T1 Patient Monitor

Operator’s Manual

Manufacturer's Responsibility

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the electrical installation (a)8 (i)13.4 (rs/.m51 T-6.7 13.4 (a)8 (t))7 (h)1 (a)8 (a)8 (t r)1 ((.7 (ro)m3 (re)13 (c)0.7 (o)m.9 (p.4 (elg)5 (e)13

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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, contact Mindary Service.
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.

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FOR YOUR NOTES

1 Safety

1.1 Safety Information

WARNING

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

CAUTION

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

NOTE

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

1.1.1 Warnings

WARNINGS

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.

Ensure that the patient monitor is supplied with continuous electric power during work. Sudden power failure may lead to data loss.

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 and future upgrades must be carried out by the personnel trained and authorized by Mindray only.

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.

PATIENTS WITH A PACEMAKER – On ventricular paced patients, episodes of Ventricular Tachycardia may not always be detected. Do not rely entirely upon the system's automated arrhythmia detection algorithm. Keep pacemaker patients under close surveillance.

The physiological data and alarm messages displayed on the equipment are for reference only and cannot be directly used for diagnostic interpretation.

To avoid inadvertent disconnection, route all cables in a way to prevent a stumbling hazard. Wrap and secure excess cabling to reduce risk of entanglement or strangulation by patients or personnel.

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 phones and X-ray equipment 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.

Disposable accessories are not designed to be reused. Reuse may cause a risk of contamination and affect the measurement accuracy.

Always install or carry the equipment properly to avoid damage caused by a drop, impact, strong vibration or other mechanical force.

Dry the equipment immediately in case of rain or water spray.

When no battery is installed, ensure that the monitor is supplied with continuous electric power during operation. 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.

Disposable accessories are not designed to be reused. Reuse may cause a risk of contamination and affect the measurement accuracy.

Contact the Mindray service personnel for replacements if you find the housing is broken.

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.

Remove the battery before shipping the monitor or if it will not be used for an extended period of time.

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. Therefore, The possibility of hazards arising from software errors is minimized.

This manual describes all features and options. Your equipment may not have all of them. They are not available in all geographies.

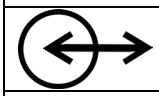
Remove the battery before shipping the monitor or if it will not be used for an extended period of time.

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.

	ON/OFF for a part of equipment		Direct current
	Battery indicator		Network connector
	Multifunctional connector		Serial number
	Unlocking		Equipotentiality
	VGA connector		Direction and angle of rotation
	Lock; tighten		Alternating current
	Date of Manufacture		Symbol for “MANUFACTURER”
	Input/output		USB connector
IPX1	Protected against vertically falling water drops per IEC 60529	IPX2	Protected against vertically falling water drops when ENCLOSURE tilted up to 15° per IEC 60529
	Defibrillation-pro 0.2(w)0.7 [(p)-11.3 (ro 0.2(w)0.7 i)-2 (l602 (lla)19.3 (t)1.7 (i)-2 (o)6.3 (n)]TJ0 TTJ0.001.733.001.7fn)12		

2 The Basics

2.1 Monitor Description

2.1.1 Intended Use

2.1.2 Equipment Features

The monitor is intended to be used in a hospital environment including, but not limited to, ICU, CCU, PICU, NICU, RICU, emergency room, operating room, postoperative observation ward, etc.

The monitor can be used in two ways:

