1 Admitting a Patient

The monitor displays physiological data and stores it in trends as soon as a patient is connected. This allows you to monitor a patient that is not admitted yet. However, it is recommended that you admit a patient so that you can clearly identify them 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 is combined with the previous patient's data. 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 monitor to the new patient, or
   - [**No**] to clear the data saved in the monitor.
4. In the [**Patient Demographics**] menu, enter the demographic details, of which:
   - [**Patient Cat.**] allows the user to select patient size (Neo, Ped, Adu) which will determine the way your 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

- **The [Patient Cat.] and [Paced] fields always contain a value, regardless of whether the patient is fully admitted or not. If you do not specify settings for these fields, the 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 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 always displays 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, select [**Ok**] to discharge the current patient. If no patient is admitted, you can choose either:

- [**Yes**] to apply the data in your 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 Querying and Obtaining Patient Information

The monitor can obtain patient information from Hospital Information System (hereafter called HIS) through the eGateway. To query or obtain patient information from the 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**]. Then select [**Ok**]
2. Select the patient information area to enter the [**Patient Demographics**] menu.
3. Select [**Obtain Patient Info. >>**] to enter the [**Obtain Patient Information**] menu.
4. Input a query condition and then select [**Query**]. The monitor displays the requested patient information.
5. Select a patient and then click [**Import**] to update the corresponding patient information.
6. Select ✕ to exit the [**Obtain Patient Information**] menu.

NOTE

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

4.4 Associating Patient Information

After associating patient information with the HIS, the monitor automatically updates the patient information if the corresponding HIS information changes. The monitor can associate the patient's MRN (Medical Record Number), first name, last name, date of birth, and gender with the HIS.

NOTE

- **A keyword takes effect only when being defined in the eGateway. Refer to *eGateway Integration Manager Installation Guide* (P/N: 046-002447-00) for details.**
- **The monitor displays corresponding patient information only when all the keywords have been entered.**

4.5 Editing Patient Information

To edit the patient information after a patient has been admitted, 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**].

4.6 Discharging a Patient

To discharge a patient:

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

NOTE

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

4.7 Transferring Patient Data

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

From the [**User Maintenance**] menu, select [**Others >>**]. In the pop-up 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 enables the HR alarm and lethal arrhythmia alarm after transferring the patient data.**

4.7.1 Transferring Data from the Monitor to a USB Drive

To transfer data from the monitor to a USB drive:

1. Connect a USB drive into the monitor's USB port. Select [**Main Menu**]→[**Patient Setup >>**].
2. Select [**Transfer to Storage Medium**]. In the pop-up 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 monitor.

4.7.2 Transferring Data from a USB Drive to the Monitor

To transfer data from a USB drive to the monitor:

1. Connect the USB drive to the destination monitor.
2. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password → [**Others >>**] → [**Data Transfer Method**] →[**USB Drive**]. Then:
   - Select [**Transfer**] to transfer the patient data to the monitor, or
   - Select [**Cancel Transfer**] to cancel the transfer operation.
   - Select [**Unload USB Drive**] to unload the USB drive without transferring the patient data.
3. After you select [**Transfer**], in the pop-up menu you can select the patient data contents that need to be transferred. [**Patient Demographics**] must be selected. After [**Ok**] is selected, the monitor compares the patient information stored in both the storage medium and monitor and manages the patient data based on the following.
   - Different Patient: The monitor erases all the current patient data, transfers the patient data from the storage medium, and loads the configuration according to the patient category.
   - Same Patient: In the pop-up dialog box, you can:
     - Select [**Yes**] to merge the patient data in the monitor and storage medium.
     - Select [**No**] to erase all the current patient data in the monitor and transfer the patient data from the storage medium.
4. Wait until the message [**Transfer from storage medium successful.**] appears before removing the USB drive.

CAUTION

- **The USB drive you use may be write-protected. In this case, make sure the USB drive is in read/write mode.**
- **Do not remove the storage medium during data transfer process. Otherwise, data files may be damaged.**
- **The normal monitoring function will be affected during data export. Do notperform any monitoring activity during data export.**

4.8 Connecting to a CMS

If your monitor is connected to a CMS:

- All patient information, measurement data and settings on the monitor can be transferred to the CMS.
- All patient information, measurement data and settings can be displayed simultaneously on the 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 monitor and the CMS.

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

5 Managing Configurations

5.1 Introduction

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

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

- General
- OR
- ICU
- NICU
- CCU

Each department has three different sets of configurations: one for each patient category [**Neo**], [**Ped**], and [**Adu**].

NOTE

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

The system configuration items can be classified as:

- Parameter configuration items

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

- Conventional configuration items

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

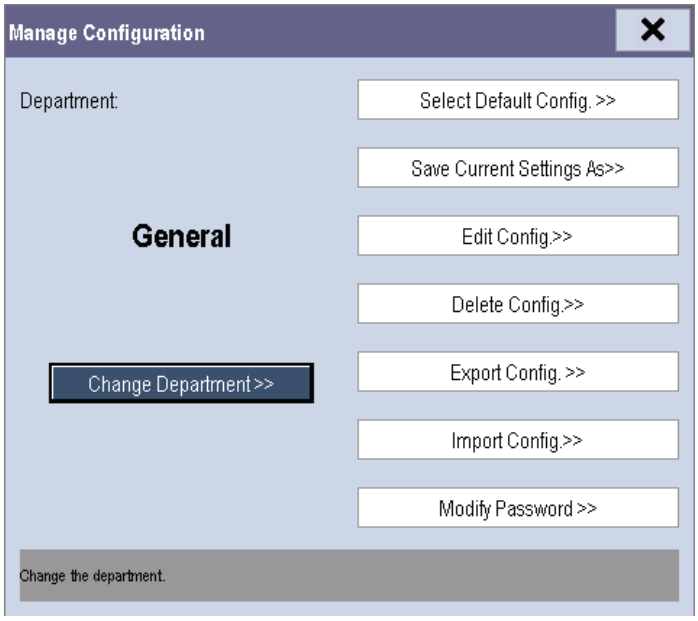
- User maintenance items

These items relate to user maintenance settings, e.g., unit setup, time format and data format.
For the important configuration items and their default values and user maintenance items, see appendix ***C*** Default Configurations.

5.2 Entering the [Manage Configuration] Menu

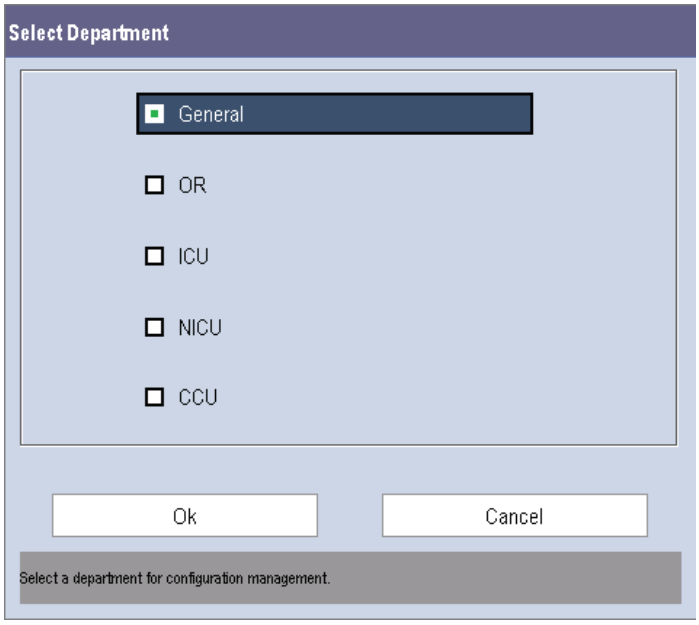
To access the [**Manage Configuraion**] menu:

1. Press the [**Menu**] hardkey on the monitor's front panel 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.**

5.4 Setting Default Configuration

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

- The monitor restarts after being switched off for more than 120 seconds.
- A patient is admitted.
- A patient is discharged.
- Patient data is cleared.
- Patient category is changed.

To set the default configuration:

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

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

When you select [**Load the Latest Config**], the latest configuration when the monitor is started or a patient is admitted is loaded.

NOTE

- **To identify which configuration is restored when the 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 a user configuration. Up to 5 user configurations can be saved.

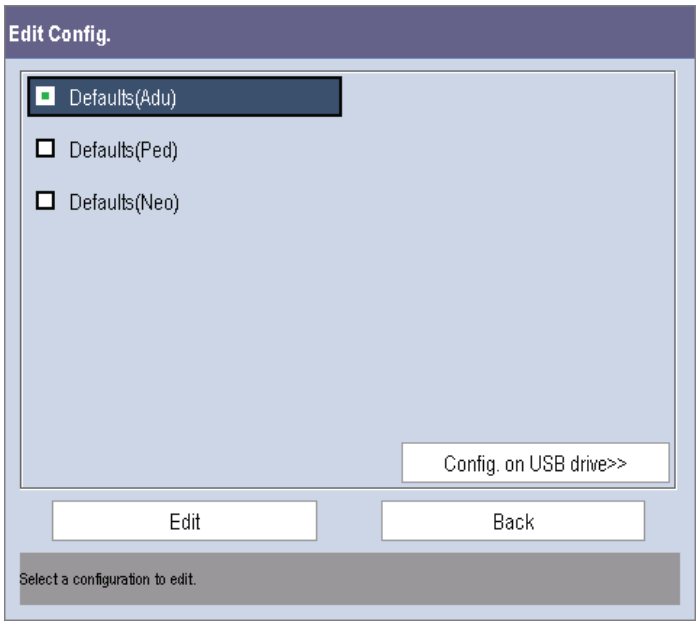
To save current settings:

1. Select [**Save Current Settings As >>**] in the [**Manage Configuration**] menu.
2. In the pop-up dialog box, enter the configuration name and then select [**Ok**]. The current settings are saved as a user configuration with the name you entered.

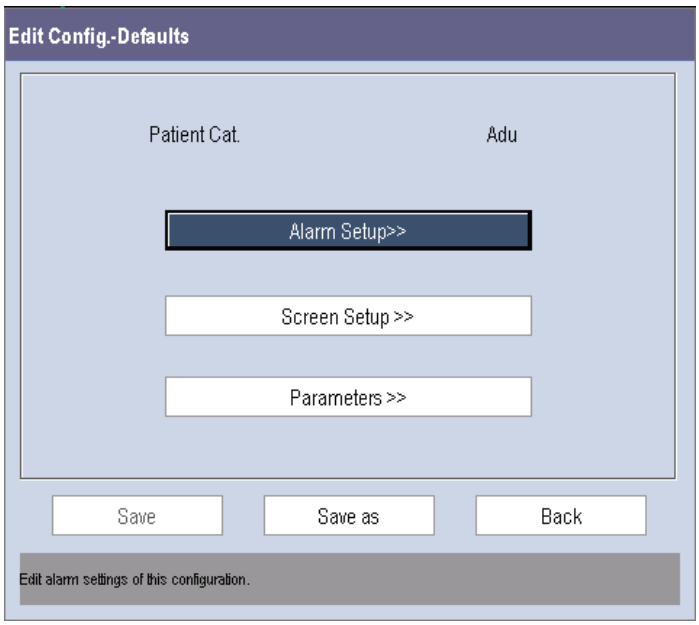
5.6 Editing Configurations

To edit a configuration:

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



2. The pop-up menu shows the existing monitor configurations. 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 [**Parameters >>**] to enter the corresponding menu in which settings can be changed. The changed alarm setup items 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 as another file with another name.

5.7 Deleting a Configuration

To delete a configuration:

1. Select [**Delete Config. >>**] in the [**Manage Configuration**] menu.
2. The pop-up menu shows the existing monitor's user configurations. 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 pop-up.

5.8 Transferring a Configuration

When installing several monitors with identical user configurations it is not necessary to set each unit separately. Use a USB drive to transfer the configuration from monitor to monitor.

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 from 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 to ensure that all the settings are appropriate for your patient.

To load a configuration,

1. Select [**Load Configuration >>**] from the [**Main Menu**]. The pop-up menu shows the existing configurations on the monitor.
2. Selecting [**Config. on USB drive >>**] to show the existing configurations on the USB drive.
3. Select a desired configuration.
4. Select [**View**] to see the configuration details. In the pop-up 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**].

5.10 Restoring the Latest Configuration Automatically

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

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

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 pop-up menu.
3. Select [**Ok**].

6 User Screens

6.1 Configuring Your Screens

You can configure your monitor's screens by setting:

- Waveform line size
- The color in which each measurement's numerics and waveforms are displayed
- The parameter to monitor.

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

6.1.1 Changing the Waveform Line Size

To change the waveform line size:

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

6.1.2 Changing Measurement Colors

To change the measurement colors:

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

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

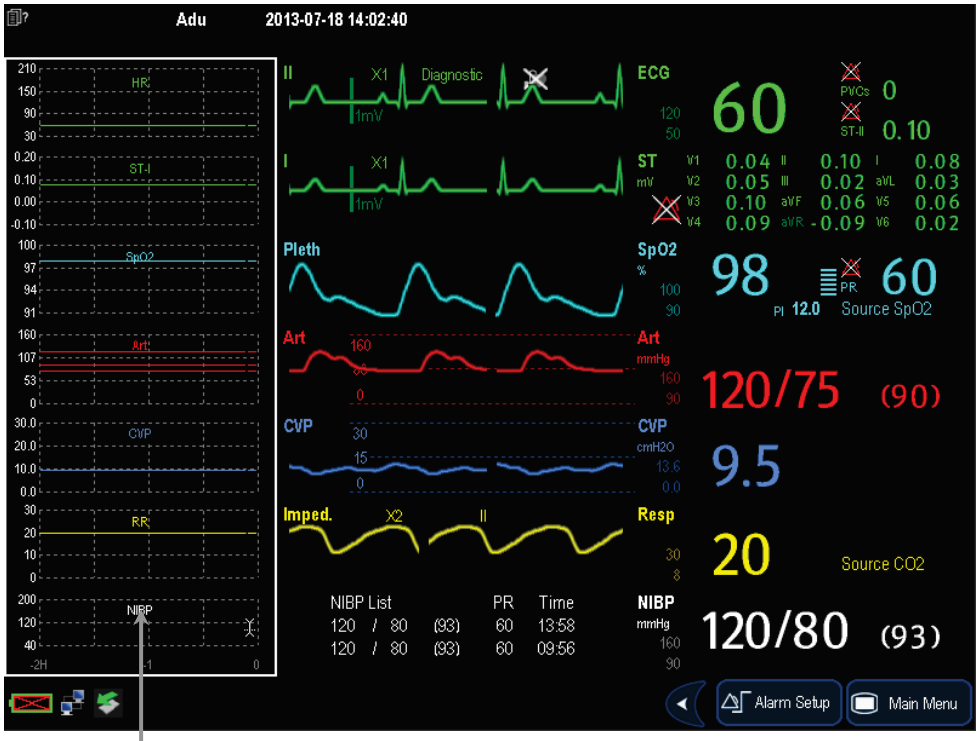
6.2 Viewing Minitrends

6.2.1 Having a Split-Screen View of Minitrends

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

To have a split-screen view of minitrends:

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



Minitrends View

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

6.2.2 Setting Minitrends

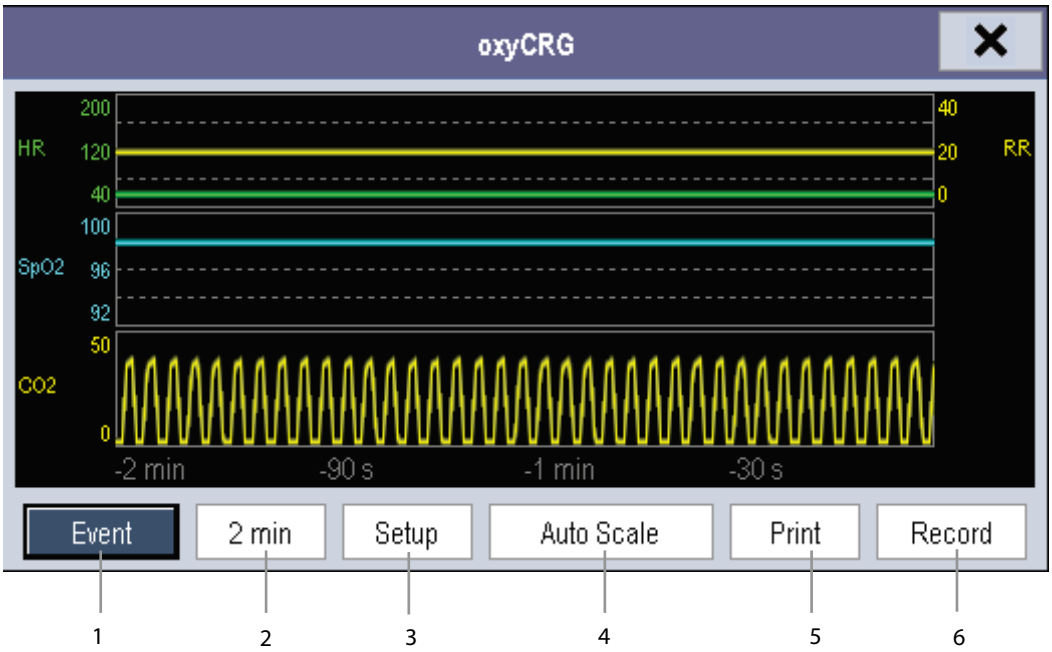
Select the minitrends area. From the pop-up [**Minitrend Setup**] menu:

- 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:

- Select the [**OxyCRG**] QuickKey;
- Select the [**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 waveform (Resp or CO_2 waveform). At the bottom, there are controls:

1. Event

   You can enter the [**Review**] menu by selecting the [**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 the real-time OxyCRG to a printer.

6. Record

   Select [**Record**] to print the currently displayed OxyCRG trends to the recorder.

6.4 Viewing Other Patients

6.4.1 Care Group

You can select up to 10 monitors (including telemetry) connected to the sameCMS 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 monitors from the [**Connected Monitor List**], and then select the ✕ button. The selected monitors constitute a Care Group.

NOTES

- **Monitors using software version prior to 05.17.00 cannot view or be viewed by monitors of software version 05.17.00 or later.**

6.4.2 Viewing the Care Group Overview Bar

The Care Group overview bar is located 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:

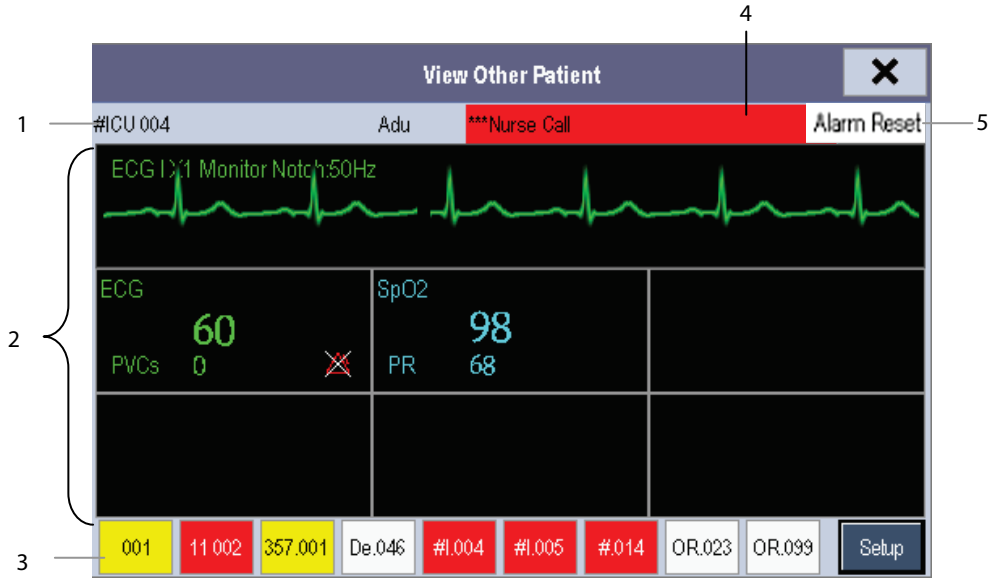
- Red: indicates the bed is having high-level physiological alarms or the telemetry is in alarm, such as nurse call or event.
- Yellow: indicates the bed is having medium-level or low-level physiological alarms, or medium-level technical alarms.
- Blue: indicates the bed is having low-level technical alarms.
- Light grey: indicates the bed fails to be networked.
- Dark grey: indicates the bed is in the Standby mode.

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

For more details about Care Group alarms, refer to the chapter ***24 Batteries***.

6.4.3 Understanding the View Other Patient Window

When you first open the [**View Other Patient**] window, the monitor automatically selects a device 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. See section ***6.4.2 Viewing the Care Group Overview Bar*** for information.
4. Message Area: shows physiological, technical and prompt messages from the currently viewed monitor. It also shows the alarm given by the device 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: resets alarms from the currently viewed bed. Refer to section ***7.8 Resetting Alarms***.

   When the [**Reset Other Bed's Alarms**] is disabled, no button will appear here.

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 pop-up 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 pop-up menu.

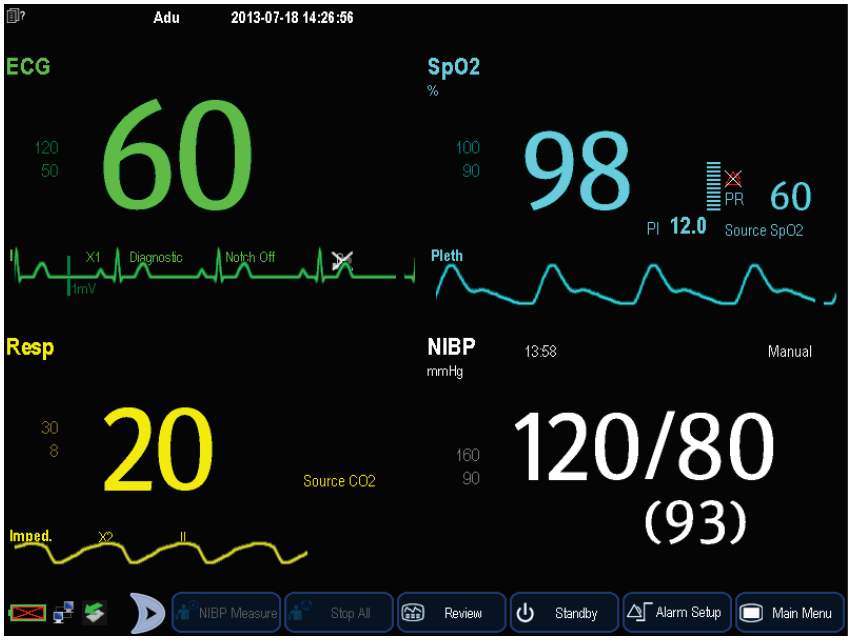
WARNING

- **The data presented in the [View Other Patient] window has a delay. Do not rely on this window for realtime data.**
- **The** **icon indicates network disconnection. You cannot view other monitors when this icon is displayed.**

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 to view. For parameters having a waveform, the waveform will also be displayed.

7 Alarms

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

WARNING

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

For troubleshooting specific alarms, see appendix ***D Alarm Messages***.

7.1 Alarm Categories

The monitor's alarms can be classified into two categories: physiological alarms and technical alarms.

1. Physiological alarms

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

2. Technical alarms

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

   Apart from the physiological and technical alarm messages, the monitor will show some messages telling the system status or patient status. Messages of this kind are included in 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

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

	Physiological alarms	Technical alarms
High level	Indicate that the patient is in a life threatening situation, such as Asystole, Vfib/Vtac and so forth, and emergency treatment is required.	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 the patient's vital signs appear abnormal and 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 the patient's vital signs appear abnormal and 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 monitor will indicate it to the user through visual or audible alarm indications.

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

7.3.1 Alarm Lamp

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

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

7.3.2 Alarm Messages

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 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 monitor will select the highest level alarm, 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, when an exclusive physiological alarm and a normal high level physiological alarm are triggered simultaneously, only exclusive physiological alarm messages will be displayed.**

7.3.5 Alarm Status Symbols

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

- indicates alarms are paused.
- indicates alarm is 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

To set 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 then select a value 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 minimum alarm volume setting remains unchanged when the monitor shuts down and restarts.

7.4.2 Changing the Alarm Volume

To change 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 high priority alarm volume 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 in the alarm symbols area of 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 order and then select the appropriate settings.

WARNING

- **When the alarm sound is switched off, the 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 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 then select [**ISO**], [**Mode 1**] or [**Mode 2**].

NOTE

- **User or factory default configurations have no impact on the alarm tone pattern setup. 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 silenced or turned off, the monitor issues a periodic reminder tone.

To set the reminder tones:

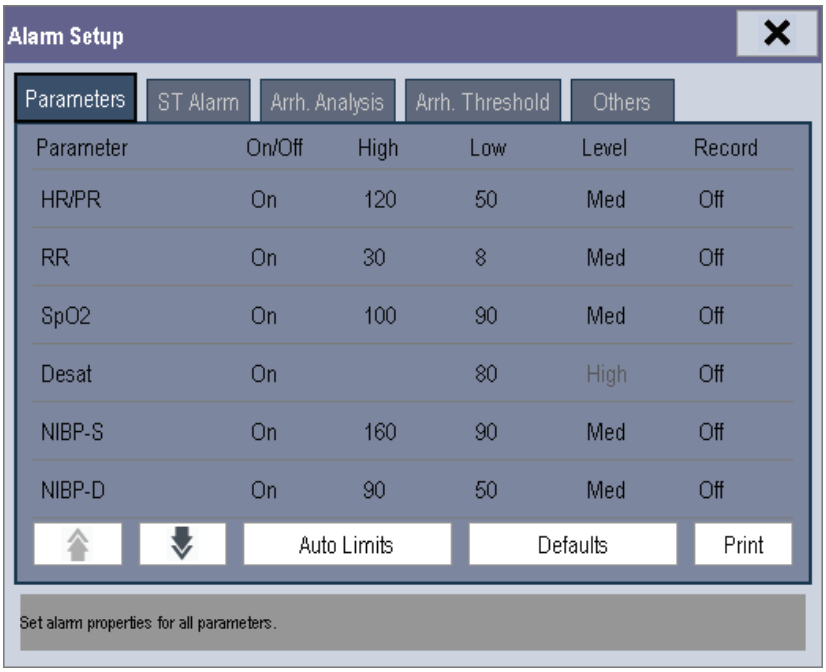
1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Alarm Setup >>**] to enter the [**Alarm Setup**] menu.
   - ◆ To switch the reminder tones on or off, select [**Reminder Tones**] and and then select [**On**] or [**Off**].
   - ◆ To set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



NOTE

- **The On/Off column is only visible when used with a CMS. This column is not visible with Panorama CMS.**

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

7.5.1 Setting Alarm Properties for All Parameters

In the [**Main Menu**], select [**Alarm Setup >>**]→[**Parameters**]. You can review and set alarm limits, alarm switches, 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 limit 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. 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 [**Alarm Setup Men**u]. 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 guidelines:

Module	Parameter	Low alarm limit		High alarm limit		Auto alarm limits range
		Adult/ pediatric	Neonate	Adult/ pediatric	Neonate	
ECG	HR/PR	(HR × 0.8) or 40 bpm (whichever is greater)	(HR – 30) or 90 bpm (whichever is greater)	(HR × 1.25) or 240 bpm (whichever is smaller)	(HR + 40) or 200 bpm (whichever is smaller)	Adult/pediatric: 35 to 240 Neonate: 55 to 225
Resp	RR	(RR × 0.5) or 6 rpm (whichever is greater)	(RR – 10) or 30 rpm (whichever is greater)	(RR × 1.5) or 30 rpm (whichever is smaller)	(RR + 25) or 85 rpm (whichever is smaller)	Adult/pediatric: 6 to 55 Neonate: 10 to 90
SpO_2	SpO_2	Same as the default alarm limit	Same as the default alarm limit	Same as the default alarm limit	Same as the default alarm limit	Same as the measurement range
NIBP	NIBP-S	(SYS × 0.68 + 10) mmHg	(SYS – 15) or 45 mmHg (whichever is greater)	(SYS × 0.86 + 38) mmHg	(SYS + 15) or 105 mmHg (whichever is smaller)	Adult: 45 to 270 Pediatric: 45 to 185 Neonate: 35 to 115
	NIBP-D	(Dia × 0.68 + 6) mmHg	(Dia – 15) or 20 mmHg (whichever is greater)	(Dia × 0.86 + 32) mmHg	(Dia + 15) or 80 mmHg (whichever is smaller)	Adult: 25 to 225 Pediatric: 25 to 150 Neonate: 20 to 90
	NIBP-M	(Mean × 0.68 + 8) mmHg	(Mean – 15) or 35 mmHg (whichever is greater)	(Mean × 0.86 + 35) mmHg	(Mean + 15) or 95 mmHg (whichever is smaller)	Adult: 30 to 245 Pediatric: 30 to 180 Neonate: 25 to 105

Module	Parameter	Low alarm limit		High alarm limit		Auto alarm limits range
		Adult/ pediatric	Neonate	Adult/ pediatric	Neonate	
Temp	T1	(T1 – 0.5)°C	(T1 – 0.5) °C	(T1 + 0.5)°C	(T1 + 0.5)°C	1 to 49°C
	T2	(T2 – 0.5)°C	(T2 – 0.5) °C	(T2 + 0.5)°C	(T2 + 0.5)°C	1 to 49°C
	TD	Same as the default alarm limit	Same as the default alarm limit	Same as the default alarm limit	Same as the default alarm limit	Same as the measurement range
IBP: ART/ Ao/ UAP/ BAP/ FAP/ LV/ P1-P4 (Arterial pressure)	IBP-S	(SYS × 0.68＋10) mmHg	(SYS – 15) or 45 mmHg (whichever is greater)	(SYS × 0.86 + 38) mmHg	(SYS + 15) or 105 mmHg (whichever is smaller)	Adult: 45 to 270 Pediatric: 45 to 185 Neonate: 35 to 115
	IBP-D	(Dia × 0.68 + 6) mmHg	(Dia – 15) or 20 mmHg (whichever is greater)	(Dia × 0.86 + 32) mmHg	(Dia + 15) or 80 mmHg (whichever is smaller)	Adult: 25 to 225 Pediatric: 25 to 150 Neonate: 20 to 90
	IBP-M	(Mean × 0.68 + 8) mmHg	(Mean – 15) or 35 mmHg (whichever is greater)	(Mean × 0.86 + 35) mmHg	(Mean + 15) or 95 mmHg (whichever is smaller)	Adult: 30 to 245 Pediatric: 30 to 180 Neonate: 25 to 105
PA	IBP-S	SYS × 0.75	SYS × 0.75	SYS × 1.25	SYS × 1.25	3 to 120 mmHg
	IBP-D	Dia × 0.75	Dia × 0.75	Dia × 1.25	Dia × 1.25	
	IBP-M	Mean × 0.75	Mean × 0.75	Mean × 1.25	Mean × 1.25	
IBP: CVP/ ICP/ LAP/ RAP/ UVP/ P1-P4 (Venous pressure)	IBP-M	Mean × 0.75	Mean × 0.75	Mean × 1.25	Mean × 1.25	3 to 40mmHg
CO_2	$EtCO_2$	0 to 32 mmHg: remains the same	0 to 32 mmHg: remains the same	0 to 32 mmHg: remains the same	0 to 32 mmHg: remains the same	Same as the measurement range
		32 to 35 mmHg: 29 mmHg	32 to 35 mmHg: 29 mmHg	32 to 35 mmHg: 41 mmHg	32 to 35 mmHg: 41 mmHg	
		35 to 45 mmHg: ($etCO_2$-6) mmHg	35 to 45 mmHg: ($etCO_2$-6) mmHg	35 to 45 mmHg: ($etCO_2$+6) mmHg	35 to 45 mmHg: ($etCO_2$+6) mmHg	
		45 to 48 mmHg: 39 mmHg	45 to 48 mmHg: 39 mmHg	45 to 48 mmHg: 51 mmHg	45 to 48 mmHg: 51 mmHg	
		> 48 mmHg: remains the same	> 48 mmHg: remains the same	> 48 mmHg: remains the same	> 48 mmHg: 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

Module	Parameter	Low alarm limit		High alarm limit		Auto alarm limits range
		Adult/ pediatric	Neonate	Adult/ pediatric	Neonate	
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

7.5.3 Setting Alarm Delay Time

You can set the alarm delay time for alarms of continuously measured parameters. If the alarm condition is resolved within the delay time, the monitor will not sound 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
- SpO_2 Desat
- 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**], [**5 s**], [**10 s**] and [**15 s**]. The delay is effective to the following technical alarms: SpO_2 Sensor Off, SpO_2 Too Much Light, SpO_2 Low Signal and SpO_2 Interference.

7.5.5 Setting Recording Length

You can change the length of the recorded waveforms. In the [**Others**] window of the [**Alarm Setup**] menu, select [**Recording Length**] and then select [**8 s**], [**16 s**] or [**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 (Cardiopulmonary Bypass Mode)

When performing CPB, you can put the monitor in CPB mode in order to reduce unnecessary alarms. The CPB mode is activated only if you set the department to [**OR**]. To set the department to [**OR**]:

1. Press the [**Menu**] 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 alarms are switched off.
In the CPB mode, [**CPB Mode**] is displayed in the physiological alarm area with a red background color.

To enter CPB mode:

1. Select the [**CPB Mode**] Quickkey or select [**Enter CPB Mode**] in the [**Others**] window of the [**Alarm Setup**] menu.
2. Then select [**Ok**] in the pop-up dialog box.

7.6 Pausing Alarms

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

- No alarm lamps flash and no alarms are sounded.
- No numerics or alarm limits 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 sound symbol area.

If the time interval of the monitor's last shutdown from this start-up is greater than 2 minutes, the 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 [**Alarm Pause**] hardkey.

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

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

7.7 Switching Off All Alarms

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

- For physiological alarms, no alarm lamps flash and no alarms are sounded.
- For physiological alarms, no numerics or alarm limits flash.
- No physiological alarm messages are shown.
- [**Alarm Off**] is displayed in the physiological alarm area with a red background.
- 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 [**Alarm Pause**] hardkey.

WARNING

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

7.8 Resetting Alarms

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

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

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

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

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

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

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Alarm Setup >>**] to enter the [**Alarm Setup**] menu.

3. Select [**Alarm Light on Alarm Reset**], and then select [**On**] or [**Off**].

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

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

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

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

7.9 Latching Alarms

The alarm latching setting for your monitor defines how the alarm indicators behave when you do not acknowledge them. When alarms are set to non-latching, their alarm indications end when the alarm condition ends. If you switch alarm latching on, 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.

To set alarms to latching or non-latching:

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

NOTE

- **Changing of alarm priority may affect the latching status of corresponding alarms. Determine if you need to reset the latching status for the specific alarm after changing 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 self-test is performed. In this case the alarm lamp is lit in yellow and red respectively, and the system gives a beep. This indicates that the visible and audible alarm indicators are functioning correctly.

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

7.11 Using Care Group Alarms

7.11.1 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.

When a 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.

7.11.2 Setting Care Group Alert Tone

When a monitor in the Care Group issues an alarm, your monitor prompts you by sounding an alert tone. To set the alert tone:

1. In the [**Main Menu**], select [**Screen Setup >>**]→[**Screen Layout >>**]→[**Choose Screen**].
2. In the [**Choose Screen**] window, select [**View Others Screen**].
3. In the view other patient window, select [**Setup>>**], and set [**Alert Tone**] to [**Repeat**], [**Once**] or [**Off**].

7.11.3 Resetting Care Group Alarms

You can reset the alarm of the currently viewed bed in the View Other Patient window. This function can be set in the [**Alarm Setup**] menu from the [**User Maintenance**] menu only.

When [**Reset Other Bed's Alarms**] is set to [**On**] in [**Maintenance**]→[**User Maintenance**]→[**Alarm Setup**], the [**Alarm Reset**] button appears on the [**View Other Patient**] window. You can reset the alarm system for the selected monitor by pressing the button. Refer to section ***7.8 Resetting Alarms*** for details.

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

FOR YOUR NOTES

8 Monitoring ECG

8.1 Introduction

The electrocardiogram (ECG) measures the electrical activity of the heart and displays it on the monitor as a waveform and a numeric. This section also tells you about ST monitoring and arrhythmia monitoring. ECG monitoring provides two algorithms:

- Mortara algorithm
- Mindray algorithm (currently unavailable in the US and Canada)

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

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 defibrillation-proof ECG cables during defibrillation.**
- **Do not touch the patient, or table, or instruments during defibrillation.**
- **The neutral electrode of the HF surgical unit shall properly contact the patient. Otherwise, burns may result.**
- **The equipment is not intended for direct cardiac application.**

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

To prepare the patient and place the electrodes:

1. Prepare the patient's skin. Proper skin preparation is necessary for good signal quality at the electrode site, as the skin is a poor conductor of electricity. To properly prepare the skin, choose flat areas and then:
   - ◆ 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.

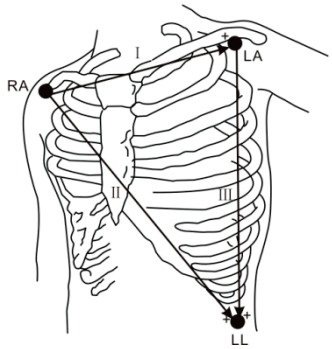
8.3.2 Choosing AHA or IEC Lead Placement

To choose 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**], 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 hospital standard.

8.3.3 ECG Lead Placements

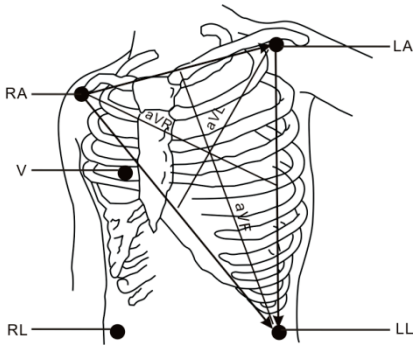
The electrode placement illustrations in this chapter adopt the AHA standard.



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.

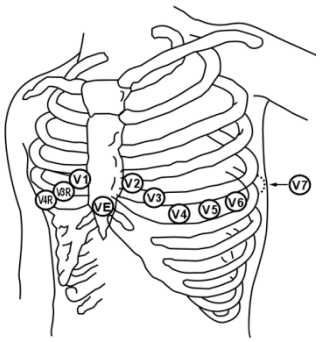


5-Leadwire Electrode Placement

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.

Lead Placement for Surgical Patients

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

WARNING

- **When using electrosurgical units (ESU), patient leads should be placed in a position that is equal distance from the Electrosurgery electrotome and the grounding plate to avoid burns to the patient. Never entangle the ESU cable and the ECG cable together.**
- **When using electrosurgical units (ESU), never place ECG electrodes near to the grounding plate of the ESU, as this can cause a lot of interference on the ECG signal.**

8.3.4 Checking Paced Status

It is important to set the paced status correctly when you start monitoring ECG. The paced symbol is displayed 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 pop-up menu and then select [**Yes**] or [**No**].

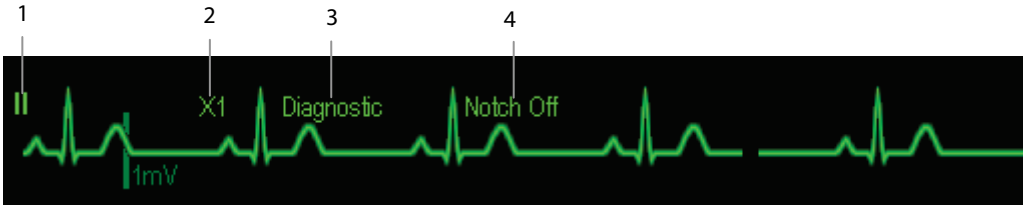
If you do not set the paced status, the monitor issues a prompt tone when pace pulse is detected. At the same time, the paced symbol flashes and the message [**Please confirm the pace of patient**] appears in the ECG waveform area. Then, please check and set the paced status of the patient.

WARNING

- **For paced patients, you must set [Paced] to [Yes]. If it is incorrectly set to [No], the 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

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 Setting Pacemaker Rate (For Mortara ECG algorithm 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 monitor can calculate HR and detect arrhythmias more accurately. When [**Paced**] is set to [**No**], the pacemaker rate cannot be set.

8.5.3 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 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 monitor will automatically switch to PR as the alarm source.

8.5.4 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 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.

8.5.5 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.

CAUTION

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

8.5.6 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 monitor can calculate HR and detect arrhythmias more accurately. When [**Paced**] is set to [**No**], the pacemaker rate cannot be set.

8.5.7 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.

8.5.8 Choosing an ECG Display Screen

When monitoring with a 5-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 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.

8.5.9 Setting the Notch Filter

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

To set the notch filter:

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

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

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

8.5.10 Changing the Pacer Reject Settings

Select [**ECG Setup**]→[**Others>>**]→[**Pacer Reject**], and then select [**On**] or [**Off**].

When [**Paced**] is set to [**Yes**]:

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

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

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 then select [**On**] or [**Off**] from the pop-up 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 pop-up 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 pop-up menu and select the appropriate setting. When a 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

A defibrillator synchronization pulse (100 ms, +5V) is outputted through the Multifunctional connector every time the monitor detects an R-wave.

To use the defibrillator synchronization function:

1. Connect the monitor and the defibrillator with a synchronization cable.
2. Set [**Filter**] to [**Diagnostic**] on the monitor.

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.**
- **After defibrillation is finished, select the filter mode as required.**

8.6 About ST Monitoring

- 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.

NOTE

- **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**] and then select [**On**] or [**Off**].

Reliable ST monitoring can hardly be ensured if:

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

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

8.6.2 Changing ST Filter Settings

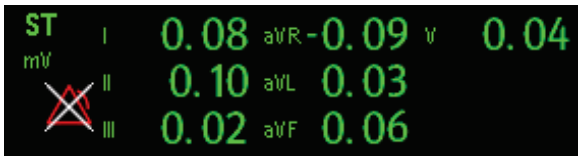
ST-segment analysis can be carried out only when the filter mode is set to [**Diagnostic**] or [**ST**]. When ST-segment analysis is switched on, [**Filter**] will automatically switch to [**ST**] if it is not [**Diagnostic**] or [**ST**]. When ST-segment analysis is switched off, the filter mode automatically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

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

8.6.3 Understanding the ST Display

8.6.3.1 ST Numerics

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

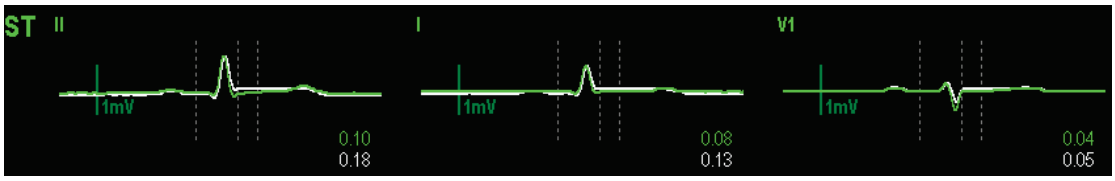


8.6.3.2 ST Segment

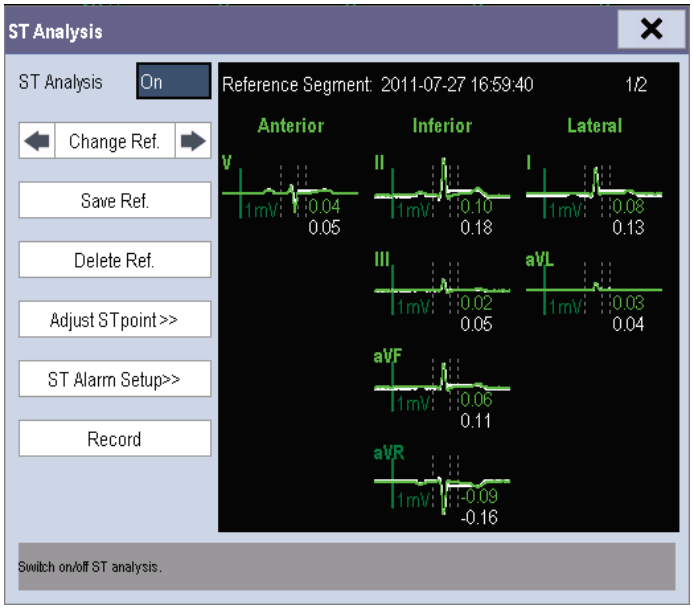
ST segment shows a QRS complex segment for each measured ST lead. The current ST segment is drawn in the same color as the ECG wave, usually green, superimposed over the stored reference segment, drawn in a different color. The information is updated once every ten seconds.

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



Select the ST parameter window or ST segment area to enter the [**ST Analysis**] menu.



8.6.4 Saving the Current ST Segment as Reference

Select [**Save Ref.**] in the [**ST Analysis**] menu to save the current segment as a reference. Up to 20 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 earliest saved group is deleted automatically.**

8.6.5 Changing the Reference Segment

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

8.6.6 Deleting a Reference Segment

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

8.6.7 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.