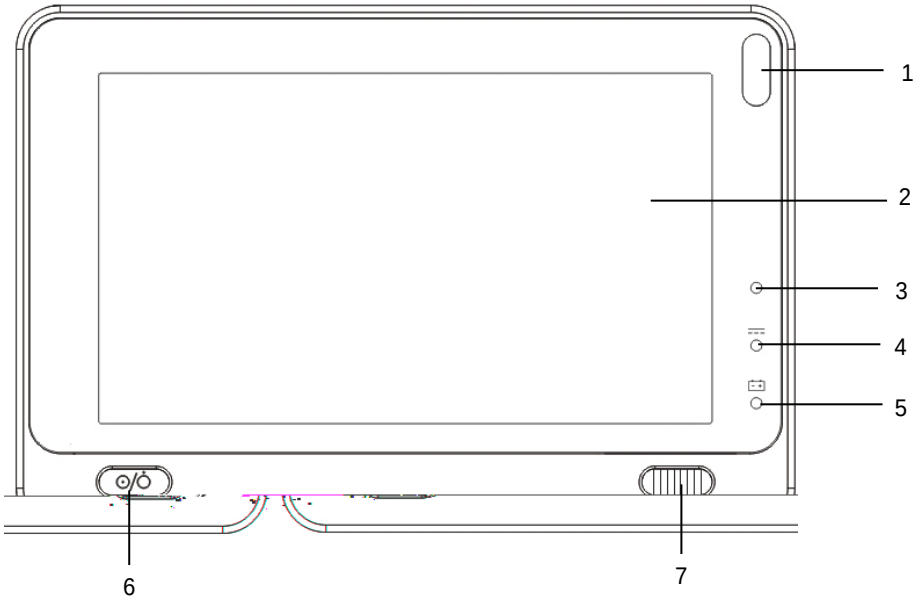
As a stand-alone patient monitor, or

As a multi-parameter module (MPM) for the Mindray Passport 17M (and Passport 12M) T17.006 Tc0.3 4..6 to)410.3 ([(mo)8.3 (n)14.4

2.2 Equipment Description

2.2.1 Main Unit

2.2.1.1 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. Ambient light sensor

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

4. External power supply indicator

   On: when external DC power supply is connected.

   Off: when external DC power supply is disconnected.

5. Battery LED

   On: when the battery is installed and the external DC power supply is connected.

   Off: when no battery is installed, or the installed battery is malfunctioning, or no external DC power supply is connected when the monitor is powered off.

   Flashing: when the monitor operates on battery power.

6. 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.

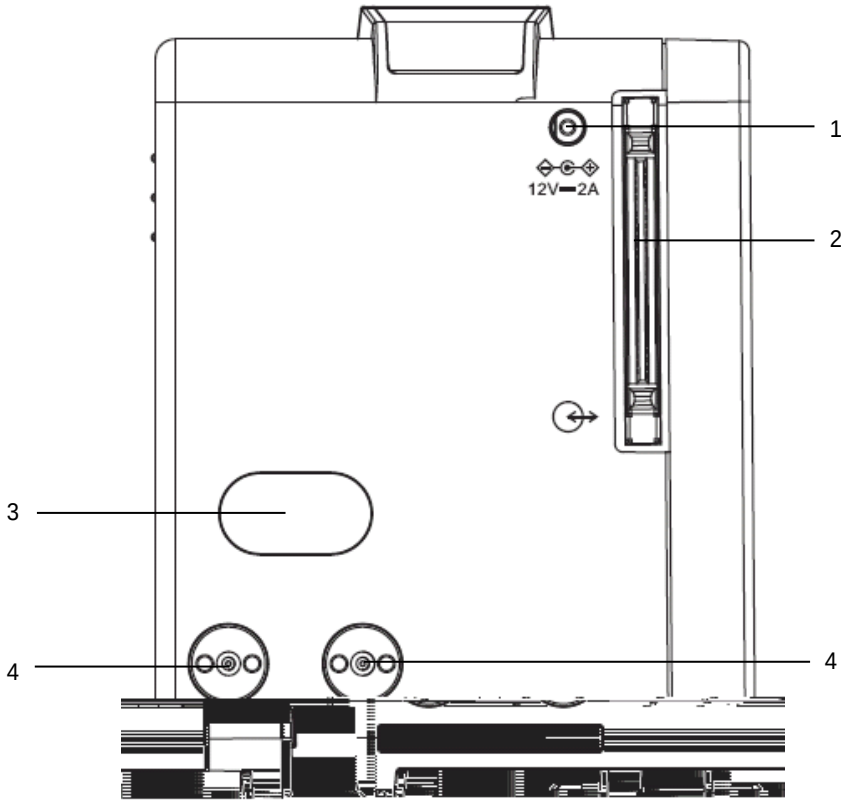
   An indicator is built into this switch. It turns on when the monitor is on and turns off when the monitor is off.

7. Lock/unlock switch

   When the T1 is not connected with the external display, sliding this switch to the right locks/unlocks the touch screen.

   When the T1 is connected to the external display, sliding this switch to the right switches screen display between the T1 and the external display.

2.2.1.2 Left View

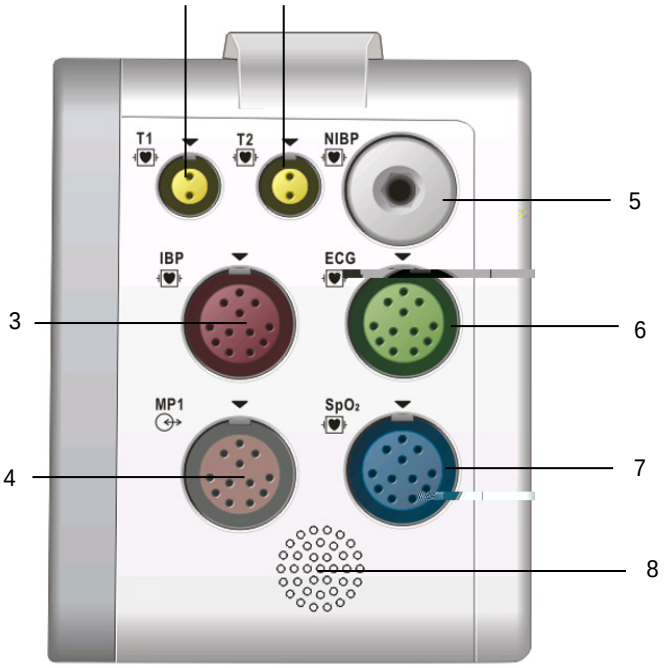


1. External DC power supply connector
2. Main unit multi-pin connector: connects the T1 to the T1 handle or T1 docking station.
3. Infrared filter: used for communication between the T1 and host monitor.
4. Contact: connects power to the T1 from the T1 docking station or the host monitor.

NOTE

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

2.2.1.3 Right View



1. Temp probe 1 connector
2. Temp probe 2 connector
3. IBP cable connector
4. Multifunctional connector: outputs analog ECG, IBP and defibrillation synchronization signals.
5. NIBP cuff connector
6. ECG cable connector
7. SpO_2 cable connector
8. Speaker