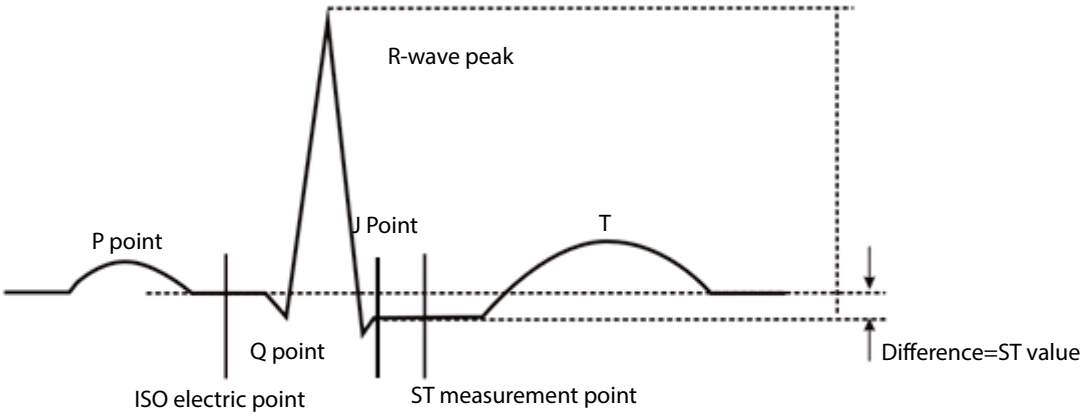
8.6.9 Setting the ST Alarm Delay Time

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 ST measurement points are appropriate for your patient.**

To adjust the ST measurement points:

1. In the [**ST Analysis**] menu, select [**Adjust ST Point >>**]. In the [**Adjust ST Point**] window, three vertical lines represent the ISO, J and ST point positions respectively.
2. Use the arrows ⬅ and ➡ besides the [**View Leads**] button to select an ECG lead with obvious J point and R wave.
3. Sdjust the position of [**ISO**], [**J**] or [**ST Point**]:
   - The ISO-point (isoelectric) position is given relative to the R-wave peak. Position the ISO-point in the middle of the flattest part of the baseline (between the P and Q waves).
   - The J-point position is given relative to the R-wave peak and helps locating the ST-point. Position the J-point at the end of the QRS complex and the beginning of the ST segment.
   - The ST-point is positioned a fixed distance from the J-point. Move the J-point to position the ST-point at the midpoint of the ST segment. Position the ST-point relative to the J-point at either [**J+60/80ms**], [**J+40ms**], [**J+60ms**] or [**J+80ms**]. When [**J+60/80ms**] is selected, the ST-point will be positioned 80 ms (heart rate 120 bpm or less) or 60 ms (heart rate more than 120 bpm) from the J-point.

NOTE

- **Only Mindray ECG algorithm (currently unavailable in the US and Canada) has the function of automatic J point detection.**

8.7 About Arrhythmia Monitoring

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

WARNING

- **Arrhythmia analysis program is intended to detect ventricular arrhythmias. It is not designed to detect atrial or supraventricular arrhythmias. It may incorrectly identify the presence or absence of an arrhythmia. Therefore, a physician must analyze the arrhythmia information with other clinical findings.**
- **The arrhythmia detection is not intended for neonatal patients.**
- **Heart-rate reading may be affected by cardiac arrhythmias. Do not rely entirely on rate meter alarms when monitoring patients with arrhythmia. Always keep these patients under close surveillance.**

8.7.1 Understanding the Arrhythmia Events

Mortara ECG algorithm

Arrhythmia Message	Description	Category
Asystole	No QRS complex detected within the set time threshold (in absence of ventricular fibrillation or chaotic signals).	Lethal arrhythmia
Vfib	Ventricular fibrillation occurs and persists for 6 seconds.	
Vtac	Ventricular HR is greater or equal to the preset threshold and the number of consecutive PVCs is greater than the preset threshold.	
PVCs	PVCs/min exceeds high limit	Nonlethal arrhythmia
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.	
VT > 2	Ventricular HR is greater than or equal to the preset threshold and the number of PVCs is greater than or equal to 3 but less than the preset threshold.	
Vent. Rhythm	Ventricular HR is less than the preset threshold and the number of PVCs is greater than or equal to 3.	
Bigeminy	A dominant rhythm of N, V,N, V, N, V.	
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.	

Mindray ECG algorithm (currently unavailable in the US and Canada)

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.	
VT > 2	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.	
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.	

8.7.2 Changing Arrhythmia Alarm Settings

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

WARNING

- **If you switch off all arrhythmia analysis alarms, the monitor cannot give any arrhythmia analysis alarm. Always keep the patient under close surveillance.**
- **The priority of lethal arrhythmia alarms is always high. It is unchangeable.**

8.7.3 Changing Arrhythmia Threshold Settings

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

Mortara ECG algorithm

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

Mindray ECG algorithm (currently unavailable in the US and Canada)

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	5	bpm
Brady Low	15 to 120	Adult: 50 Pediatric: 75	5	bpm
Extreme Tachy	120 to 300	Adult: 160 Pediatric: 180	5	bpm
Extreme Brady	15 to 60	Adult: 35 Pediatric: 50	5	bpm

Arrh. event	Range	Default	Step	Unit
Multif. PVC's Window	3 to 31	15	1	/min
Vtac Rate	100 to 200	Adult, pediatric: 130	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

8.7.4 Setting the Extended Arrhythmia (For Mindray ECG Algorithm only, currently unavailable in the US and Canada)

The following arrhythmia events are defined as extended arrhythmia:

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

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

CAUTION

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

8.7.5 Reviewing Arrhythmia Events

Please refer to section ***19.4 Reviewing Events***.

8.8 ECG Relearning

8.8.1 Initiating an ECG Relearning Manually

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

- Incorrect arrhythmia alarms
- Loss of ST measurement, and/or
- Inaccurate heart rate

ECG relearning allows the monitor to learn the new ECG template 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 monitor is learning, the message [**ECG Learning**] is displayed in the technical alarm area.

WARNING

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

8.8.2 Automatic ECG Relearning

ECG relearning is initiated automatically whenever:

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

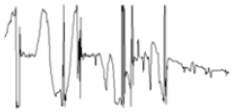
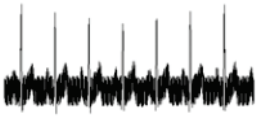
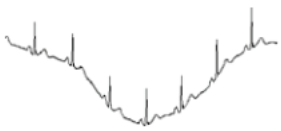
8.9 Troubleshooting

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
Noisy ECG traces	Loose or dry electrodes	Apply fresh and moist electrodes.

Symptoms	Possible Cause	Correction Action
	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 section ***27.1 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 section ***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 section ***8.3.1 Preparing the Patient and Placing the Electrodes*** and apply fresh and moist electrodes.
	Cable or lead wires damaged	Change cable and lead wires.
Excessive alarms: heart rate, lead fault	Electrodes dry	Repeat skin preparation as described in section ***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 section ***8.5.4 Changing ECG Wave Settings***.
	Electrodes dry / old	Apply fresh and moist electrodes.
	Skin improperly prepared	Repeat skin preparation as described in section ***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 section ***8.5.4 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 section ***8.3.1 Preparing the Patient and Placing the Electrodes*** and apply fresh and moist electrodes.
	ECG Filter set to ST or Diagnostic mode	Set ECG Filter to "Monitor" mode.

FOR YOUR NOTES

9 Monitoring Respiration (Resp)

9.1 Introduction

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

9.2 Safety Information

WARNING

- **When monitoring the patient's respiration, do not use ESU-proof ECG cables.**
- **If you do not set the detection level for the respiration correctly in manual detection mode, it may not be possible for the monitor to detect apnea. If you set the detection level too low, the monitor is more likely to detect cardiac activity, and to falsely interpret cardiac activity as respiratory activity in the case of apnea.**
- **The respiration measurement does not recognize the cause of apneas. It only indicates an alarm if no breath is detected when a pre-configured time has elapsed since the last detected breath. Therefore, it cannot be used for diagnostic purpose.**
- **If operating under conditions according to the EMC Standard EN 60601-1-2 (Radiated Immunity 3V/m), field strengths above 1V/m may cause erroneous measurements at various frequencies. Therefore it is recommended to avoid the use of electrically radiating equipment in close proximity to the respiration measurement unit.**

9.3 Understanding the Resp Display

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

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

NOTE

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

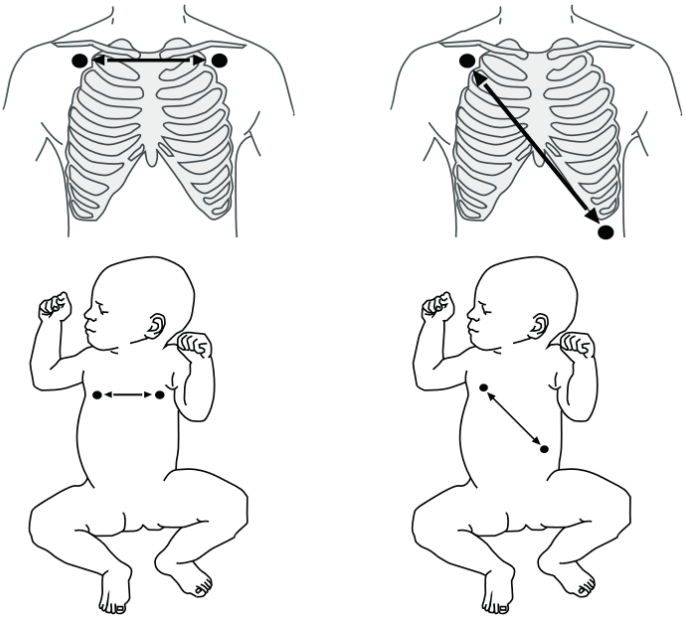
9.4 Placing Resp Electrodes

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

As the respiration measurement adopts the standard ECG electrode placement, you can use different ECG cables (3-lead, or 5-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 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 then select [**Auto**] or [**Manual**].

- In auto detection mode, the 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 section ***9.4.4 Lateral Chest Expansion***.

9.8 Changing Resp Wave Settings

WARNING

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

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

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

9.9 Setting Respiration Rate 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 [**Alarm Reset**] key 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 pop-up menu, you can set alarm properties for this parameter.

10 Monitoring PR

10.1 Introduction

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

1. PR: detected beats per minute.
2. PR Source

NOTE

- **A functional tester or SpO_2 simulator can be used to determine pulse rate accuracy.**

10.2 Setting the PR Source

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

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

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

10.3 Selecting the Active Alarm Source

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

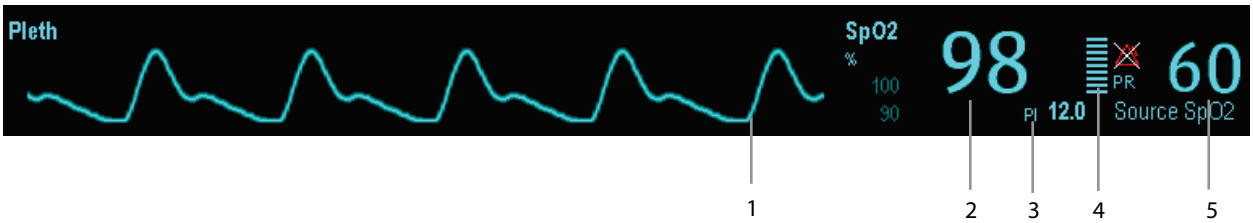
When PR is used as the alarm source, the PR source will be used as a source for the QRS tone. You can change the QRS volume by adjusting [**Beat Vol**] in the [**SpO2 Setup**] menu. When a valid SpO_2 value exists, the system will adjust the pitch tone of QRS volume according to the SpO_2 value.

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. R eposition 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 Masimo SpO_2 module. For Masimo 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 the pleth wave): detected pulsations per minute.

NOTE

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

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.**
- **The equipment is not intended for use in an MRI environment.**
- **Prolonged continuous monitoring may increase the risk of undesirable changes in skin characteristics, such as irritation, reddening, blistering or burns. Inspect the sensor site every two hours and move the sensor if the skin quality changes. Change the application site every four hours. For neonates, or patients with poor peripheral blood circulation or sensitive skin, inspect the sensor site more frequently.**

11.3 Identifying SpO_2 Modules

To identify which SpO_2 module is incorporated into your monitor, see the color of the SpO_2 connector and the company logo located at the monitor. The color of the cable connector matches the company as shown below:

- 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

To apply 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 pop-up menu, you can set low alarm limit, alarm switch, and alarm recording for [**Desat**]. When the SpO_2 value is below the desat alarm limit and desat alarm switch is set on, the message [**SpO2 Desat**] is displayed.

11.5.3 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 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 monitor responds to changes in the patient's oxygen saturation level. Contrarily, the longer the averaging time is, the slower the monitor responds to changes in the patient's oxygen saturation level, but the 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 Masimo SpO_2 module:

,1. Select [**Averaging**] in the [**SpO2 Setup**] menu.

2. Then select [**2-4 s**], [**4-6 s**], [**8 s**], [**10 s**], [**12 s**], [**14 s**] or [**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 alarms can be distracting. Nellcor's Sat-Seconds alarm management technique is used to reduce these nuisance alarms.

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

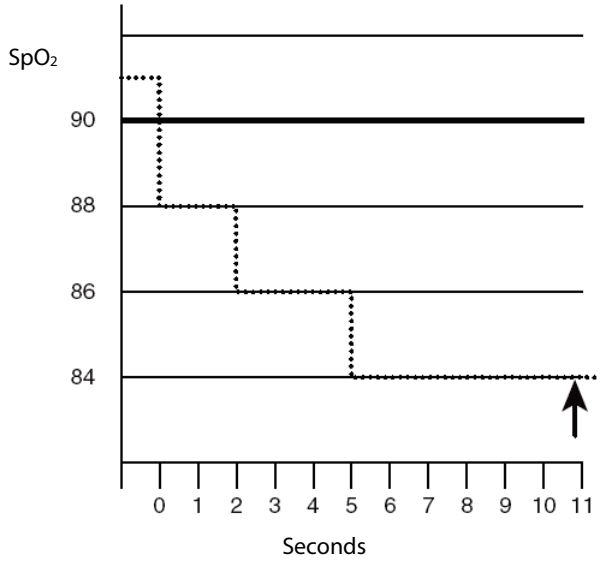
With Sat-Seconds alarm management, high and low alarm limits are set in the same way as traditional alarm management. A Sat-Seconds limit is also set. The Sat-Seconds limit controls the amount of time that SpO_2 saturation may be outside the set limits before an alarm sounds. The method of calculation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

Sat-Seconds= Points × Seconds

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

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

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



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

NOTE

- **The "SpO2 Too Low" or "SpO2 Too High" alarm is presented in the case that SpO_2 value violates the alarm limits for 3 times within one minute even if the setting of Sat-Seconds is not reached.**

11.5.7 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 Masimo 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 [**SpO2SensorOff Lev.**] in the pop-up menu.

11.5.10 Setting the SpO_2 Tone Mode

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

WARNING

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

11.6 Measurement Limitations

If you doubt the SpO_2 measurement, check the patient's vital signs first. Then check the 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.

NOTE

- **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 section ***3.12.1 Switching the Parameters On/Off***.
Unable to obtain SpO_2 reading	Patient has poor perfusion	Switch limbs/notify physician
	Sensor not on patient	Check if the "**SPO2 Sensor Off**" alarm is reported. If so, reapply the sensor. If not, contact the service personnel.
	Cables loose/not connected	Check if the sensor and cable are properly connected.
	Ambient light	Check if the "**SpO2 Too Much Light**" alarm is reported. If so, move the sensor to a place with lower level of ambient light or cover the sensor to minimize the ambient light.

Symptoms	Possible Cause	Correction Action
No SpO_2 waveform	Waveform not selected to display	Switch the SpO_2 monitoring function on as described in ***3.12.1 Switching the Parameters On/Off***.
	Cable or sensor not plugged in	Check that the cable is properly connected and sensor securely applied.
Low amplitude 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.

12 Monitoring NIBP

12.1 Introduction

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

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

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

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

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

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

NOTE

- **Blood pressure measurements determined with this device are equivalent to those obtained by a trained observer using the cuff/stethoscope auscultatory method or an intra-arterial blood pressure measurement device, within the limits prescribed by the American National Standard, Manual, electronic, or automated sphygmomanometers.**

12.2 Safety

WARNING

- **Be sure to select the correct patient category setting for your patient before measurement. Do not apply the higher adult settings for pediatric or neonatal patients. Otherwise it may present a safety hazard.**
- **Do not measure NIBP on patients with sickle-cell disease or on the limb where skin damage has occurred or is expected.**
- **Use clinical judgment to determine whether to perform frequent unattended blood pressure measurements on patients with severe blood clotting disorders because of the risk of hematoma in the limb fitted with the cuff.**
- **Do not use the NIBP cuff on a limb with an intravenous infusion or arterial catheter in place. This could cause tissue damage around the catheter when the infusion is slowed or blocked during cuff inflation.**
- **NIBP reading can be affected by the measurement site, the position of the PATIENT, exercise, or the patient's physiologic condition. If you doubt the NIBP measurements, determine the patient's vital signs by alternative means and then verify that the monitor is working correctly.**
- **Do not apply cuff on the arm on the side of a mastectomy.**

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 three methods of measuring NIBP:

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

12.5 Setting Up the NIBP Measurement

12.5.1 Preparing 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; and,
- Middle of the cuff at the level of the right atrium of the heart.

NOTE

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

12.5.2 Preparing to Measure NIBP

To prepare for the NIBP measurement:

1. Power on the monitor.
2. Verify that the patient category is correct. If not, select the [**Patient Setup**] QuickKey → [**Patient Demographics**] → [**Patient Cat.**] and set the patient category to [**Adu**], [**Ped**] or [**Neo**].
3. Plug the air tubing into the NIBP connector on the 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 the patient's upper arm or leg 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. Avoid compression or restriction of pressure tubes. Air must pass unrestricted through the tubing.

WARNING

- **Continuous CUFF pressure due to connection tubing kinking may cause blood flow interference and resulting harmful injury to the patient.**

NOTE

- **Equipment use 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 [**NIBP**] 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

To enable the NIBP auto cycling and set the interval:

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

12.5.6 Starting a STAT Measurement

To start a STAT measurement:

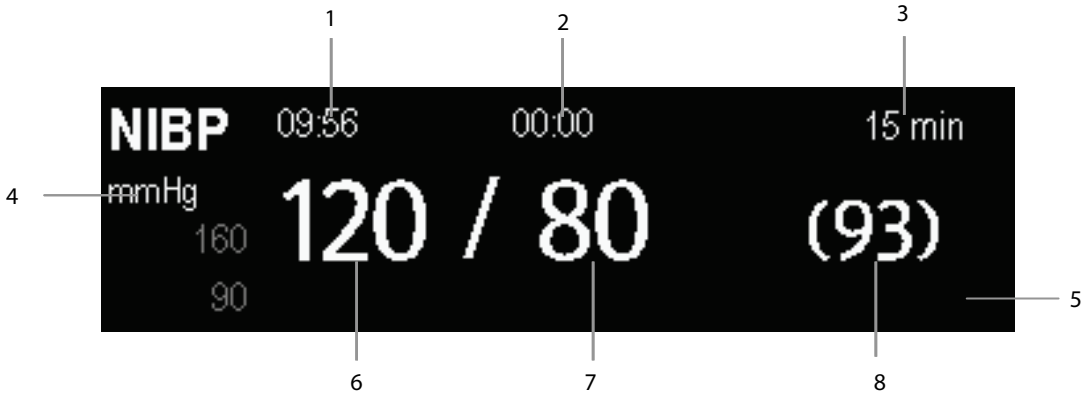
1. Select the NIBP parameter window to enter the [**NIBP Setup**] menu.
2. Select [**NIBP STAT**]. The STAT mode initiates 5 minutes of continuous, sequential, automatic NIBP measurements.

WARNING

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

12.6 Understanding the NIBP Numerics

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



1. Time of last measurement
2. Time remaining to next measurement
3. Measurement mode
4. Unit of pressure: mmHg or kPa
5. Prompt message area: shows NIBP-related prompt messages
6. Systolic pressure
7. Diastolic pressure
8. Mean pressure obtained after the measurement and cuff pressure obtained during the measurement

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

12.7 Changing NIBP Settings

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

12.7.1 Setting the Initial Cuff Inflation Pressure

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

NOTE

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

12.7.2 Setting NIBP Alarm Properties

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

12.7.3 Displaying NIBP List

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

NIBP List			PR	Time
120	/ 80	(93)	60	16:53
120	/ 80	(93)	60	15:52

You can not 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 then select [**mmHg**] or [**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 [**NIBP**] hardkey on the monitor's front panel, 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.

13 Monitoring Temp

13.1 Introduction

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

13.2 Safety

WARNING

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

13.3 Making a Temp Measurement

The equipment is intended for monitoring skin temperature and core temperature.

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

13.4 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 Setting the Temperature Unit

Select [**Unit Setup >>**] from the [**User Maintenance**] menu. In the pop-up menu, select [**Temp Unit**] and then select [**ºC**] or [**ºF**].

14 Monitoring IBP

14.1 Introduction

The Passport 12 monitor can monitor up to 4 invasive blood pressures and Passport 8 monitors can monitor up to 2 invasive blood pressures (using an external module). The 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 Zeroing the Transducer

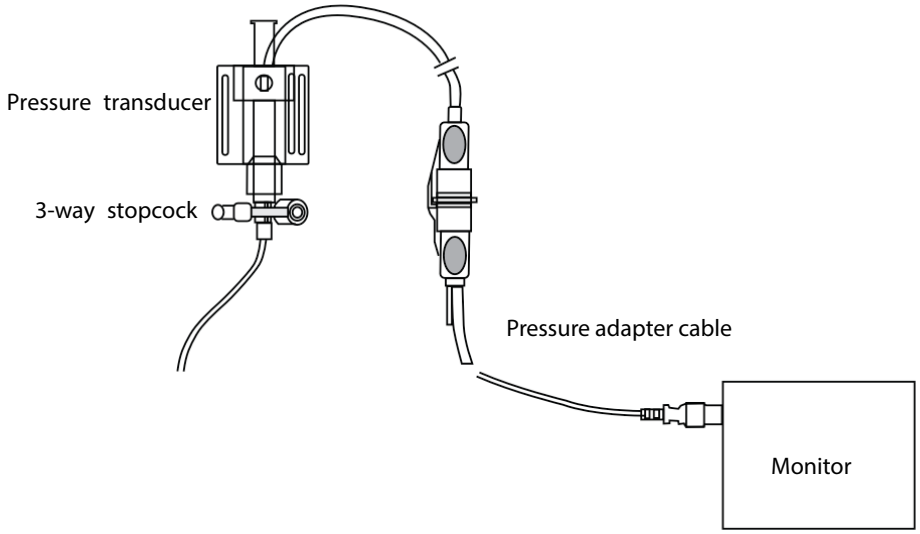
To avoid inaccurate pressure readings, the monitor requires a valid zero. Zero the transducer in accordance with your hospital policy (at least once per day).