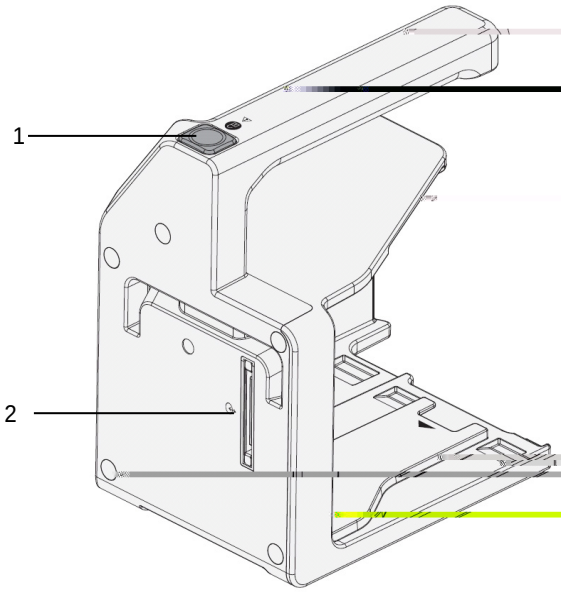
2.2.1.4 Bottom View

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

2.2.2 T1 handle

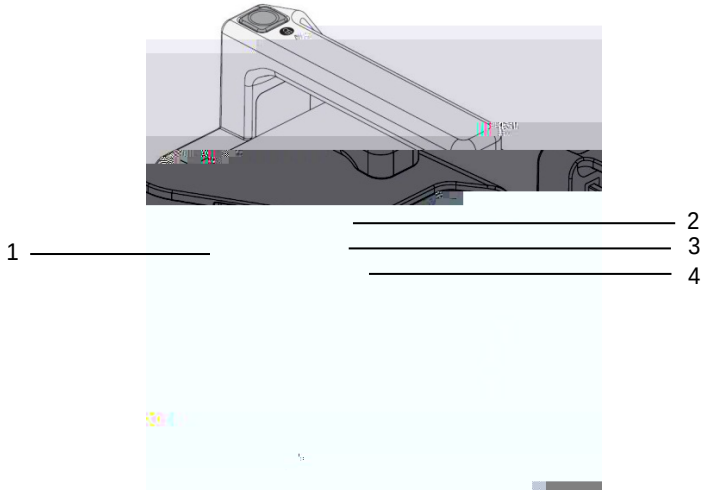
The T1 handle is used to connect a T1 and an external parameter module as well as providing bed rail mounting capability. It can also be connected to the T1 docking station.

2.2.2.1 Left View



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

2.2.2.2 Right View

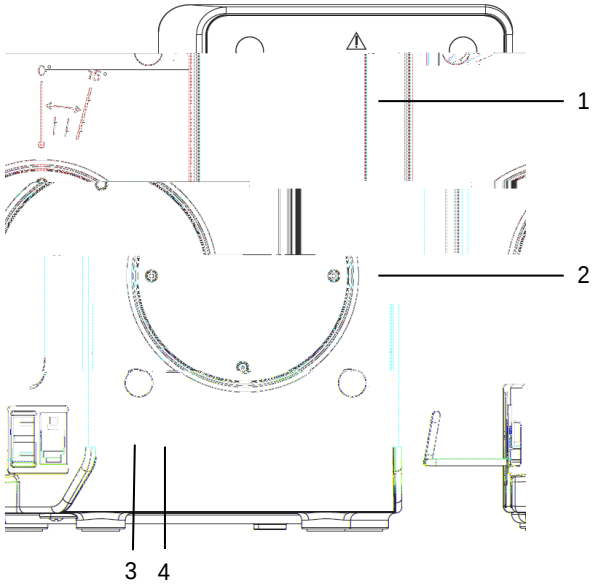


1. T1 handle multi-pin connector 2: connects the T1 handle and the T1.
2. Pogo pins: used for communication between the T1 handle and external parameter module.
3. Infrared filter: used for communication between the T1 handle and external parameter module.
4. Contact: power input connector of the external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

2.2.3 T1 Docking Station

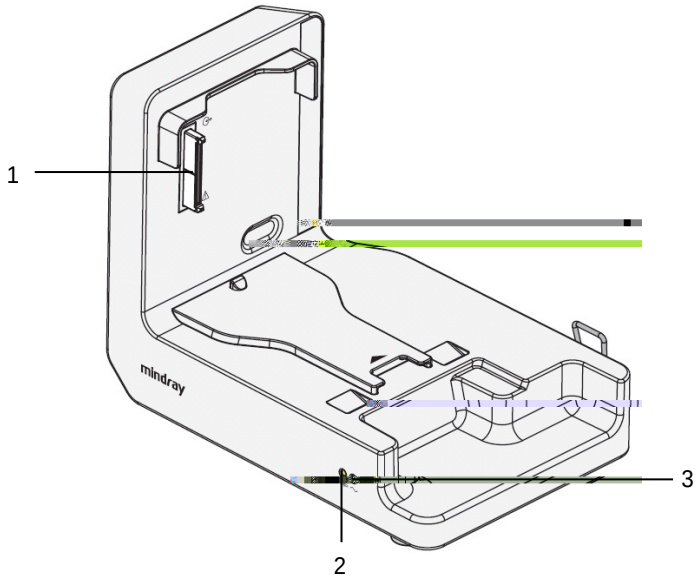
The T1 docking station is used to connect the T1 or T1 handle to provide power, charge the installed battery, and support connection to an external display, USB drive, network cables, and the Passport 12M/17M patient monitors.

2.2.3.1 Left View



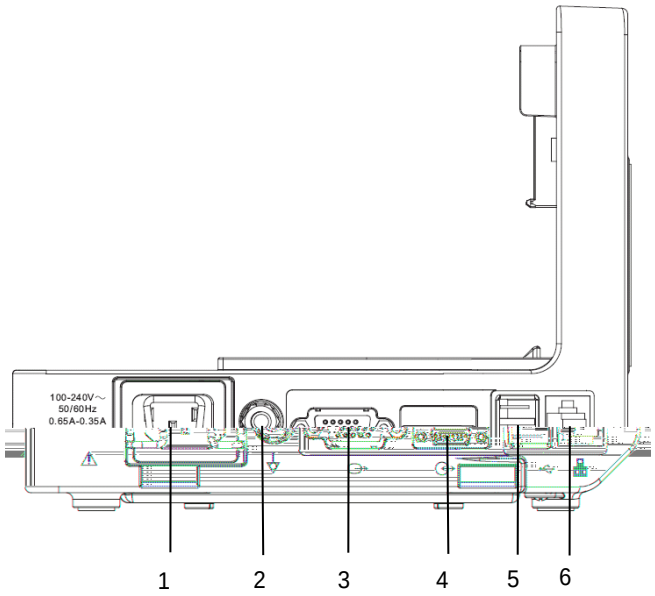
1. Symbol: indicates the direction and angle that the T1 docking station can rotate when the T1 docking station is fixed onto a transverse or a vertical rod.
2. Pole mount seat: used to fix the pole mount to the docking station and then to a transverse or a vertical rod.

2.2.3.2 Right View



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

2.2.3.3 Rear View



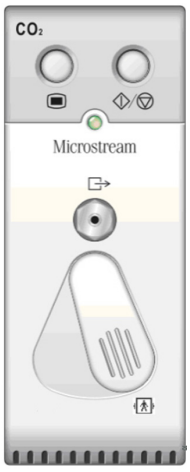
1. AC power input
2. Equipotential grounding terminal

   When using the monitor together with other devices, connect their equipotential grounding terminals together to eliminate the potential differences between them.
3. VGA connector: connects the external display
4. External device connector: connects the T1 to the host monitor through a cable.
5. USB connector: connects USB devices, including the USB drive, mouse and keyboard.
6. Network connector: a standard RJ45 connector which connects the monitor to the CMS or CIS. It can also be used to transfer data.

2.2.4 External Parameter Modules

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

Sidestream CO_2 module



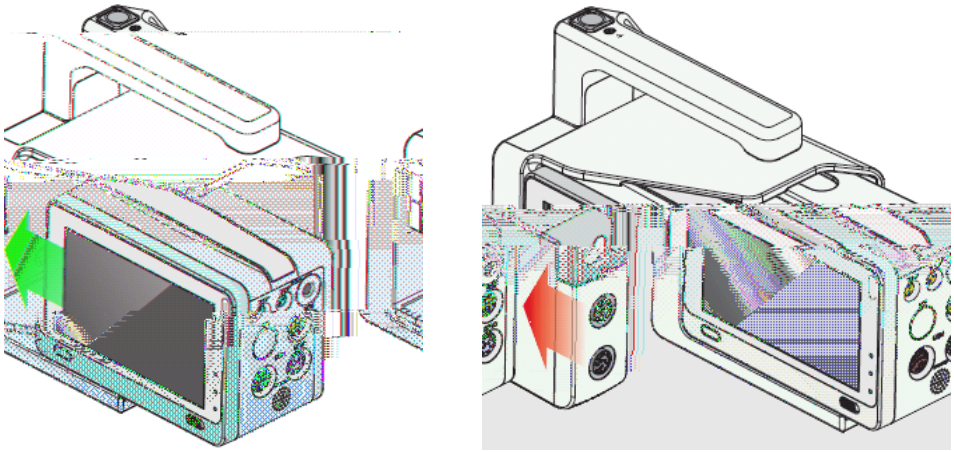
Microstream CO_2 module

2.3 Installation

The T1 handle and T1 docking station are part of the equipment. Use only the specified T1 handle and T1 docking station.