Zero whenever:

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

To zero the transducer:

1. Turn off the stopcock to the patient.



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

NOTE

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

14.4 Setting Up the Pressure Measurement

To set up the pressure measurement:

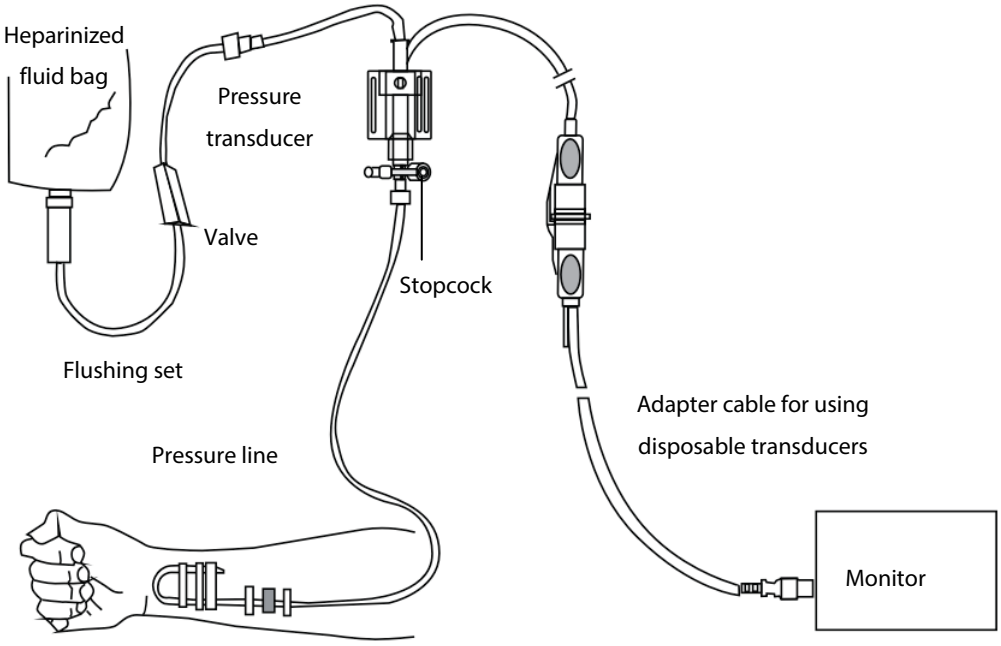
1. Plug the pressure cable into the IBP connector.
2. Prepare the flush solution.
3. Flush the system to exhaust all air from the tubing. Ensure that the transducer and stopcocks are free of air bubbles.

WARNING

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

4. Connect the pressure line to the patient catheter.
5. Position the transducer so that it is level with the heart, approximately at the level of the midaxillary line.

6. Select the appropriate label.
7. Zero the transducer. After a successful zeroing, turn off the stopcock to the air and turn on the stopcock to the patient.

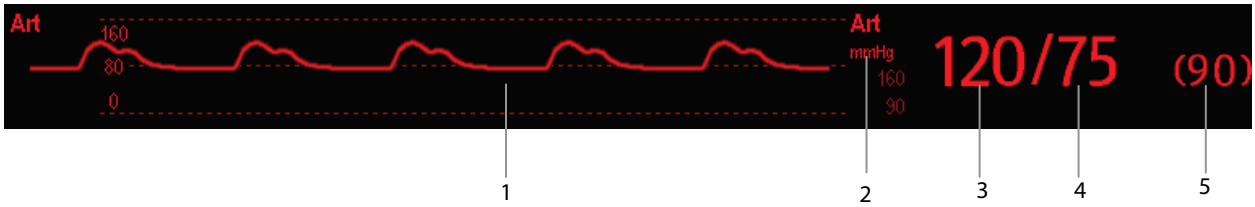


WARNING

- **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.**

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

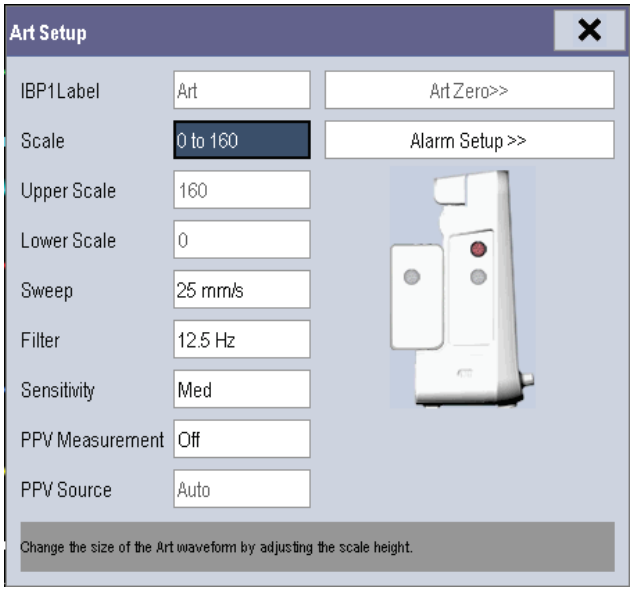
For some pressures, the parameter window may show the mean pressure only. For different pressures, their defaults unit may be different. If the Art and ICP pressures are measured simultaneously, the ICP parameter area will display numeric CPP, which is obtained by subtracting ICP from the Art mean.

14.6 Changing IBP Settings

14.6.1 Changing a Pressure for Monitoring

To change a pressure for monitoring:

1. Select the pressure you want to change to enter its setup menu. In the menu, there is a figure showing the current IBP measurement connector.



2. Select [**Label**] and then select your desired label from the list. Labels already used cannot be selected.

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

NOTE

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

14.6.2 Setting Alarm Properties

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

14.6.3 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 monitor responds to changes in the patient's blood pressure. Contrarily, the longer the averaging time is, the slower the 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 then select [**High**], [**Med**] or [**Low**], the corresponding averaging time is about 1 s, 8 s and 12 s respectively.

14.6.4 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.

14.6.5 Setting the Pressure Unit

Select [**Unit Setup >>**] from the [**User Maintenance**] menu. In the pop-up menu, select [**Press. Unit**] and then select [**mmHg**] or [**kPa**]. Select [**CVP Unit**] and then select [**mmHg**], [**cmH2O**] or [**kPa**].

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 by enabling the PPV measurement.

WARNING

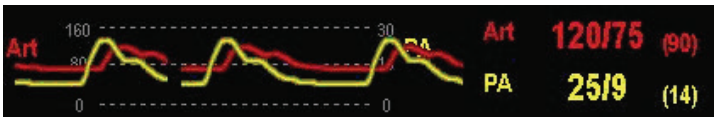
- **This monitor can calculate PPV from beat-to-beat values of any arterial pulsatile pressure. The circumstances under which the calculation of a PPV value is clinically meaningful, appropriate and reliable must be determined by a physician.**
- **The clinical value of the derived PPV information must be determined by a physician. According to recent scientific literature, the clinical relevance of PPV information is restricted to sedated patients receiving controlled mechanical ventilation and mainly free from cardiac arrhythmia.**
- **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.**

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 opens 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 the 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

- **The CVP scale changes simultaneously 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

To prepare for the PAWP measurement:

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. Refer to section ***15.4 Setting Up the C.O. Measurement*** for more information.
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.

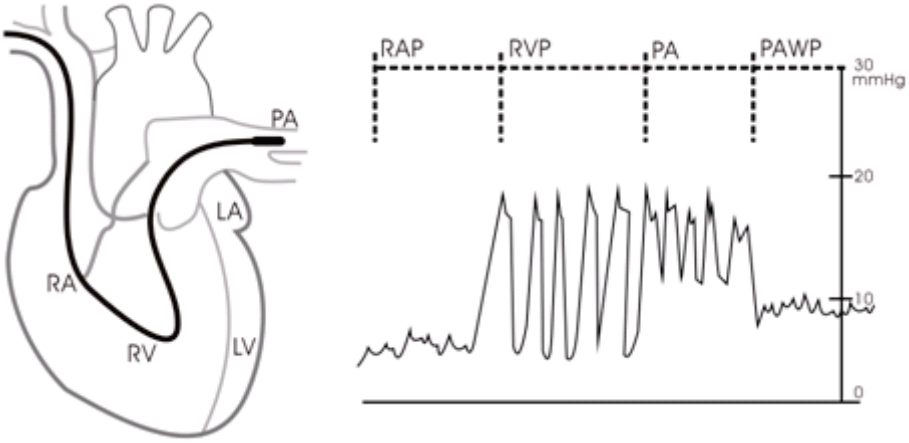
NOTE

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

14.8.2 Setting Up the PAWP Measurement

To setup the PAWP measurement:

1. Wedge the flotation catheter into the pulmonary artery. Then inflate the balloon and pay attention to the PA waveform changes on the screen.



2. After obtaining a stable PAWP waveform, press the [**Freeze**] key to freeze the waveform and deflate the balloon.
3. You can adjust the PAWP scale to an appropriate position by adjusting ▲ or ▼ beside the [**Adjust**] button. Press the [**Confirm**] key to save one PAWP measurement.
4. If you need to start a new measurement, select [**Next Measure**].

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 an 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.

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 section ***14.4 Setting Up the Pressure Measurement***.
	Kinked catheter	Change the position of catheter.
	Blood in tubing	Pressurize the solution bag to 300 mmHg. For details, refer to the instructions for use of the solution bag.
IBP not displayed/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 section ***14.3 Zeroing the Transducer***.
Dashes "- -" display in place of numerics.	The measured result is invalid or out of range. IBP might be set to non-pulsatile labels like CVP, LA, RA, and ICP.	Change to a pulsatile label.
Abnormally high or low readings	Transducer too High or too Low.	Adjust the position of the transducer and make sure that it is level with the heart, approximately at the level of the midaxillary line. Zero the transducer as described in ***14.3 Zeroing the Transducer***.
Unable to Zero	Stopcock not open to atmosphere.	Check the transducer and make sure the stopcock is turned to the air.
PAWP button disabled	One IBP channel must be labeled PA	Label an IBP channel as PA. (Also Label an IBP channel as P1/P2/P3/P4, it will automatically change to PA)

FOR YOUR NOTES

15 Monitoring Cardiac Output

15.1 Introduction

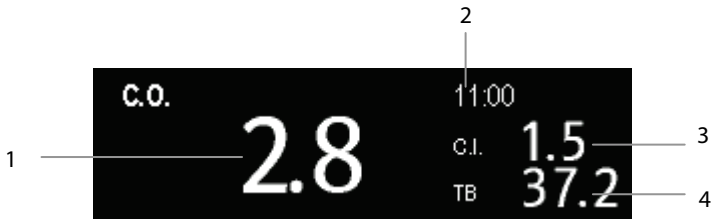
The cardiac output (C.O.) measurement invasively measures cardiac output and other hemodynamic parameters using the right heart (atria) thermodilution method. A cold solution of known volume and temperature is injected into the right atrium through the proximal port of a pulmonary artery (PA) catheter. 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 technical suggestions to obtain accurate C.O.:

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

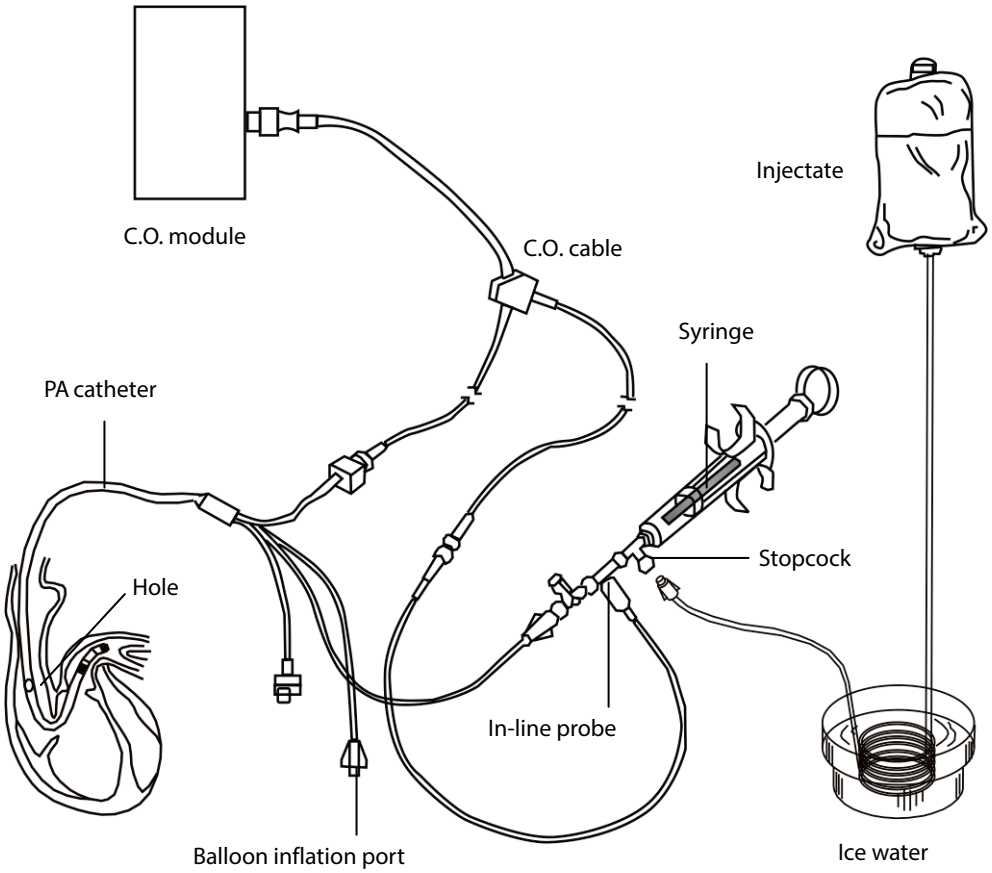
15.4 Setting Up the C.O. Measurement

WARNING

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

To set up the C.O. measurement:

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

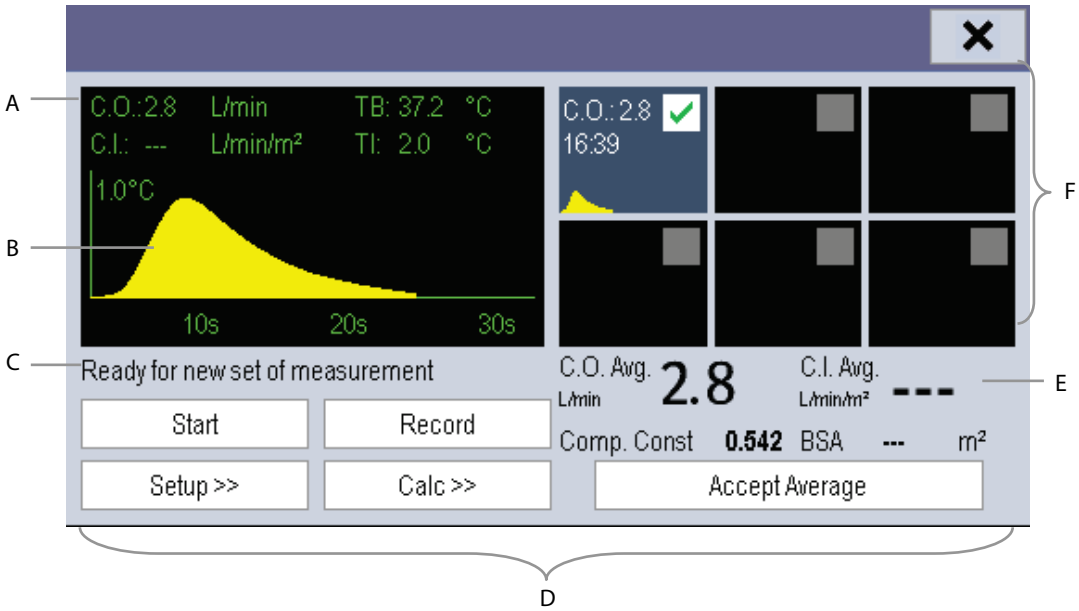
- **The above picture illustrates when using a TI sensor (PN 6000-10-02079). The connection may be different if other TI sensors are used.**

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(°C)**] is disabled. If you select [**Manual**], you need to enter the injectate temperature at [**Manual TI(°C)**] 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 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.

CAUTION

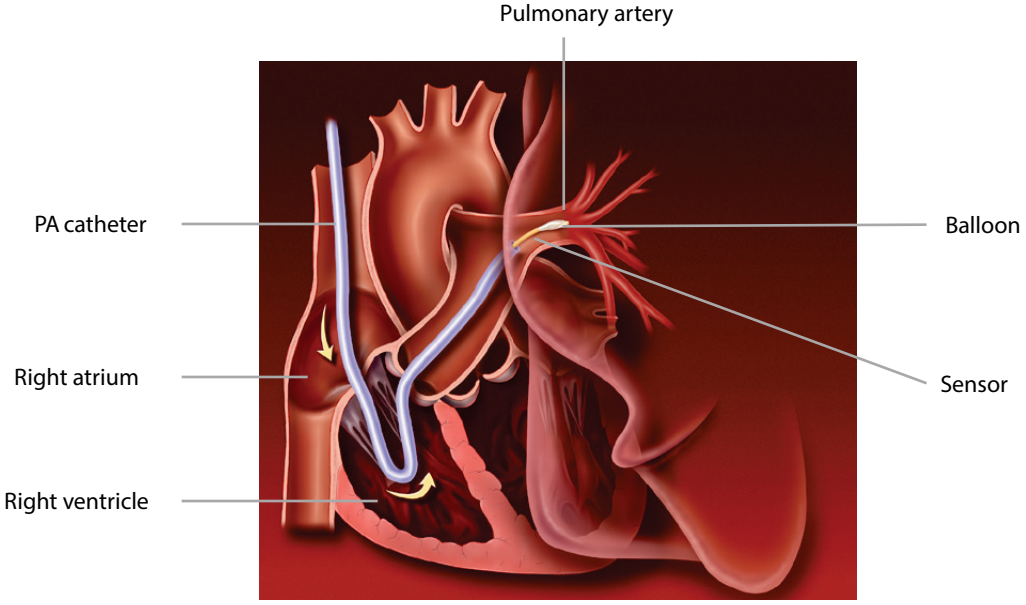
- **Starting a measurement without blood temperature being stable may cause measuring failure.**

NOTE

- **During a cardiac output measurement, blood temperature alarms are inactive.**
- **Please refer to the Instructions for Use of the pulmonary artery catheter 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 pop-up menu, select [**Temp Unit**] and then select [**°C**] or [**°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 pop-up menu.

16 Monitoring CO_2

16.1 Introduction

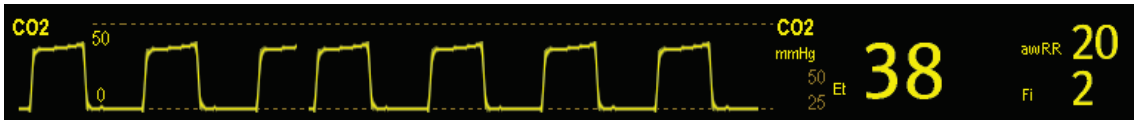
CO_2 monitoring is a continuous, non-invasive technique for determining the concentration of CO_2 in the patient's airway by measuring the absorption of infrared (IR) light of specific wavelengths. CO_2 has its own absorption characteristic and the amount of light passing the gas probe depends on the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

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

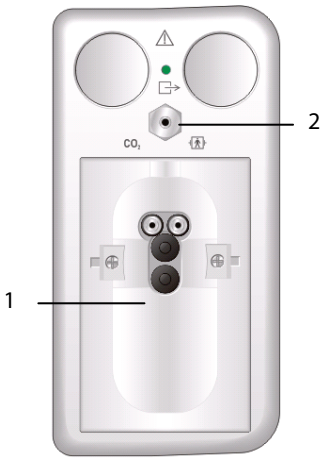
The measurement provides:

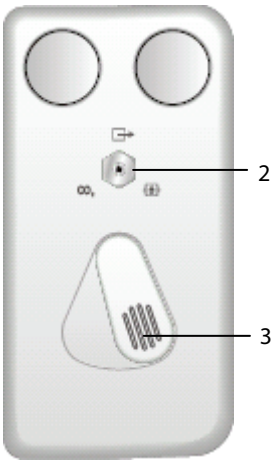
1. A CO_2 waveform.
2. End tidal CO_2 value ($EtCO_2$): the CO_2 value measured at the end of the expiration phase.
3. Fraction of inspired CO_2 ($FiCO_2$): the smallest CO_2 value measured during inspiration.
4. Airway respiration rate (awRR): the number of breaths per minute, calculated from the CO_2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



16.2 CO_2 Module

This monitor uses an external module to perform CO_2 monitoring.





1. CO_2 watertrap seat
2. Gas outlet
3. Connector for sampling line

16.3 Preparing to Measure CO_2

WARNING

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

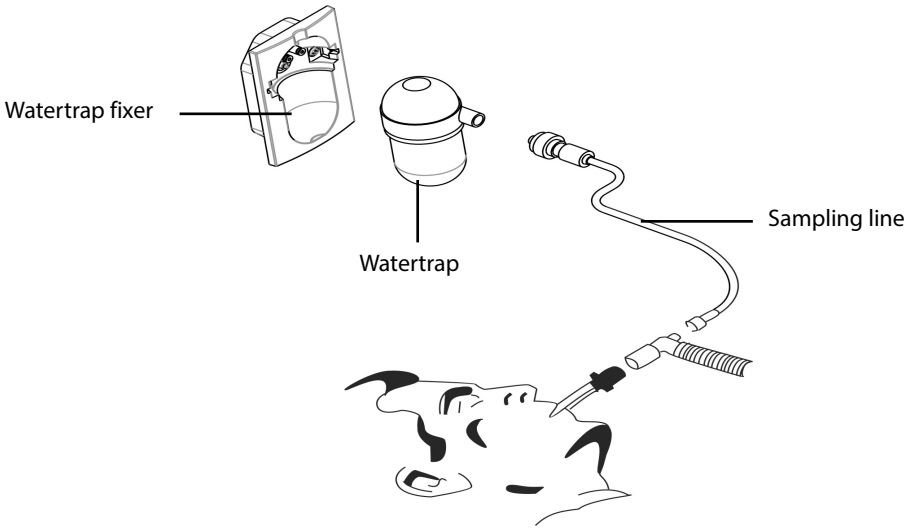
NOTE

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

16.3.1 Making a Sidestream CO_2 Measurement

To make a sidestream CO2 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 operating temperature. The message [**CO2 Sensor Warmup**] is displayed during warm-up.
3. After warm-up is finished, you can perform CO_2 measurements.

CAUTION

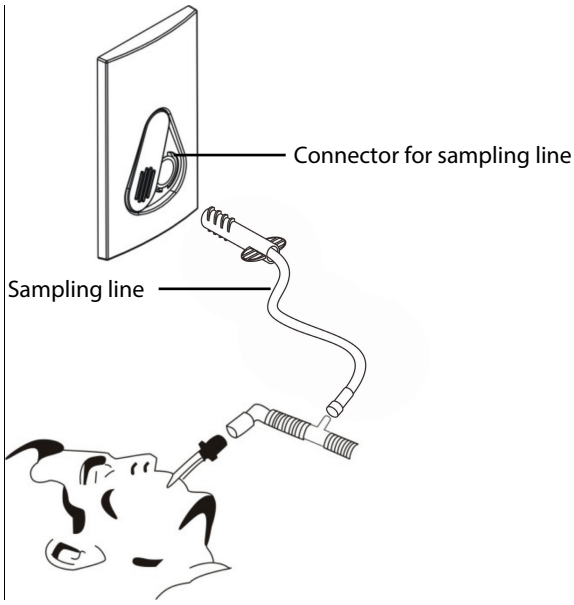
- **The watertrap collects water drops condensed in the sampling line and therefore prevents them from entering the module. To avoid blocking the airway, empty the watertrap container whenever half full. Dispose of accumulated fluids in accordance with hospital policy or your local regulations.**
- **The watertrap has a filter preventing bacterium, water and secretions from entering the module. After long-term use, dust or other substances may compromise the performance of the filter or even block the airway. In this case, replace the watertrap. It is recommended that you replace the watertrap once a month, or when the watertrap is found leaky, damaged or contaminated.**
- **Do not apply adult watertrap to the neonate patient. Otherwise, patient injury could result.**

NOTE

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

16.3.2 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.



16.4 Changing CO_2 Settings

16.4.1 Accessing CO_2 Menus

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

16.4.2 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:

1. Select [**Operating Mode**] in the [**CO2 Setup**] menu
2. Select [**Standby**] or [**Measure**].

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

For the sidestream CO_2 module, you can set a delay time after which, the CO_2 module will enter 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, or since the CO_2 module was powered on, or since the CO_2 module was switched to the measuring mode, or the automatic Standby time is re-set.

To set the Standby time:

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

16.4.3 Setting the CO_2 Unit

To set the CO_2 unit:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance**]→enter the required password →[**Unit Setup >>**].
2. In the Unit Setup menu, select [**CO2 Unit**] and then select [**mmHg**], [**%**] or [**kPa**].

16.4.4 Setting up Gas Compensations

⚠WARNING

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

For the sidestream CO_2 module:

1. Select the CO_2 parameter window to access the [**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.

16.4.5 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.

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. Select the CO_2 parameter window to access the [**CO2 Setup**] menu, and then select [**BTPS Compen**].
2. Select either [**On**] for BTPS or [**Off**] for ATPD, depending on which compensation applies.

16.4.6 Setting the Apnea Alarm Delay

To set the apnea alarm delay:

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

The monitor will alarm if the patient has stopped breathing for longer than the selected apnea time. The setting of [**Apnea Delay**] takes effect simultaneously to the Resp, CO_2, and AG modules.

⚠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.**

16.4.7 Choosing a Time Interval for Peak-Picking

For microstream 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. Select the CO_2 parameter window to access the [**CO2 Setup**] menu.
2. Select [**Max Hold**]
3. Select [**Single Breath**], [**10 s**], [**20 s**] or [**30 s**]
   - [**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.

16.4.8 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:

1. Select the CO_2 parameter window to access the [**CO2 Setup**] menu.
2. Select an appropriate setting from [**Flow Rate**].

WARNING

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

16.4.9 Setting up the CO_2 Wave

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

- Select [**Wave Type**] and then select [**Draw**] or [**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**].

16.5 Setting RR Source

To set RR source:

1. Select the CO_2 parameter window to access the [**CO2 Setup**] menu.
2. Select [**RR Source**] and then select a source or [**Auto**] from the dropdown list.

The [**RR Source**] setting takes effect simultaneously to the Resp, CO_2, and AG modules. For details, please refer to section ***9.9 Setting Respiration Rate Source***.

16.6 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 monitor is exposed to).

16.7 Measurement Limitations

Some adverse effects can influence the CO_2 performance.

CAUTION

- **The following factors may influence the accuracy of measurement:**
  - Leaks or internal venting of sampled gas
  - Mechanical shock
  - Cyclic pressure up to 10 kPa (100 cmH_2O)
  - Other sources of interference, if any
- **Measurement accuracy may be affected by the breath rate and I/E ratio as follow:**
  - $etCO_2$ is within specification for breath rate ≤ 60 bpm and I/E ratio ≤ 1:1;
  - $etCO_2$ is within specification for breath rate ≤ 30 bpm and I/E ratio ≤ 2:1.
- **Measurement accuracy is unspecified for breath rate larger than 60 bpm.**

16.8 Leakage test

When the sidestream CO_2 module needs maintenance, the monitor displays the message in the CO_2 waveform window: [**Need maintenance. Enter CO2 setup menu.**] Then:

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

16.9 Troubleshooting the Sidestream CO_2 Sampling System

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

16.10 Removing Exhaust Gases from the System

WARNING

- **Anesthetics: 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, or to the anesthesia machine/ventilator, to avoid exposing medical staff to anesthetics.**

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

16.11 Zeroing the Sensor

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

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:

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

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

16.12 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.

Oridion Information

16.13 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 also incorporates the features of the O_2 module and BIS module. The AG measurement is applicable for adult, pediatric and neonatal patients. AG monitoring is for Passport 12 patient monitors only.

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 measurements, there are multiple IR filters. The higher the concentration of gas in a given volume the more IR light is absorbed. This means that higher concentration of IR absorbing gas cause a lower transmission of IR light. The amount of IR light transmitted after it has been passed through an IR absorbing gas is measured. From the amount of IR light measured, the concentration of gas present can be calculated.

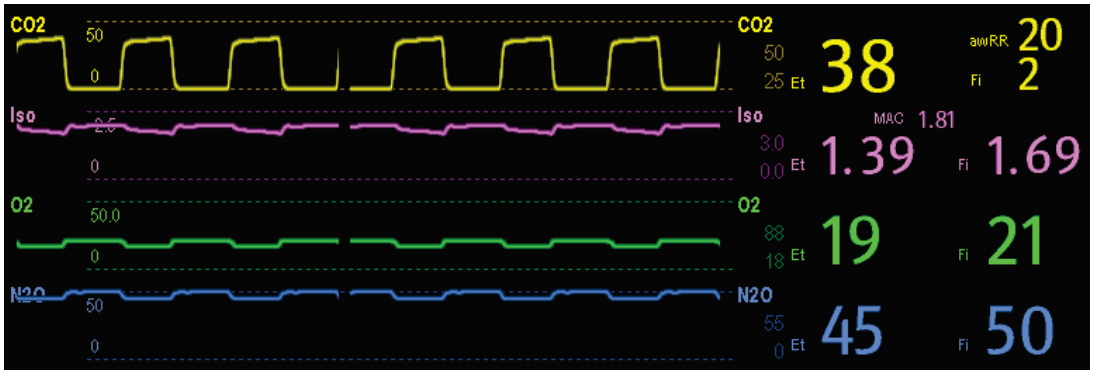
Oxygen does not absorb IR light as other breathing gases and is therefore measured relying on its paramagnetic properties. Inside the O_2 sensor are two nitrogen-filled glass spheres mounted on a strong rare metal taut-band suspension. This assembly is suspended in a symmetrical non-uniform magnetic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

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 anesthetic agents.

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	N2O
1 MAC	6%*	1.15%	1.7%	2.1%	0.77%	105%**

* The data is taken from a 25-year-old patient.

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

NOTE

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

The formula to calculate the MAC value is as follows:

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

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

The formula for calculating age correction of 1 MAC is:

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

For example, the Des concentration at 1 MAC of a 60-year old patient is $6\% \times 10^{(-0.00269 \times (60-40))} = 6\% \times 0.88$.

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

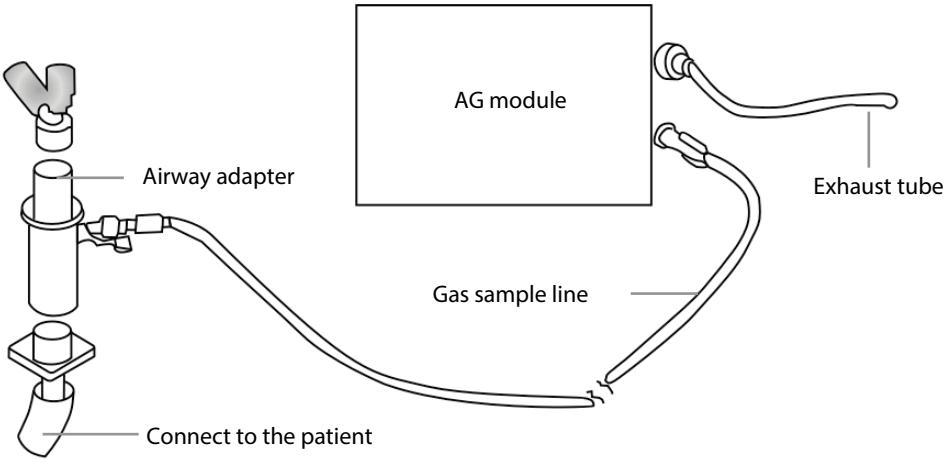
$$MAC = \frac{4.0\%}{6\% \times 0.88} + \frac{0.5\%}{0.77\% \times 0.88} + \frac{50\%}{105\% \times 0.88} = 2.04$$

NOTE

- **The formula above is only suitable for patients who are older than one year. If the patient is less than one year, the system uses one year 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 watertrap connector.
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 monitor and the monitor will prompt [**AG Startup**]. Then the AG module starts to warmup and at the same time the 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.**
- **Check that the alarm limit settings are appropriate before taking measurement.**

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. To avoid blocking the airway, empty the watertrap container whenever half full. 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 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.**

17.5 Changing AG Settings

17.5.1 Setting Gas Unit

For N2O and AA, the unit of the measured gas is fixed to % .

To set the gas unit:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance**] →enter the required password→[**Unit Setup >>**].
2. In the Unit Setup menu, you can select [**CO2 Unit**] or [**O2 Unit**] and then select [**mmHg**], [**%**] or [**kPa**].

17.5.2 Setting the Apnea Alarm Delay

To set the apnea alarm delay:

1. Select the AG parameter area to access the [**AG Setup**] menu.
2. Select [**Apnea Delay**] and select the appropriate setting.

The monitor alarms if the patient has stopped breathing for longer than the preset apnea time. The [**Apnea Delay**] setting takes effect simultaneously to the Resp, CO_2, and AG modules.

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 purposes.**

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%, switch the compensation off.

If the AG module incorporates the O_2 module, the system directly uses the O_2 concentration detected by the O_2 module to make compensation. 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 AG module Standby mode relates to the Standby mode of the monitor as follows:

- If the monitor enters the Standby mode, the AG module also enters the Standby mode.
- If the monitor exits the Standby mode, the AG module also exits the Standby mode.
- If the AG module enters or exits the Standby mode, it does not affect the monitor.

To enter or exit the Standby mode manually, in the agent's setup menu, select [**Operating Mode**] and then select [**Standby**] or [**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

Select the AG parameter area to access the [**AG Setup**] menu, in which you can:

- Select [**CO2 Wave Type**] and then select [**Draw**] or [**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 waveform by adjusting the scale.

17.5.7 Setting RR Source

To set RR source:

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

The [**RR Source**] setting takes effect simultaneously to the Resp, CO_2, and AG modules. For details, please refer to the section ***9.9 Setting Respiration Rate Source***.

17.6 Changing the Anesthetic Agent

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

The AG module can identify two anesthetic agents automatically. When the proportion of 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 measurement accuracy:

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

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**] appears.

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**] displays.

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.

17.8.3 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**] displays.

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

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

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

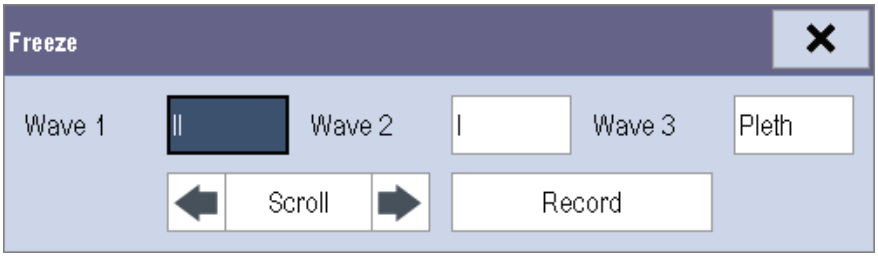
18 Freezing Waveforms

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.

18.1 Freezing Waveforms

To freeze waveforms, select the [**Freeze**] hardkey on the monitor's front panel.

- The system closes the displayed menu (if any), and opens the [**Freeze**] menu.



- All displayed waveforms are frozen, i.e. the waveforms stop being refreshed.

NOTE

- **The freeze feature exerts no effect on the split-screen view of minitrends, OxyCRG and other patients.**

18.2 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 last waveform, there is an upward arrow. The freeze time displays 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.

18.3 Unfreezing Waveforms

To unfreeze the frozen waveforms, you can either:

- Select the ✕ button at the upper right corner of the [**Freeze**] menu,
- Select the [**Freeze**] hardkey on the monitor's front panel, or
- Perform any other action that causes the screen to be readjusted or opens a menu, such as inserting or removing a module, pressing the [**Menu**] hardkey, etc.

18.4 Recording Frozen Waveforms

To record the frozen waveforms:

1. In the [**Freeze**] menu, select, in order, [**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.

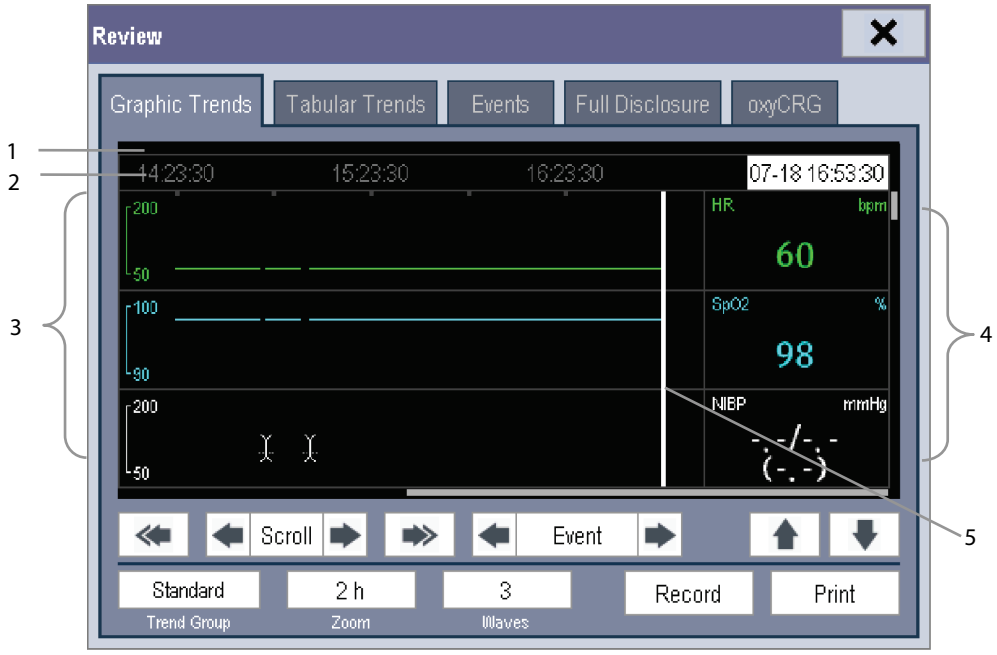
19 Review

19.1 Accessing Respective Review Windows

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

19.2 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:

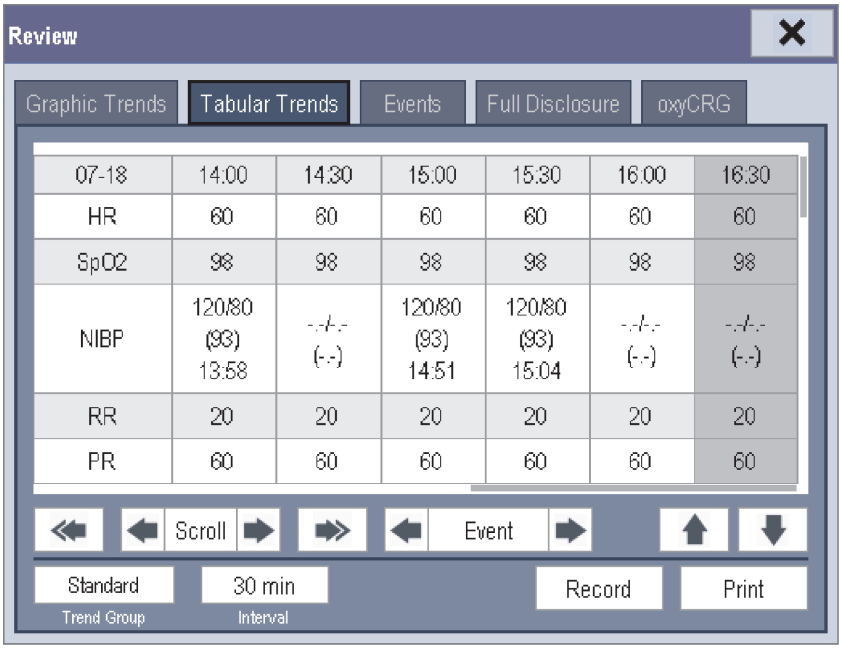
- Select [**Trend Group**] and you can select a trend group for viewing in the popup menu. If [**Custom 1**] or [**Custom 2**] is selected, you can further select [**Define Trend Group**]. Then you can select the parameters for viewing in the popup menu.
- Select [**Zoom**] to set the time length of the review window.
- Select [**Waves**] to set the number of waves displayed in one page.

- 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 displays above the parameter area. Numeric measurement values corresponding to the cursor location change as the cursor is moved. The measurement value that triggered a high level alarm has a red background. The one that triggered a medium/low level alarm has a yellow background.
- Select ⬅ or ➡ beside [**Event**] to position the cursor to a different event time.
- Select the [**Record**] button to print the currently displayed graphic trends by the recorder.
- Select the [**Print**] button to set and print the graphic trends report by the printer. For how to set the graphic trends report, refer to chapter ***22 Printing***.

19.3 Reviewing Tabular Trends

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



Events are marked with colors in window's top area. Red represents high level alarm event. Yellow represents medium/low level alarm event. Green represents manual event.

In this review window:

- Select [**Trend Group**] and you can select a trend group for viewing in the popup menu. If [**Custom 1**] or [**Custom 2**] is selected, you can further select [**Define Trend Group**]. Then you can select the parameters for viewing in the popup menu.
- Select [**Interval**] to change the resolution of the trend data and then select the appropriate setting:

- [**5 s**] or [**30 s**]: select to view up to 4 hours of tabular trends at 5- or 30-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 a high level alarm has a red background. The one that triggered a medium/low level alarm has a yellow background.

■ Select ⬅ or ➡ beside [**Event**] to position the cursor to a different event time.

■ Select the [**Record**] button to 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 patient's history. By further selecting [**Record**], you can print the displayed tabular trends with the recorder.

■ Select the [**Print**] button to set and print the tabular trends report with the printer. For how to configure the tabular trends report, refer to chapter ***22 Printing***.

19.4 Reviewing Events

19.4.1 Marking Events

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

Select [**Main Menu**]→[**Mark Event >>**]. In the popup menu, you can select the waves to store after triggering a manual event. You can select [**Trigger Manual Event**] from the [**Mark Event**] menu or the [**Manual Event**] 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.

19.4.2 Reviewing Events

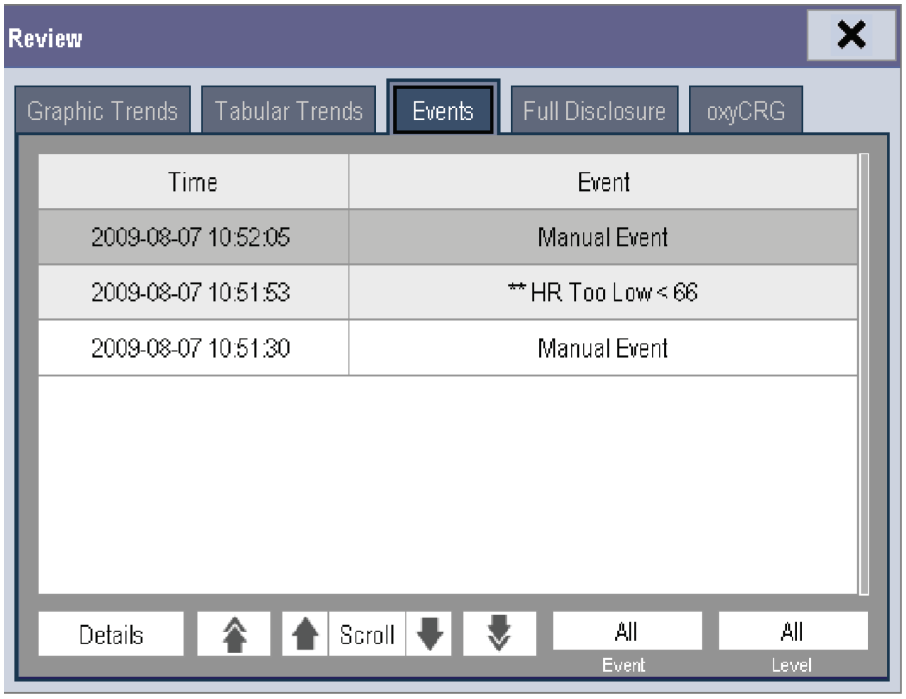
The monitor saves the events in real time. You can review these events.

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

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

NOTE

- **Pausing or switching off alarms will not be recorded as events. The time of these operations will not be recorded in the system log.**
- **Earlier-recorded events might be overwritten by later ones if the events log reaches capacity.**



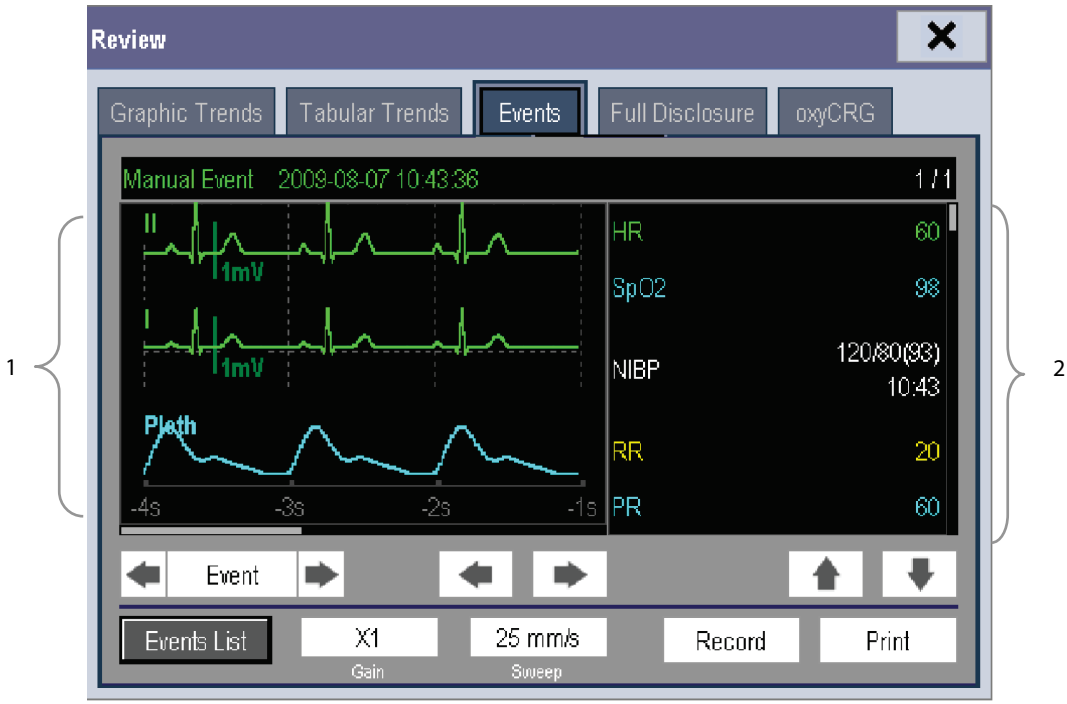
In this window:

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

After selecting the desired event, you can select [**Details**] to access the following window. In this window, the waveform area displays the waveforms related to the event, and the parameter area displays the parameter values happened at the event trigger time.

NOTE

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



1. Waveform area

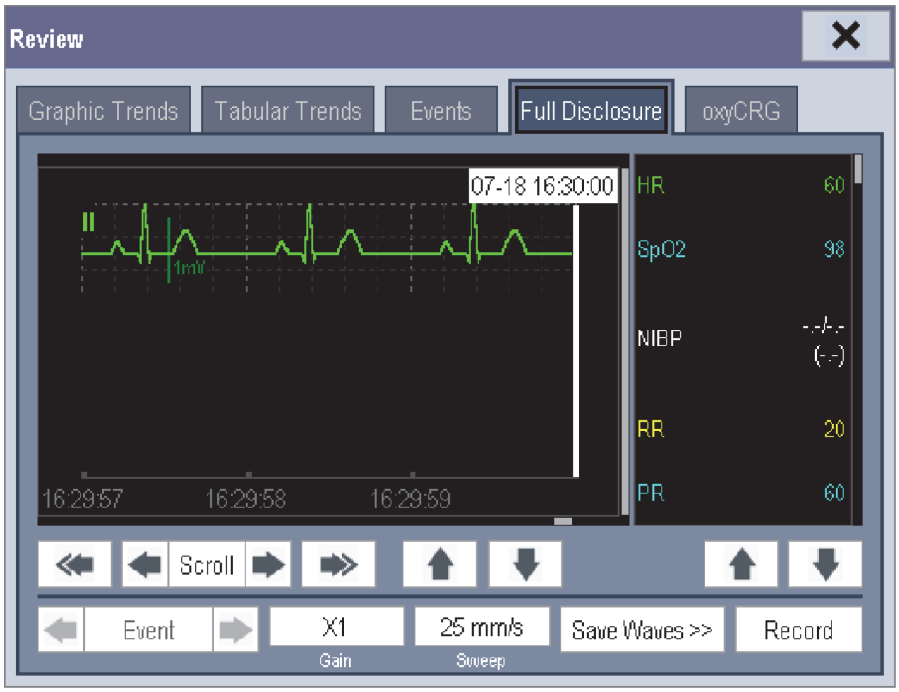
2. Parameter area

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 the displayed alarm events with the recorder.
- Select [**Print**] to print the displayed alarm event to the pre-connected laser printer.
- Select [**Events List**] to view the events list.

19.5 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 waveforms, your monitor must have 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.

20 Calculations

20.1 Introduction

The calculation feature is available with your 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 monitor.**

20.2 Dose Calculations

20.2.1 Performing Calculations

To perform a dose calculation:

1. Select [**Main Menu**]→[**Calc >>**]→[**Dose >>**], or select [**Calculations**] QuickKey→[**Dose >>**].
2. Select [**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 only then can the calculated values be used
4. Enter the patient's weight.
5. Enter other values.
6. Verify if the calculated values are correct.

20.2.2 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.**

20.2.3 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 the displayed titrated values by the recorder.

20.2.4 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

20.3 Oxygenation Calculations

20.3.1 Performing Calculations

To perform an oxygenation calculation:

1. Select [**Main Menu**]→[**Calc >>**]→[**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 displayed oxygenation calculations are printed out by the recorder.
- Review the previously performed calculations by selecting [**Review**].

20.3.2 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

20.3.3 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	$VO_2 / (CaO_2 - CvO_2)$

20.4 Ventilation Calculations

20.4.1 Performing Calculations

To perform a ventilation calculation:

1. Select [**Main Menu**]→[**Calc >>**]→[**Ventilation >>**], or select [**Calculations**] QuickKey→[**Ventilation >>**].
2. Enter values for calculation. If the 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 displayed ventilation calculations are printed out by the recorder.
- ■ Review the previously performed calculations by selecting [**Review**].

20.4.2 Entered Parameters

Abbreviation	Unit	Full spelling
FiO_2	%	percentage fraction of inspired oxygen
RR	rpm	respiration rate
$PeCO_2$	mmHg	partial pressure of mixed expiratory CO_2
$PaCO_2$	mmHg	partial pressure of carbon dioxide in the arteries
PaO_2	mmHg	partial pressure of oxygen in the arteries
TV	ml	tidal volume
RQ	None	respiratory quotient
ATMP	mmHg	atmospheric pressure

20.4.3 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

20.5 Hemodynamic Calculations

20.5.1 Performing Calculations

To perform a hemodynamic calculation:

1. Select [**Main Menu**]→[**Calc >>**]→[**Hemodynamic >>**], or select [**Calculations**] QuickKey→[**Hemodynamic >>**].
2. Enter values for calculation.
   - ◆ For a monitored patient, [**HR**], [**Art mean**], [**PA mean**] and [**CVP**] are automatically taken from the currently measured values. If you have just 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 are blank.
   - ◆ For an unmonitored patient, confirm the entered values.
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 calculations are printed out by the recorder.
- ■ Review the previously performed calculations by selecting [**Review**].

20.5.2 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

20.5.3 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

20.6 Renal Calculations

20.6.1 Performing Calculations

To perform a renal calculation:

1. Select [**Main Menu**]→[**Calc >>**]→[**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 displayed renal calculations are printed by the recorder.
- ■ Review the previously performed calculations by selecting [**Review**].

20.6.2 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

20.6.3 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.

20.7 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:

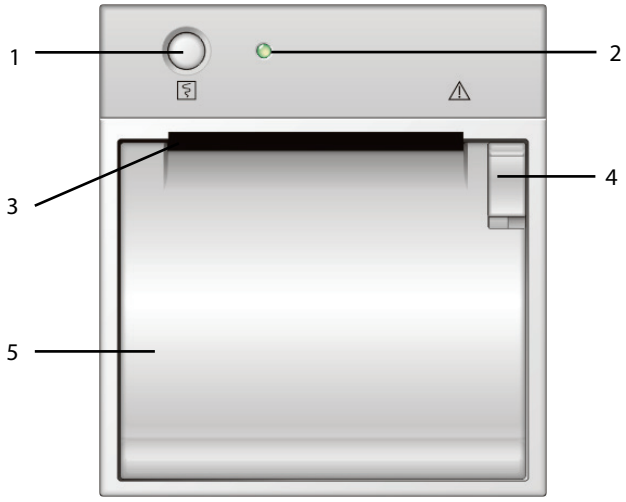
- You can select ◀, ▶ ◀◀ or ▶▶ to view more values.
- The values that exceed the range are displayed in a yellow background. The [**Unit**] field displays parameter units. If some parameter values are outside of their normal ranges, you can view their normal range in the [**Unit**] field by selecting [**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

21 Recording

21.1 Using a Recorder

The thermal recorder prints patient information, measurement numeric and 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

21.2 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.

NOTE

- **For details about alarm recording, refer to the chapter 7 Alarms.**
- **For details about task-related recordings, refer to respective sections of this manual.**

21.3 Starting and Stopping Recordings

To manually start a recording, you can either:

- Press the [**Record**] hardkey on the front of the monitor,
- Select the hardkey on the front of 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:

- Press the [**Record**] or 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: prints two columns of '*' at the end of the report.
- Manually or abnormally stopped recording: prints one column of '*' at the end of the report.

21.4 Setting up the Recorder

21.4.1 Accessing the Record Setup Menu

By selecting [**Main Menu**]→[**Record Setup** >>], you can access the [**Record Setup**] menu.

21.4.2 Selecting Waveforms for Recording

The recorder can record up to 3 waveforms at a time. You can select, in order, [**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.

21.4.3 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 then select [**8 s**] or [**Continuous**].

- [**8 s**]: record 4-second waveforms respectively before and after current moment.
- [**Continuous**]: record the waveforms from the current moment until stopped manually.

21.4.4 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.

21.4.5 Changing the Recording Speed

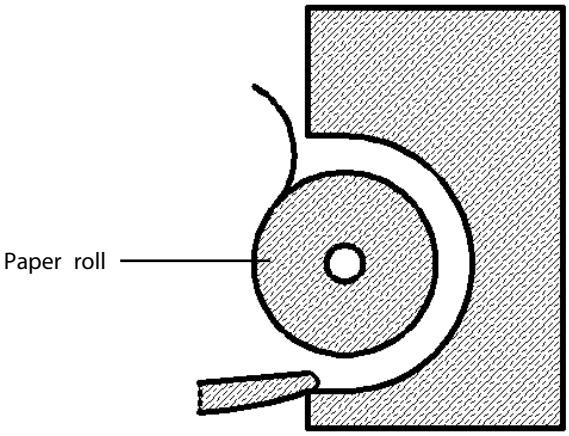
In the [**Record Setup**] menu, select [**Paper Speed**] and then select [**25 mm/s**] or [**50 mm/s**]. This setting is for all recordings containing waveforms.

21.4.6 Clearing Recording Tasks

In the [**Record Setup**] menu, select [**Clear All Tasks**]. All queued recording tasks are cleared and the current recording is stopped.

21.5 Loading Paper

1. Press the latch in the upper right corner of the recorder door to open it.
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 are reloading paper or resolving an issue.**

21.6 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.

21.7 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 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.**

22 Printing

22.1 Printer

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

- HP LaserJet 1505n
- HP LaserJet P2035n
- HP LaserJet P4015n
- HP LaserJet Pro 400 M401n401dn
- HP LaserJet 600 M602

The reports specifications are:

- Paper: A4, Letter
- Resolution: 300 dpi

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

22.2 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 monitor directly with a network cable, and then start printing what you want.
- the CMS

  If your monitor is connected to a CMS, it is recommended to use the CMS for printing.

22.3 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.

NOTE

- **If [Panorama] is selected in [Factory Maintenance], the [Central Station] option appears in the [Printer] drop-down list automatically. Select the option, and then you can print real-time waveforms, graphic and tabular trends displaying on the screen of Panorama Central Station for the patient.**

- 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 and select [**A4**] or [**Letter**].

22.4 Starting Report Printouts

Reports	Contents	Procedures
ECG reports	ECG waveforms and relevant parameter values	Select [**Main Menu**]→[**Print Setup >>**]→[**ECG Reports >>**]→[**Print**]
Tabular trends	Depends on the selected parameter group, resolution and time period	Select [**Main Menu**]→[**Print Setup >>**]→[**Tabular Trends Reports >>**]→[**Print**], or select [**Main Menu**]→[**Review >>**]→[**Tabular Trends**]→[**Print**]→[**Print**]
Graphic trends	Depends on the selected parameter group, resolution and time period	Select [**Main Menu**]→[**Print Setup >>**]→[**Graphic Trends Reports >>**]→[**Print**], or select [**Main Menu**]→[**Review >>**]→[**Graphic Trends**]→[**Print**]→[**Print**]
Arrh. alarm review	ECG waveforms and relevant parameter values	Select [**Print**] in [**Arrh. Events**]
Parameter alarm review	Depends on the selected alarms	Select [**Main Menu**]→[**Review >>**]→[**Alarms**]→[**Print**]
Realtime waves	Depends on the selected waveforms	Select [**Main Menu**]→[**Print Setup >>**]→[**Realtime Reports >>**]→[**Print**]

22.5 Stopping Report Printouts

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

22.6 Setting Up Reports

22.6.1 Setting Up ECG Reports

You can print ECG reports only from the full-screen or half-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.

22.6.2 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 2014-4-2 08:00:00 to 2014-4-2 10:00:00. In addition, the [**Back**] can be set to either:
  - [**Auto**]: if [**Report Layout**] is set to [**Time Oriented**], the report will be printed by time. If [**Report Layout**] is set to [**Parameter Oriented**], the report will be printed by parameter.
  - [**All**]: if you select [**All**], all trend data will be printed out. In this case, there is no need to set [**From**].
- [**Interval**]: choose the resolution of the tabular trends printed on the report.
- [**Report Layout**]: if you select [**Time Oriented**], the report will be printed by time. If you select [**Parameter Oriented**], the report will be printed by parameter.
- [**Select Parameter >>**]: from the pop-up menu, you can:
  - [**Currently Displayed Trended Parameters]**: print the parameter trend data selected from the [**Tabular Trends**].
  - [**Standard Parameter Group**]: select the standard parameter group for printing.
  - [**Custom**]: define a parameter group for printing from the parameters displayed in the lower part of the menu.

22.6.3 Setting Up Graphic Trends Reports

To set up graphic trends reports, select [**Main Menu**]→[**Print Setup >>**]→[**Graphic Trends Reports >>**]. Setting up graphic trends reports is similar with tabular trends reports. Refer to section ***22.6.2*** Setting Up Tabular Trends Reports for details.

22.6.4 Setting Up Realtime Reports

To set up realtime reports, select [**Main Menu**]→[**Print Setup >>**]→[**Realtime Reports >>**].

- [**Sweep**]: set the wave print speed to 12.5 mm/s, 25 mm/s, 50 mm/s, or Auto.
- [**Select Wave >>**]: from the pop-up menu, you can:
  - [**Current**]: print the currently displayed waves.
  - [**Select Wave**]: select the desired waves for printing.

22.7 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 all contents that are set as end case reports.

For example, to set the ECG report as an end case report:

1. Select [**Main Menu**]→[**Print Setup >>**]→[**ECG Report >>**].
2. Select [**End Case Report**]→[**Set as End Case Report**] and then select [**Ok**] from the pop-up dialog box.
3. Set as described in section ***22.6.1Setting Up ECG Reports***.

22.8 Printer Statuses

22.8.1 Printer Out of Paper

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

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

22.8.2 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.

23 Other Functions

23.1 Analog Output

The monitor provides analog output signals to accessory equipment via the multifunctional connector on the rear of the monitor.

NOTE

- **The analog output feature is seldom applied in clinical applications. You can contact your service personnel for more details.**

23.2 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 disk.

To export the log,

1. Connect a USB disk to the monitor's USB connector. See section ***2.3.3 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**].

23.3 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.

23.3.1 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.

23.3.2 Transferring Data by Different Means

NOTE

- **Never enter the data transfer mode when the monitor is in normal operation or performs monitoring. You must re-start the monitor to exit the data transfer mode.**

Transfer data via a crossover network cable

Before transferring data using a crossover network cable:

1. Connect one end of the crossover network cable to the 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 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:

1. Connect the 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.

23.4 Nurse Call

The monitor provides a nurse call connector to output nurse call signal when a user-defined alarm occurs. To obtain nurse call signal, use the nurse call cable (***PN: 009-003116-00***) we supply to connect the hospital nurse call system to the nurse call connector of 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 then select [**Pulse**] or [**Continuous**].
  - [**Pulse**]: the nurse call signal is a pulse signal and each pulse lasts one second. When multiple alarms occur simultaneously, only one pulse signal is outputted. If an alarm occurs but the previous one is not cleared, a new pulse signal will also be outputted.
  - [**Continuous**]: the nurse call signal lasts until the alarm ends, i.e. the duration of a nurse call signal is equal to that of the alarm condition.

- Select [**Contact Type**] and then select [**Normally Open**] or [**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 silence status.

WARNING

- **To obtain the nurse call signal, use the nurse call cable (*PN: 009-003116-00*) we supply. Otherwise the nurse call function will not work and the monitor may be damaged.**
- **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.**

23.5 Network Connection

CAUTION

- **Disconnecting from the network may result in loss of data, including parameter waveforms and measurements, alarm events, trends and patient data, or cause function failure. In case of network disconnection, check the patient and solve the network problem as soon as possible.**

23.5.1 Setting the Network Type

The monitor supports both wired and wireless network. To set the network type, you can select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Network Setup >>**].

23.5.2 Setting up the Wireless Network

A Mindray proprietary wireless network, installed by approved Mindray service personnel, is required to support wireless networking.

This proprietary network will have the following capabilities:

- Support the 802.11g wireless protocol
- Have a channel bandwidth of 20 MHz
- Support WPA2-PSK security
- Provide a signal strength at the monitor of no less than -65 dBm

NOTE

- **Keep network authentication information (e.g, password) safe to protect the network from being accessed by unauthorized users.**
- **Authentication and encryption other than WPA2-PSK may expose sensitive data leak or malicious setting.**
- **The total throughput of all the wireless devices connected to the wireless network should be less than the effective transmitting capability of the wireless network. The throughput capacity of a single Passport 8 is 729 kbps and a single Passport 12 is 747 kbps.**
- **Do not connect non-medical devices to the wireless network.**
- **Where the monitor is located, the signal strength of other Wi-Fi devices on the same channel should be no greater than -85 dBm.**
- **Where the monitor is located, the signal strength of other Wi-Fi devices on adjacent channels should be no greater than -50 dBm.**
- **The recommended distance between the patient monitor and other non-Wi-Fi wireless devices, including wireless devices at the frequency of 2.4GHz (e.g. cellular mobile communication networks, microwave ovens, interphones, cordless phones and electro-surgical units) is no less than 20 cm.**

23.6 Setting the CMS

You can configure up to 30 CMSs for your monitor. To set the CMSs,

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

2. Set CMS names and corresponding IP addresses.

23.6.1 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 no CMS is selected, this area displays "???".

23.6.2 Clearing the Selected CMS at Startup

You can clear the selected CMS each time the monitor restarts after being powered off for more than 2 minutes.

To clear the selected CMS:

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

2. Set [**Clear CMS IP at startup**] to [**On**]

The selected CMS will not be cleared when only one CMS is configured, or the monitor is restarted within 2 minutes.

This function is switched off by default.

23.7 Setting the Multicast Parameters

To set the Multicast parameters:

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

2. Set [**Multicast Addr**] and [**TTL**].

3. Select [**Ok**] to save the setting.

FOR YOUR NOTES

24 Batteries

24.1 Overview

This monitor is designed to operate from rechargeable Lithium-ion battery power when AC power is not available. If the AC power is interrupted during patient monitoring, the monitor automatically runs from the battery. The Passport 12 patient monitor is capable of storing up to two batteries. The Passport 8 patient monitor is capable of storing one battery.

NOTE

- **It is recommended to always install a fully charged battery in the monitor to ensure normal monitoring in case of accidental power failure.**

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.
- Indicates that the battery is almost depleted and needs to be charged immediately. Otherwise, the monitor shuts down automatically.
- Indicates that no battery is installed.

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

If the battery is depleted, the battery symbol on the screen flashes, the technical alarm area displays [**Battery Depleted**], the alarm lamp flashes, and the monitor produces alarm sound. Connect the equipment to AC mains to run the equipment and charge the battery. Otherwise the equipment will shut down.

24.2 Charging a Battery

The battery is charged whenever the monitor is connected to an AC power source regardless of whether or not the monitor is turned on. When the battery is charging, the AC power indicator and battery indicator are both on. If the monitor is powered on, the battery status symbol on the monitor screen displays when the charging is complete.

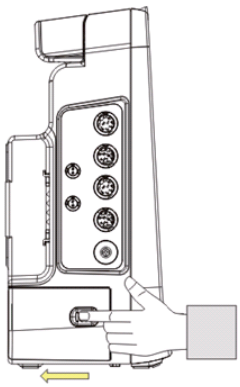
24.3 Replacing a Battery

When the Passport 12 patient monitor uses two battery packs, one battery pack can be easily exchanged while the monitor operates from the other. If the Passport 12 patient monitor uses one battery pack, you should insert a new battery pack before the old one depletes.

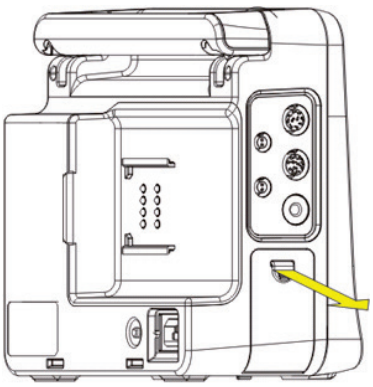
When the Passport 8 patient monitor operates on battery power, make sure the monitor is powered off before replacing a battery.

To replace a battery, follow this procedure:

1. Open the battery door.



Passport 12



Passport 8

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 pointed inward.
4. Close the battery door.

24.4 Battery Guidelines

Battery life expectancy 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 after 500 full charge/discharge cycles or every 3 years from first use, whichever occurs first.

To get the most out of the battery, observe the following guidelines:

- The battery performance test must be performed every six months, before monitor repairs, or whenever battery performance is suspect.
- Condition the batteries every 3 months, or when its run time becomes noticeably shorter.
- Take out the battery before the monitor is shipped or will not be used for more than two weeks.
- 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.
- When storing batteries, make sure that the battery terminals do not come into contact with metallic objects. If batteries are stored for an extended period of time, they should be placed in a cool place with a partial charge of 40% to 60% capacity.
- Storing batteries at a high temperature for an extended period of time will significantly shorten the life expectancy of a battery. Do not store the battery at a temperature beyond -20 °C - 60 °C (-4°F - 140°F).

CAUTION

- **Keep the battery out of the reach of children.**
- **Use only specified batteries.**
- **Charge the batteries in this monitor.**
- **High ambient temperature shortens battery run time.**
- **Extremely high ambient temperature may activate battery overheat protection, resulting the monitor powering off.**
- **If the battery shows signs of damage or signs of leakage, replace it immediately. Do not use a faulty battery in the monitor.**
- **The Lithium-ion batteries have a service life of 3 years. Please replace your battery when it reaches the end of its service life. Failure to replace the battery may cause serious damage to your device from battery overheating.**

24.5 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 battery charge level indicator does not indicate the capacity or operating time of the battery. It only indicates the current battery charge level. The actual battery capacity decreases over time with the use of the battery. For an old battery, its capacity and operating time may not fulfill battery specifications even the battery charge level indicates the battery is in full charge. 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 power to the monitor and allow the battery to charge uninterrupted for 10 hours.
4. Remove AC power and allow the monitor to run from the battery until it shuts off.
5. Apply AC 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 performance of a rechargeable battery will deteriorate over time. The battery performance test must be performed every six months, before monitor repairs, or whenever the battery performance is suspected. To check the performance of a battery, follow this procedure:

1. Disconnect the monitor from the patient and stop all monitoring or measuring.
2. Turn off the monitor.
3. Apply AC power to the monitor and allow the battery to charge uninterrupted for 4 hours.
4. Remove AC power and allow the monitor to run from the battery until it shuts off.
5. Record the battery operating time.

The battery operating time directly reflects its performance. If the battery operating time is noticeably shorter than that stated in the specifications, contact your Mindray service personnel.

NOTE

- **The battery might be damaged or may have malfunctioned if it only operates for a short time 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.**
- **Replace a battery that has visual signs of damage or no longer holds a charge. Remove the old battery from the monitor and recycle it according to local laws.**

24.6 Battery Recycling

Remove the old battery from the monitor and recycle it properly. Follow local laws for proper battery disposal.

⚠WARNING

- **Do not disassemble batteries, dispose of them in fire, or cause them to short circuit. They may ignite, explode, leak or heat up, causing personal injury.**

25 Care and Cleaning

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.

WARNING

- **Use only Mindray approved cleaners and disinfectants 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.**

CAUTION

- **The responsible hospital or institution shall carry out all cleaning and disinfection procedures specified in this chapter.**

25.1 General Points

Keep your equipment and accessories clean. To avoid damage to the equipment, follow these guidelines:

- Always dilute cleaners and disinfectants according the manufacturer's instructions or use lowest possible concentration.
- Do not immerse part of the equipment into liquid.
- Do not pour liquid onto the equipment or accessories.
- Do not allow liquid to enter the case.
- Never use abrasive materials (such as steel wool or silver polish), or erosive cleaners (such as acetone or acetone-based cleaners).

WARNING

- **Be sure to turn off the system and disconnect all power cables from the outlets before cleaning the equipment.**

CAUTION

- **If you spill liquid on the equipment or accessories, contact Mindray or your service personnel.**

NOTE

- **To clean or disinfect reusable accessories, refer to the instructions delivered with the accessories.**

25.2 Cleaning

Your equipment should be cleaned on a regular basis. Before cleaning the equipment, consult your hospital's regulations for cleaning the equipment.

Recommended cleaning agents are:

- Sodium hypochlorite bleach (10%)
- Hydrogen peroxide (3%)
- Ethanol (70%)
- Isopropanol (70%)

To clean your equipment, follow these rules:

1. Shut down the monitor and disconnect it from AC power.
2. Clean the display screen using a soft, clean cloth dampened with a cleaning agent.
3. Clean the exterior surface of the equipment using a soft cloth dampened with a cleaning agent.
4. Wipe off all the cleaning solution with a dry cloth after cleaning if necessary.
5. Dry your equipment in a ventilated, cool place.

25.3 Disinfecting

Disinfect the monitor as required in your hospital's servicing schedule. Cleaning equipment before disinfecting is recommended.

The recommended disinfectants include:

- Isopropanol 70%
- Ethanol (70%)
- Perform® classic concentrate OXY ($KHSO_4$ solution).

CAUTION

- **Never use EtO or formaldehyde for disinfection.**

25.4 Sterilization

Sterilization is not recommended for this equipment, related products, accessories, or supplies unless otherwise indicated in the Instructions for Use that accompany the products, accessories or supplies.

26 User Maintenance

CAUTION

- **Failure on the part of the responsible individual hospital or institution using this equipment to implement a recommended maintenance schedule may cause undue equipment failure and possible health hazards.**
- **The safety checks or maintenance involving any disassembly of the equipment should be performed by professional servicing personnel. Otherwise, undue equipment failure and possible health hazards could result.**
- **No modification of this equipment is allowed.**
- **Do not open the equipment housings. All servicing and future upgrades must be carried out by the personnel trained and authorized by Mindray only.**
- **If you discover a problem with any of the equipment, contact your service personnel or Mindray.**
- **The service personnel must be properly qualified and thoroughly familiar with the operation of the equipment.**

26.1 General Inspection

A thorough inspection should be performed by qualified service personnel to ensure the reliability before first use, after your monitor has been used for 6 to 12 months, or whenever your monitor is repaired or updated.

Follow these guidelines when inspecting the equipment:

- Make sure that the environment and power supply meet the specifications.
- 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 specifications.
- Make sure that the batteries meet the performance specifications.
- Make sure that the monitor is in good working condition.

In case of any damage or abnormity, do not use the monitor. Contact the hospital's biomedical engineers or your service personnel immediately.

26.2 Maintenance and Testing Schedule

The following maintenance and tests, except for visual inspection, power on test, touchscreen calibration, battery check, ECG calibration, NIBP leakage, CO_2 leakage, and AG leakage, should be carried out by the service personnel only. Ensure the monitor is safety and performance tested by qualified service personnel before initial installation, after repair or upgrade, or during regularly scheduled maintenance. Contact your service personnel if any maintenance is required. Make sure to clean and disinfect the equipment before any test and maintenance.

CAUTION

- **Changing the settings in [User Settings >>] and [Factory Maintenance >>] menus may cause data loss.**
- **Service personnel should acquaint themselves with the test tools and make sure that the test tools and cables are applicable.**

<table>
<tr><th colspan="2">Check/Maintenance Item</th><th>Recommended Frequency</th></tr>
<tr><td colspan="3">Performance Tests</td></tr>
<tr><td colspan="2">Visual inspection</td><td>When first installed or reinstalled.</td></tr>
<tr><td rowspan="2">ECG test</td><td>Performance test</td><td rowspan="14">1. If the user suspects that the measurement is incorrect.
2. Following any repairs or replacement of relevant module.
3. At least once every two years.

Note: At least once a year is recommended for NIBP, CO_2 and AG.</td></tr>
<tr><td>Verificvation</td></tr>
<tr><td colspan="2">Resp performance test</td></tr>
<tr><td colspan="2">SpO_2 test</td></tr>
<tr><td rowspan="2">NIBP test</td><td>Pressure check</td></tr>
<tr><td>Leakage test</td></tr>
<tr><td colspan="2">Temp test</td></tr>
<tr><td>IBP test</td><td>Performance test</td></tr>
<tr><td colspan="2">C.O. test</td></tr>
<tr><td rowspan="3">CO_2 tests and calibration</td><td>Leakage test</td></tr>
<tr><td>Pressure check</td></tr>
<tr><td>Calibration</td></tr>
<tr><td rowspan="3">AG test</td><td>Leakage test</td></tr>
<tr><td>Performance test</td></tr>
<tr><td>Calibration</td></tr>
<tr><td colspan="2">Nurse call relay performance test</td><td rowspan="2">If the user suspects that the analog output does not work well.</td></tr>
<tr><td colspan="2">Analog output performance test</td></tr>
<tr><td colspan="3">Electrical Safety Tests</td></tr>
<tr><td colspan="2">Electrical safety tests</td><td>At least once every two years.</td></tr>
<tr><td colspan="3">Other Tests</td></tr>
<tr><td colspan="2">Power on test</td><td>1. When first installed or reinstalled.
2. Following any maintenance or the replacement of any main unit parts.</td></tr>
<tr><td colspan="2">Touchscreen calibration</td><td>1. When the touchscreen appears abnormal.
2. After the touchscreen is replaced.</td></tr>
<tr><td colspan="2">Recorder check</td><td>Following any repair or replacement of the recorder.</td></tr>
<tr><td rowspan="2">Battery check</td><td>Functionality test</td><td>1. When first installed.
2. Whenever a battery is replaced.</td></tr>
<tr><td>Performance test</td><td>Once a year or if the battery run time reduced significantly.</td></tr>
</table>

26.3 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 >>**].

26.4 ECG Verification

The ECG signal may be inaccurate due to hardware or software problems. As a result, the ECG wave amplitude becomes greater or smaller. In that case, you need to verify 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 the square wave and wave scale and then measure the difference between them if necessary. If the difference exceeds 5%, contact your service personnel.

26.5 NIBP Leakage Test

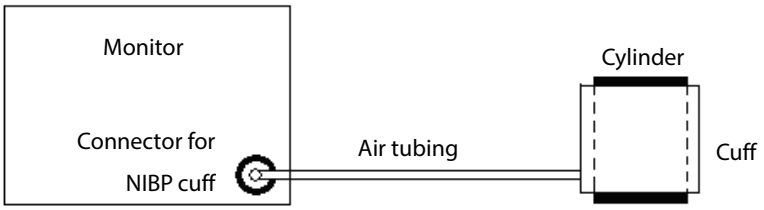
The NIBP leakage test checks the integrity of the system and of the valve. It is required at least once a year or when you doubt the measured NIBP. If the test failed, corresponding prompt messages will be given. If no message is displayed, it means no leakage is detected.

Tools required:

- An adult cuff
- An air tubing
- A correct sized cylinder

Follow this procedure to perform the leakage test:

1. Set the patient category to [**Adu**].
2. Connect the cuff to the NIBP connector on the monitor.
3. Wrap the cuff around the cylinder as shown below.



4. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]. Enter the required password and then select [**Ok**].
5. Select [**Module Maintenance >>**]→[**NIBP Leakage Test**]. The NIBP display shows [**Leakage Testing…**].

After about 20 seconds, the monitor will automatically deflate. This means the test is completed. If the message [**NIBP Pneumatic Leak**] is displayed, it indicates that the NIBP airway may have leakages. Check the tubing and connections for leakages. If you ensure that the tubing and connections are all correct, perform a leakage test again.

If the problem persists, contact your service personnel.

NOTE

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

26.6 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.

26.7 AG Tests

26.7.1 AG Leakage Test

Follow this procedure to perform the test:

1. Plug the AG module into the module rack.
2. Wait 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 60 s. Select [**Main menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Calibrate AG >>**], and check that current flow rate is less than 10ml/min.

If the flow rate is less than 10ml/min and the alarm message [**AG Airway Occluded**] does not disappear, it indicates that the module does not leak.

If the alarm message does not appear, or the flow rate is greater than or equal to 10ml/min, it indicates that the module leaks. If the problem remains, contact your service personnel for help.

26.8 Calibrating the Touchscreen

1. Select [**Main Menu**]→[**Maintenance >>**]→ [**Cal. Touchscreen**].
2. ⊕ will, in turn, appear at different positions of the screen. Select each ⊕ as it appears on the screen.
3. After the calibration is completed, the message [**Screen Calibration Completed!**] is displayed. Select [**Ok**] to confirm the completion of the calibration.

26.9 Entering/Exiting Demo Mode

To enter the Demo mode:

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

To exit the Demo mode:

1. Select [**Main Menu**]→[**Maintenance >>**].
2. Select [**Exit Demo**] and then select [**Ok**].
3. The monitor exits the Demo mode.

⚠ **WARNING**

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

FOR YOUR NOTES

27 Accessories

The accessories listed in this chapter comply with the requirements of IEC 60601-1-2 when in use with the patient monitor. The accessory material that contacts the patients has undertaken the bio-compatibility test and is verified to be in compliance with ISO 10993-1. For details about the accessories, refer to the instructions for use provided with the accessory.

WARNING

- **Use accessories specified in this chapter. Using other accessories may cause damage to the patient monitor or not meet the claimed specifications.**
- **Single-use accessories are not designed to be reused. Reuse may cause a risk of contamination and affect the measurement accuracy.**

CAUTION

- **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.**

27.1 ECG Accessories

ECG Electrodes

Model	Quantity	Patient Category	Part No.
31499224	10 pieces	Adult	0010-10-12304
2258-3	3 pieces	Neonate	900E-10-04880

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	ESU-proof		0010-30-42723
3/5-leadwire	/	Defibrillation-proof	Adult, pediatric	040-001416-00
3/5-leadwire	/	ESU-proof		009-003652-00

Cable Sets

3-Electrode Cable Sets						
Type	**Compatible with**	**Model**	**Patient Category**	**Part No.**	**Length**	**Remark**
Clip	AHA	EL6303A	Adult, pediatric	0010-30-42731	1m	Long
		EL6305A	Infant, neonate	0010-30-42896	1m	Long
Snap	AHA	EL6301B	Adult, pediatric	0010-30-42734	1m	Long
		EL6311B	Infant, neonate	040-000146-00	1m	Long, disposable

5-Electrode Cable Sets						
Type	**Compatible with**	**Model**	**Patient Category**	**Part No.**	**Length**	**Remark**
Clip	AHA	/	Adult, pediatric	0012-00-1514-01	0.457m	/
		/		0012-00-1514-02	0.61m	/
		/		0012-00-1514-03	1.016m	Long
		EL6501A		0010-30-42727	0.6m	/
		EL6503A		0010-30-42729	1m to 1.4m	Long
Snap	AHA	/		0012-00-1503-01	0.457m	/
		/		0012-00-1503-02	0.61m	/
		/		0012-00-1503-03	1.016m	Long
		EL6501B		0010-30-42735	1.4m for RL and LL; 1m for others	Long

27.2 SpO_2 Accessories

Extension Cable

Module type	Remarks	Part No.
Masimo	8 pins, purple connector	115-020768-00
Nellcor	8 pins	0010-20-42712

SpO_2 Sensors

Masimo SpO_2 Module			
Type	**Model**	**Patient Category**	**Part No.**
Disposable	LNCS NeoPt	Pediatric, neonate	0600-00-0125
	LNCS Neo	Neonate	0600-00-0157
	LNCS Inf	Infant	0600-00-0158
	LNCS Pdtx	Pediatric	0600-00-0122
	LNCS Adtx	Adult	0600-00-0121
Reusable	LNCS DCI	Adult	0600-00-0126
	LNCS DCIP	Pediatric	0600-00-0127

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).

27.3 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.
/	Large adult (long)	Arm	35.5 to 46	/	0683-15-0007-01
/	Adult (long)		27.5 to 36.5	/	0683-15-0006-01
CM1201	Child		10 to 19	9.2	0683-15-0001-01
CM1202	Small adult		18 to 26	12.2	0683-15-0002-01
CM1203	Adult		24 to 35	15.1	0683-15-0003-01
CM1204	Large adult		33 to 47	18.3	0683-15-0004-01
CM1205	Thigh	Thigh	46 to 66	22.5	0683-15-0005-01

Single-Patient Cuff

Model	Patient Category	Measurement Site	Limb Circumference (cm)	Bladder Width (cm)	Part No.
CM1500A	Neonate	Arm	3.1 to 5.7	2.2	001B-30-70692
CM1500B			4.3 to 8.0	2.9	001B-30-70693
CM1500C			5.8 to 10.9	3.8	001B-30-70694
CM1500D			7.1 to 13.1	4.8	001B-30-70695
CM1501	Child		10 to 19	7.2	0683-14-0001-01
CM1502	Small adult		18 to 26	9.8	0683-14-0002-01
CM1503	Adult		25 to 35	13.1	0683-14-0003-01
CM1504	Large adult		33 to 47	16.5	0683-14-0004-01
CM1505	Adult	Thigh	46 to 66	20.5	0683-14-0005-01
/	Large adult (long)		35.5 to 46		0683-14-0007-01
/	Adult (long)		27.5 to 36.5		0683-14-0006-01

27.4 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

27.5 IBP/ICP Accessories

Material	Part No.
IBP adapter cable	0010-30-43055
IBP extended cable with dual-receptacle	040-001029-00
BD IBP Cable, 12 pin	001C-30-70757
Edwards IBP Cable, 12 pin	0010-21-12179
Hospira IBP Cable, 12 pin	001C-30-70759

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)

Manufacturer	Accessories
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

27.6 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

27.7 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

27.8 AG Accessories (for Passport 12 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

27.9 Others

Material	Part No.
Lithium battery	022-000008-00
U.S. power cord	DA8K-10-14452
DC power line to vehicle (for Passport 8 only)	M03-010089-00
Grounding cable	1000-21-00122
Nurse call cable (≤60W, ≤2A, ≤36VDC, ≤25VAC)	009-003116-00
analog output cable	009-003117-00
Synchronization cable	009-003118-00
LCD display, 17"	0000-10-11284
USB drive, 4G	023-000217-00
	023-000218-00
Recorder	TR6F-30-67306
Thermal paper	0683-00-0505-01
Wall mount bracket for external display	0010-30-42956
Bedrail Hook subassembly (Passport 12)	115-012698-00
Bedrail Hook subassembly (Passport 8)	115-012697-00
Transition Plate Kit for rolling stand and wall mount	115-012695-00
Data output package (CD, Cable, User's Guide)	6800-30-51213
Rolling Stand with Quick Release (Passport 8)	045-000924-00
Transport stand for rolling stand (Passport 12)	115-002966-00
Quick Release for wall mount (Passport 8/Passport 12)/Quick release for Passport 12 rolling stand	045-000954-00
M series wall mount with Quick Release (Passport 8 and Passport 12)	045-000931-00
VHM wall mount (Passport 8 and Passport 12)	115-006911-00

A Product Specifications

A.1 Monitor Safety Specifications

A.1.1 Classifications

The 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 (Protection against vertically falling water drops)

A.1.2 Environmental Specifications

CAUTION

- **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	Passport 8: -30 to 70 Passport 12: -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

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 Passport 12.**

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)
Battery		
Battery Type		Chargeable Lithium-Ion, 11.1DVC, 4.5 Ah
Run time	Passport 12	≥ 4 hours when powered by one 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)
	Passport 8	≥ 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
Passport 12	318mm×274mm×128mm (12.6 inch × 10.8 inch × 5.1 inch)	≤4.5 kg (10 pound)	Standard parameters, including touchscreen and recorder, and battery (2 batteries for Passport 12)
Passport 8	238mm×225mm×128mm (9.4 inch × 8.9 inch × 5.1 inch)	≤3.5 kg (7.8 pound)	

A.4 Hardware Specifications

A.4.1 Display

Host display			
	Screen Size (diagonal)	**Screen type**	**Resolution**
Passport 12	12.1″	color TFT LCD	800×600 pixels
Passport 8	8.4″		
External display			
Screen type	Medical-grade TFT LCD		

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
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 non-paced)
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 Passport 12 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 the monitor to remote equipment	The alarm delay time form the monitor to remote equipment is ≤2 seconds, measured at the 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 alarms and manual events and related parameter waveforms. The waveform recording length can be 8s, 16s, or 32s.

Arrh. events	100 arrhythmia events and relate waveforms and parameters. The waveform recording length can be 8s, 16s, or 32s.
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	IEEE 802.11b/g/n, support Wi-Fi IEEE 802.11n supports 2.4 GHz only
Code error of wireless layer	< 100 ppm
Priority	All communication data types shall have the same priority.
Transmission delay	Total delay of data transmission from the monitor to the CMS: ≤ 2s. Delay of configuration settings transmission from CMS to the monitor: ≤ 2s (measured from configuring on CMS to the settings take effect on the monitor).
Roaming	Network switchover is automatically executed when the monitor moves from the coverage area of one AP to that of another AP.
System capacity	Number of the monitor supported by a single AP is ≤ 16. Each monitor can communicate with the CMS.
Dynamic networking stability	The monitor meets its functional requirements when it moves at a rate of no more than 3.75 m/s within a 15 m non-blocking linear distance.
Network interruption alarm	When a network interruption occurs, the equipment shows a disconnection icon on the screen and presents the related alarms. When the network interruption is resolved, wireless connection recovers automatically.

A.7 Measurement Specifications

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

A.7.1 ECG

ECG	
Standards	Meet standards of EC11, EC13, EN60601-2-27/IEC60601-2-27 and IEC60601-2-25
Lead set	3-lead: I, II, III 5-lead: I, II, III, aVR, aVL, aVF, V
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: 0.05 to 150 Hz Monitor mode: 0.5 to 40 Hz Surgical mode: 1 to 20 Hz

	ST mode:	0.05 to 40 Hz
Common mode rejection ratio	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 EC11 to determine system total error and frequency response.	
Electrode offset potential tolerance	±500 mV	
Lead-off detection current	Measuring electrode: <0.1 μA Drive electrode: <1 μA	
Input offset current	Measuring electrode: ≤0.1 μA Drive electrode: ≤1 μA	
Baseline recovery time	<5 s (after defibrillation)	
Patient leakage current	<10 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 4.2.9.14 of ANSI/AAMI EC 13:2002	
ESU noise suppression	Based on the test method in clause 5.2.9.14 of EC 13, use ECG lead wires which are in compliance with AAMI. Compared with ECG baseline, the noise of peak to peak value ≤2 mV.	

Pace Pulse		
Pace pulse markers	Pace pulses meeting the following conditions are labelled with a PACE marker: Amplitude: Width: Rise time:	 ±2 to ±700 mV 0.1 to 2 ms 10 to 100 μs
Pace pulse rejection	When tested in accordance with the ANSI/AAMI EC13: Sections 4.1.4.1 and 4.1.4.3, the heart rate meter rejects all pulses meeting the following conditions. Amplitude: Width: Rise time:	 ±2 to ±700 mV 0.1 to 2 ms 10 to 100 μs
Pacer pulse detector rejection of fast ECG signals	10V/s RTI when measured in accordance with ANSI/AAMI EC13 Section 4.1.4.3.	

HR		
Measurement range	Neonate: 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 4.1.2.1 d)of ANSI/AAMI EC13, the following method is used: Heart rate is computed by averaging the most recent 16 RR intervals, unless the HR by averaging the most recent 4 heart beats is less than or equal to 48. The HR value displayed on the monitor screen is updated every second.	
Response to irregular rhythm	In compliance with the requirements in Clause 4.1.2.1 e) of ANSI/AAMI EC13, the heart rate after 20 seconds of stabilization is displayed as follows: Ventricular bigeminy (3a): 80±1 bpm Slow alternating ventricular bigeminy (3b): 60±1 bpm Rapid alternating ventricular bigeminy (3c): 120±1 bpm Bidirectional systoles (3d): 90±2 bpm	
Response time to heart rate change	Meets the requirements of ANSI/AAMI EC13: Section 4.1.2.1 f). From 80 to 120 bpm: less than 11 s From 80 to 40 bpm: less than 11 s	
Time to alarm for tachycardia	Meets the requirements of ANSI/AAMI EC13: section 4.1.2.1 g). 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 part 4.1.2.1 c) of ANSI/AAMI EC 13-2002, 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, Vent. Rhythm, Couplet, VT>2, Bigeminy, Trigeminy, R on T, Multif. PVC, Irr. Rhythm, Tachy, Brady, Missed Beats, PNP, PNC	
ST Segment Analysis		
Measurement range	-2.0 to 2.0 mV RTI	
Accuracy	-0.8 to 0.8 mV: ±0.02 mV or ±10%, whichever is greater. Beyond this range: Not specified.	
Refreshing rate	per 16 heartbeats	
Resolution	0.01 mV	
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	

Mindray algorithm (currently unavailable in the US and Canada)

Only the differences from the Mortara algorithm are listed.

HR	
HR averaging method	In compliance with the requirements in Clause 4.1.2.1 d) of ANSI/AAMI EC13, the following method is used: If the last 3 consecutive RR intervals are greater than 1200 ms, the 4 most recent RR intervals are averaged to compute the HR. Otherwise, heart rate is computed by subtracting the maximum and minimum ones from the most recent 12 RR intervals and then averaging them. The HR value displayed on the monitor screen is updated every second.
Arrhythmia Analysis Classifications	Asystole, VFib/VTac, Vtac, Vent. Brady, Extreme Tachy, Extreme Brady, PVC, Couplet, Bigeminy, Trigeminy, R on T, VT>2, PVCs, Tachy, Brady, Missed Beats, Vent. Rhythm, PNP, PNC, Multif. PVC, Nonsus. Vtac, Pause, Irr. Rhythm
ST Segment Analysis	
Refreshing rate	10 s

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	6.25 mm/s, 12.5 mm/s or 25 mm/s Accuracy: ±10%	
Respiration Rate		
Measurement range	Adult: 0 to 120 rpm Pediatric, neonate: 0 to 150 rpm	
Resolution	1 rpm	
Accuracy	7 to 150 rpm: ±2 rpm or ±2%, whichever is greater 0 to 6 rpm: Not specified.	
Apnea alarm time	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s	
Alarm limit	**Range (rpm)**	**Step (rpm)**
RR High	Adult, pediatric: (low limit + 2) to 100 Neonate: (low limit + 2) to 150	1
RR Low	0 to (high limit – 2)	

A.7.3 SpO_2

Alarm limit	Range (%)	Step (%)
SpO_2 High	(low limit + 2) to 100	1
SpO_2 Low	Masimo: Desat to (high limit – 2) Nellcor: Desat or20 (whichever is greater) to (high limit – 2)	
Desat	0 to (high limit – 2)	

Masimo SpO_2 Module

Standards	Meet standards of ISO9919
SpO_2 measurement range	1 to 100%
Resolution	1%
Accuracy	70 to 100%: ±2% (measured without motion in adult/pediatric mode) 70 to 100%: ±3% (measured without motion in neonate mode) 70 to 100%: ±3% (measured with motion) 1% to 69%: Not specified.
Refreshing rate	1 s
SpO_2 averaging time	2-4 s, 4-6 s, 8 s, 10 s, 12 s, 14 s, 16 s
Low perfusion conditions	Pulse amplitude: >0.02% Light penetration: >5%
Low perfusion SpO_2 accuracy	±2%
PI measurement range	0.02~20 %

Nellcor SpO_2 Module

Standards	Meet standards of ISO9919
Measurement range	0 to 100%
Resolution	1%
Accuracy	70 to 100%: ±2% (adult/pediatric) 70 to 100%: ±3% (neonate) 0% to 69%: Not specified.
*: When the SpO_2 sensor is applied for neonatal patients as indicated, the specified accuracy range is increased by ±1%, to compensate for the theoretical effect on oximeter measurements of fetal hemoglobin in neonatal blood.	

A.7.4 PR

Alarm limit	Range (bpm)	Step (bpm)
PR High	(low limit +2) to 300	1
PR Low	15 to (high limit-2)	

PR from Masimo SpO_2 Module

Measurement range	25 to 240 bpm
Resolution	1 bpm
Accuracy	±3 bpm (measured without motion) ±5 bpm (measured with motion)

Refreshing rate	1 s
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
Accuracy	20 to 250 bpm: ±3 bpm 251 to 300 bpm, not specified
Refreshing rate	1 s

PR from NIBP Module

Measurement range	40 to 240 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 EN60601-2-30/IEC60601-2-30, EN1060-1, EN1060-3, SP10 and EN1060-4			
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:	40 to 270	40 to 200	40 to 135
	Diastolic:	10 to 210	10 to 150	10 to 100
	Mean:	20 to 230	20 to 165	20 to 110
Accuracy	Max mean error: ±5 mmHg Max standard deviation: 8 mmHg			
Resolution	1mmHg			

Initial cuff inflation pressure range (mmHg)	Adult:	80 to 280
	Pediatric:	80 to 210
	Neonate:	60 to 140
Default initial cuff inflation pressure (mmHg)	Adult:	160
	Pediatric:	140
	Neonate:	90
Software overpressure protection	Adult:	297±3 mmHg
	Pediatric:	240±3 mmHg
	Neonate:	147±3 mmHg
Hardware overpressure protection	Adult:	≦330 mmHg
	Pediatric:	≦330 mmHg
	Neonate:	≦165 mmHg

Alarm limit	**Range (mmHg)**	**Step (mmHg)**
Sys High	Adult: (low limit+5) to 270 Pediatric: (low limit+5) to 200 Neonate: (low limit+5) to 135	5
Sys Low	40 to (high limit-5)	
Mean High	Adult: (low limit+5) to 230 Pediatric: (low limit+5) to 165 Neonate: (low limit+5) to 110	
Mean Low	20 to (high limit-5)	
Dia High	Adult: (low limit+5) to 210 Pediatric: (low limit+5) to 150 Neonate: (low limit+5) to 100	
Dia Low	10 to (high limit-5)	

**Measurement accuracy verification: In adult and pediatric modes, the blood pressure measurements measured with this device are in compliance with the American National Standard for Electronic or Automated Sphymomanometers (ANSI/AAMI SP10-1992) 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 Electronic or Automated Sphymomanometers (ANSI/AAMI SP10-1992 and AAMI/ANSI SP10A-1996) 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 EN12470-4
Technique	Thermal resistance
Measurement range	0 to 50 ℃ (32 to 122 ℉)
Resolution	0.1 ℃
Accuracy	±0.1 ℃ without probe)
Refreshing rate	1 s
Minimum time for accurate measurement	Body surface: <100 s Body cavity: <80 s

Alarm limit	Range	Step
T1/T2 High	(low limit +1) to 50°C	0.1 °C
T1/T2 Low	0.1 to (high limit -1) °C	
TD High	0.1 to 50°C	

A.7.7 IBP

Standards	Meet standard of EN60601-2-34/IEC60601-2-34.
Technique	Direct invasive measurement
IBP	
Measurement range	-50 to 300 mmHg
Resolution	1 mmHg
Accuracy	±2% or ±1 mmHg, whichever is greater (without sensor)
Refreshing rate	1 s
Pressure transducer	
Excitement voltage	5 VDC, ±2%
Sensitivity	5 μV/V/mmHg
Impedance range	300 to 3000Ω

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

A.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.: TB, TI:	0.1 L/min 0.1 °C
Accuracy	C.O.: TB, TI:	±5% or ±0.1 L /min, whichever is greater ±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 21647
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.		

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 21647
CO_2 Measurement range	0 to 99 mmHg
Accuracy*	0 to 38 mmHg: ±2 mmHg 39 to 99 mmHg: ±5% of the reading+0.08% of (the reading-38)
Accuracy drift	Meet the requirement for measurement accuracy within 6 hours
* 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	

A.7.10 AG (For Passport 12 only)

Standards	Meet standard of ISO 21647		
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 ($\%_{REL}$)	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 1 to 5 5 to 8 >8	±0.15 ±0.2 ±0.4 Not specified
	Enf, Iso, Hal	0 to 1 1 to 5 >5	±0.15 ±0.2 Not specified
	awRR	2 to 60 rpm >60 rpm	±1 rpm Not specified
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% in ISO accuracy mode) of primary agent if primary agent is greater than 10%			

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:	(low limit + 2) to 100 rpm	1 rpm
	Neonate:	(low limit + 2) to 150 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)%		

FOR YOUR NOTES

B EMC and Radio Regulatory Compliance

B.1 EMC

The device meets the requirements of IEC 60601-1-2.

Note

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

Guidance and Declaration - Electromagnetic Emissions		
The device is intended for use in the electromagnetic environment specified below. The customer or the user of the device should assure that it is used in such an environment.		
Emission tests	**Compliance**	**Electromagnetic environment - guidance**
Radio frequency (RF) emissions CISPR 11	Group 1	The device uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class 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 emissions IEC61000-3-2	Class A	
Voltage Fluctuations/Flicker Emissions IEC 61000-3-3	Complies	

WARNING

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

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

Guidance and Declaration - Electromagnetic Immunity			
The device is intended for use in the specified electromagnetic environment. The customer or the user of the device should assure that it is used in such an environment as described below.			
Immunity test	**IEC60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Conduced RF IEC61000-4-6	3 Vrms 150 kHz to 80 MHz	3Vrms	Portable and mobile RF communications equipment should be used no closer to any part of the system, including cables, than the recommended separation distance calculated from the equation appropriate for the frequency of the transmitter. Recommended separation distances: $d = 1.2\sqrt{P}$
Radiated RF IEC61000-4-3	3V/m 80MHz to 2.5GHz	3V/m	Recommended separation distances: 80 MHz～800 MHz $d = 1.2\sqrt{P}$ 800MHz-2.5GHz $d = 2.3\sqrt{P}$ Where, P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m).[b] Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey [a], should be less than the compliance level in each frequency range [b]. Interference may occur in the vicinity of equipment marked with the following symbol:
Note 1: At 80 MHz to 800 MHz, the separation distance for the higher frequency range applies. **Note 2**: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			
[a] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the [ME EQUIPMENT or ME SYSTEM] is used exceeds the applicable RF compliance level above, the [ME EQUIPMENT or ME SYSTEM] should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the [ME EQUIPMENT or ME SYSTEM]. [b] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than3 V/m.			

WARNING

- **The monitor is configured with a wireless network connector to receive wireless signal. Other devices may interfere with this monitor even though they meet the requirements of CISPR.**

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

B.2 Radio Regulatory Compliance

This Wi-Fi device complies with Canadian ICES-001. Cet appareil ISM est conforme a la norme NMB-001 du Canada.

The patient monitor including Wi-Fi module (US only) complies with part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

Operation of this equipment requires the prior coordination with a frequency coordinator designated by the FCC for the Wireless Medical Telemetry Service.

The patient monitor including Wi-Fi module - FCC and Industry Canada Radio Compliance: This device complies with Part 15 of the FCC Rules and RSS-210 of Industry Canada. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Any changes or modifications to this equipment not expressly approved by Mindray may cause harmful radio frequency interference and void your authority to operate this equipment.

The maximum antenna gain permitted complies with the e.i.r.p. limits as stated in RSS-210.
The maximum antenna gain permitted complies with the e.i.r.p. limits specified for point-to-point operation, as stated in RSS-210.

CE

The radio device used in this product is in compliance with the essential requirements and
other relevant provisions of Directive 1999/5/EC (Radio Equipment and Telecommunications Terminal Equipment Directive).

CAUTION

- **Keep a distance of at least 20cm away from the monitor when Wi-Fi function is in use.**

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					

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.

Arrh. Analysis

Item Name	Algorithm	O.M		General	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					
Extreme Tachy		*	*	Adu: 160 Ped: 180 Neo: N/A					
Extreme Brady		*	*	Adu: 35 Ped: 50 Neo: N/A					

Item Name	Algorithm	O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
Vbrd Rate		*	*	Adu, Ped: 40 Neo: N/A					
Vbrd PVCs		*	*	Adu, Ped: 5 Neo: N/A					
Pause Time		*	*	Ad, Ped: 2 Neo: N/A					
PVCs High	Mortara	*	*	Adu, Ped: 10 Neo: N/A					
Asys. Delay		*	*	Adu, Ped: 4 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					
Tachy		*	*	Adu: 120 Ped: 160 Neo: N/A					
Brady		*	*	Adu: 50 Ped: 75 Neo: 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	
Asystole Alarm		*	*	On					
VFib/VTac Alarm		*	*	On					
Vtac Alarm		*	*	On					
Vent. Brady Alarm		*	*	On					
Extreme Tachy Alarm		*	*	On					

Item Name	Algorithm	O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
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					
VT>2 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					
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					
VTac Alm Lev		*	*	High					
VT>2 Alm Lev		*	*	Low					

Item Name	Algorithm	O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
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 Specifications chapter 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 (Masimo)	*	*	Normal					
Averaging (Masimo)	*	*	8 s					
Sat-Seconds (Nellcor)	*	*	0 s					

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					
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						
Alarm	*	*	On					
Alm Lev	*	*	Med					
P1 Measure	*	*	All					
P2 Measure	*	*	All					
P3 Measure	*	*	Mean					
P4 Measure	*	*	Mean					
Sensitivity	*	*	Med					
Sweep	*	*	25 mm/s					
Filter	*		12.5 Hz					
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	Adu	*	*	70				

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
(mmHg)	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					
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					
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					

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 (°C)	*	*	39.0					
TB Low (°C)	*	*	36.0					
Comp. Const	*	*	0.542					
Auto TI	*	*	Auto					
Manual TI (°C)	*	*	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					

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Des Scale	*	*	9.0					
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.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					
	3			SpO_2+PR					
	4			Any IBP					
	5			Any IBP					
	6			CO_2					
	7			Resp					
Select Parameters for Big Numerics Screen	Parameter 1	*	*	ECG					
	Parameter 2			SpO_2+PR					
	Parameter 3			Resp					
	Parameter 4			NIBP					

C.2.3 Waveform

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	

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					
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					
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					

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
O_2 Unit			*	%					
Temp Unit			*	℃					
Network Type			*	LAN					
Latching Alarms		*	*	No					
Alarm Pause Time		*	*	2 min					
Minimum Alarm Volume		*	*	2	1	2			
Reminder Tone			*	Off					
Reminder Interval			*	1 min					
ECGLeadOff Lev.			*	Low					
SpO_2SensorOff Lev.			*	Low					
Alarm Tone Interval			*	High Level Alarm: 10 s Med/Low Level Alarm: 20 s					
Lethal Arrh. OFF			*	Disable					
Silence Other Bed			*	On					
Extended Arrh.			*	Enable					
Wave Line			*	Mediate					
ECG Standard			*	AHA					
Notch Freq.			*	50 Hz					
Data Transfer Method			*	Module					
Transferred Data Length			*	4 h					
Data Transfer Strategy			*	Always Ask					
SpO_2 Tone			*	Mode 1					
Signal Type			*	Continuous					
Contact Type			*	Normally Closed					
Nurse Call	Signal Type		**	Continuous					
	Contact Type		*	Normally Closed					
	Alm Lev	*	*	High, Med, Low					
	Alarm Cat.	*	*	Phys., Tech.					

D Alarm Messages

This chapter lists only the most important physiological and technical alarm messages. Some messages appearing on your monitor may not be included.

In this chapter:

- The "I" column indicates how indications of technical alarms perform after the alarm system is reset: "A" means that some technical alarms are cleared; "B" indicates that some technical alarms are changed to the prompt messages; and "C" indicates that a " √ " appears before the alarm message, appears in the alarm symbol area, and the indication of the alarm lamp depends on the alarm light setting. Refer to section ***7.8 Resetting Alarms*** for details.
- The "Level" 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 too weak for the monitor to perform ECG analysis. Check the patient's condition and the ECG connections.
	Asystole	H	Arrhythmia has occurred to the patient. Check the patient's condition and the ECG connections.
	VFib/VTac	H	
	Vtac	H	
	Vent. Brady	H	
	Extreme Tachy	H	
	Extreme Brady	H	
	R on T	M*	
	VT>2	M*	
	Couplet	M*	
	PVCs/min	M*	
	Bigeminy	M*	
	Trigeminy	M*	

Measurement	Alarm messages	L	Cause and solution
	Tachy	M*	
	Brady	M*	
	Missed Beats	M*	
	Irr. Rhythm	M*	
	Vent. Rhythm	M*	
	Multif. PVC	M*	
	Nonsus. Vtac	M*	
	Pause	M*	
	PNP	M*	The pacer appears abnormal. Check the pacer.
	PNC	M*	
Resp	Resp Apnea	H	The respiration signal was too weak for the monitor to 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 too weak for the monitor to 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 too weak for the monitor to 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.

Measurement	Alarm message	L	I	Cause and solution
	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.
	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 High Freq. Noise	L	A	High frequency signals are detected on the ECG analysis lead. Check for any possible source of interference around the cable and electrode.
	ECG Low Freq. Noise	L	A	Low frequency signals are detected on the ECG analysis lead. Check for any possible source of interference around the cable and electrode.
	ECG Amplitude Too Small	L	C	The ECG amplitude didn't reach the detected threshold. Check for any possible source of interference around the cable and electrode.
	ECG Config. Err	L	C	ECG configuration is wrongly downloaded. Check the downloaded configuration and re-download the correct configuration.
Resp	Resp Disturbed	L	A	The respiration circuit is disturbed. Restart the monitor.
Temp	Temp Cal. Err	H	C	A calibration failed. Restart the monitor.
	T1 Sensor Off	L	A	The Temp sensor has become detached from the patient or the module. Check the sensor connections.
	T2 Sensor Off	L	A	
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	

Measurement	Alarm message	L	I	Cause and solution
	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 Signal	L	C	
	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.
	NIBP Air Pressure Err	L	A	An error occurred to the air pressure. Verify that the monitor application site meets the environmental requirements and check if there is any source that affects the air pressure.
	NIBP Weak Signal	L	A	The patient's pulse is weak or the cuff is loose. Check the patient's condition and change the cuff application site. If the error persists, replace the cuff.
	NIBP Signal Saturated	L	A	The NIBP signal is saturated due to excess motion or other sources.
	NIBP Overrange	L	A	The measured NIBP value is not within the specified range.
	NIBP Excessive Motion	L	A	Check the patient's condition and reduce the patient motion.
	NIBP Cuff Overpress.	L	A	The NIBP airway may be occluded. Check the airway and measure again.
	NIBP Equip Err	H	A	An error occurred during NIBP measurement and therefore the monitor cannot perform analysis correctly. Check the patient's condition and NIBP connections, or replace the cuff.
	NIBP Timeout	L	A	
	NIBP Measure Failed	L	A	
	NIBP Illegally Reset	L	A	An illegal reset occurred during NIBP measurement. Check if the airway is occluded.
IBP	YY Sensor Off			Check the sensor connection and reconnect the sensor.
	YY Non-Pulsatile	L	A	The catheter may be occluded. Please flush the catheter.

Measurement	Alarm message	L	I	Cause and solution
	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 CO2 module goes beyond the specified range. After it restores within the specified range, the module will restart automatically.
	CO_2 Airway High Press.	L	C	An error occurred in the airway pressure. Check the patient connection and patient circuit, and then restart the monitor.
	CO_2 Airway Low Press.	L	C	
	CO_2 High Barometric Press.	L	C	Check the CO_2 connections, make sure that the monitor application site meets the requirements, and check for special sources that affect the ambient pressure. Restart the monitor.
	CO_2 Low Barometric Press.	L	C	
	CO_2 FilterLine Occluded	L	C	The airway or watertrap was occluded. Check the airway and remove the occlusion.
	CO_2 No Watertrap	L	B	Check the watertrap connections.
	CO_2 Check Adapter	L	A	There is a problem with the airway adapter. Check, clean or replace the adapter.
	CO_2 FilterLine Err	L	C	Check if there is a leak in the CO_2 sample line or the CO_2 sample line has been occluded.
	CO_2 Zero Failed	L	A	Check the CO_2 connections. After the sensor's temperature becomes stabilized, perform a zero calibration again.
	CO_2 System Err	L	A	Re-plug the module or restart the monitor.
	CO_2 Check Cal.	L	C	Perform a calibration.
	CO_2 Check Airway	L	C	An error occurred to the airway.
	CO_2 No Filterline	L	A	Make sure that the filterline is connected.
	CO_2 No Sensor	L	A	Make sure that the sensor is connected.
	CO_2 Main Board Err	H	C	There is a problem with the CO_2 module. Re-plug the module or restart the monitor.
	CO_2 Checking Sensor	L	C	
	CO_2 Replace Scrubber&Pump	L	C	
	CO_2 15V Overrange	H	C	
	CO_2 Hardware Err	H	C	
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

Measurement	Alarm message	L	I	Cause and solution
	N_2O Accuracy Unspecified	L	A	range.
	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.
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	

Measurement	Alarm message	L	I	Cause and solution
	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	
	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.			

FOR YOUR NOTES

E Symbols and Abbreviations

E.1 Symbols

µA	microampere
µV	microvolt
µs	Microsecond
A	ampere
Ah	ampere hour
bpm	beat per minute
bps	bit per second
ºC	centigrade
cc	cubic centimeter
cm	centimeter
dB	decibel
DS	dyne second
ºF	fahrenheit
g	gram
GHz	gigahertz
GTT	gutta
h	hour
Hz	hertz
in	inch
kg	kilogram
kPa	kilopascal
L	litre
lb	pound
m	meter
mAh	milliampere hour
Mb	mega byte
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

E.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
aVR	right arm augmented lead
awRR	airway respiratory rate
BAP	brachial arterial pressure
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
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
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
HIS	hospital information system
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
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
MRI	magnetic resonance imaging
MRN	medical record number

MVe	expiratory minute volume
MVi	inspiratory minute volume
N/A	not applied
N_2	nitrogen
N_2O	nitrous oxide
Neo	neonate
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
PPV	pulse pressure variation
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

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