2.3.1 T1 in Use with the T1 Handle

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



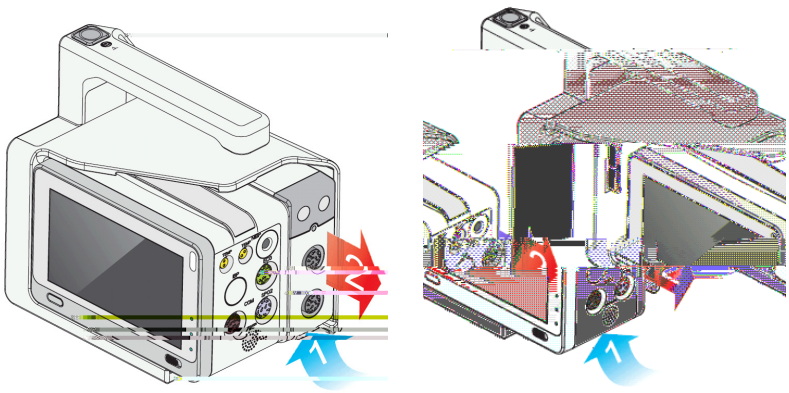
You hear a click when the T1 or the external module is pushed into place.

CAUTION

When the external module is properly installed, you should further fasten the module to the T1 handle with the lock at the bottom of the module to ensure the engagement.

To remove the T1 or external parameter module:

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

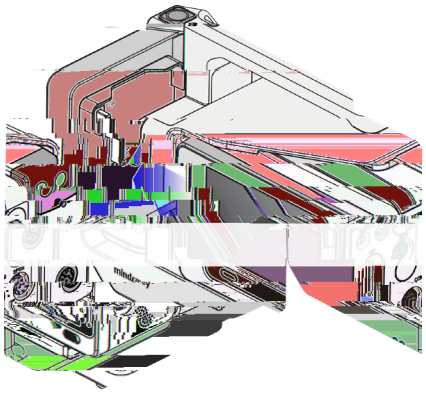


CAUTION

To prevent the T1 from falling out, do not press the release button while transporting the T1 with the T1 handle.

2.3.2 T1 Handle in Use with the T1 Docking Station

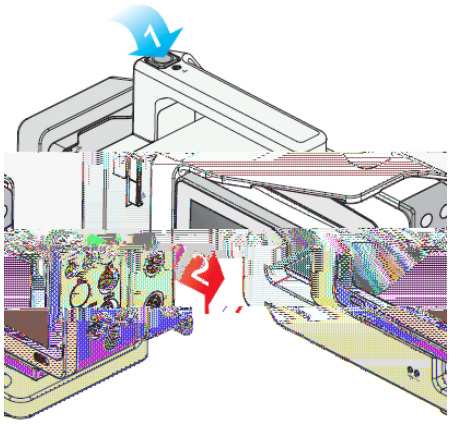
The T1 handle can be installed into the T1 docking station as indicated below:



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

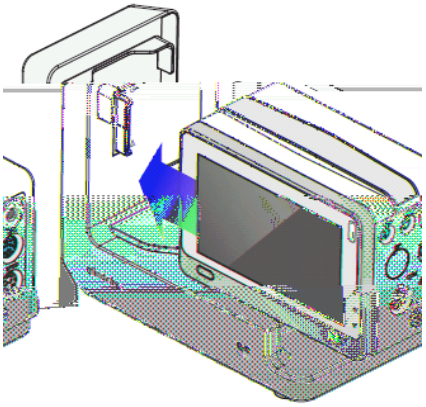
To remove the T1 handle:

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



2.3.3 T1 in Use with the T1 Docking Station

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

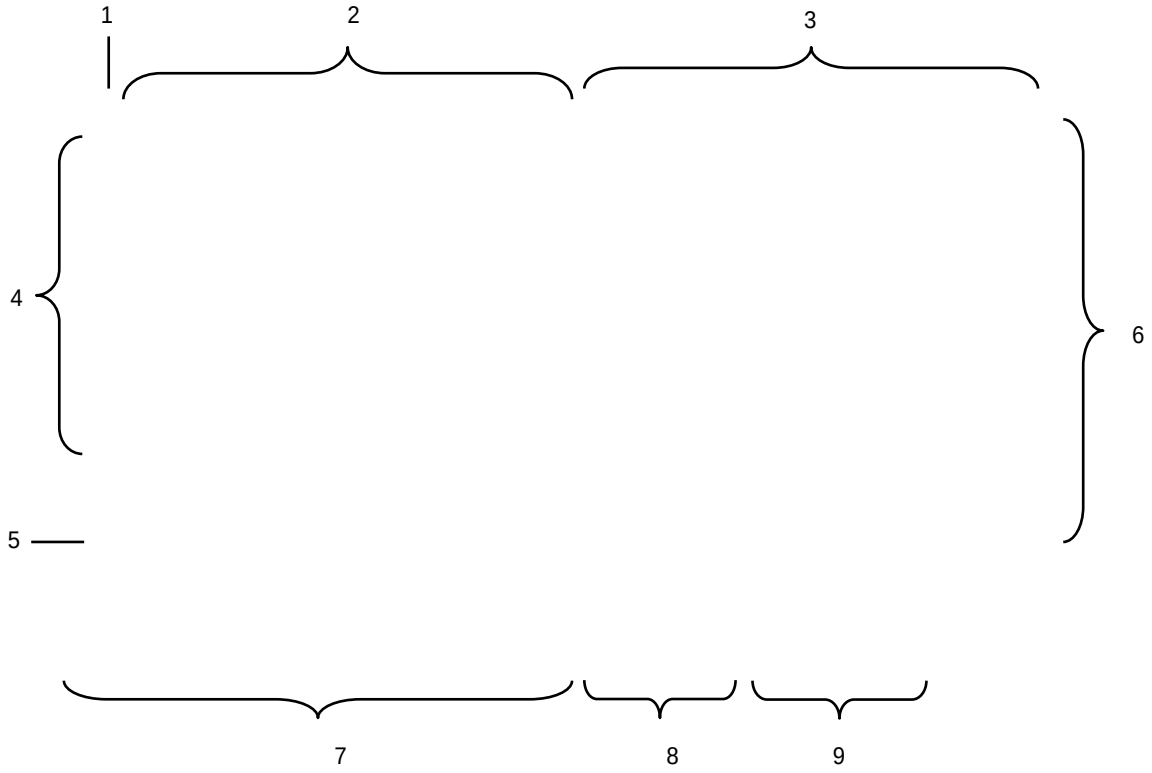


You hear a click when the T1 is pushed into place.

To remove the

2.4 Display Screen

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



1. Alarm Symbols
2. Patient Information/Technical Alarm Area

   This area shows the patient information such as department, bed number, patient name, patient category and paced status. indicates that the patient has an implanted pacemaker. If no patient is admitted, selecting this area enters the [**Patient Setup**] menu. For admitted patients, selecting this area enters the [**Patient Demographics**] menu.

   When a technical alarm is presented, patient information will be covered by the technical alarm message. When multiple alarms occur, they scroll. Selecting this area shows the Technical Alarms list.
3. Physiological Alarm Area

   This area shows physiological alarm messages. When multiple alarms occur, the messages scroll. Select this area and the physiological alarms list displays.
4. Waveform Area and Parameter Area A

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

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

6. QuickKeys Area

   This area contains QuickKeys that provides quick access to functions.

   Start or stop NIBP measurements

   Reset the alarms

   Enter/Exit the alarm paused state

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

7. Prompt Message Area

   This area shows the current configuration name and prompt messages.

8. CMS status area

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

9. Status area

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

   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 connected.

   indicates the wireless function (optional) is not connected.

   indicates a USB drive is inserted.

For details about battery status symbols, refer to chapter .

FOR YOUR NOTES

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 are responsible for providing evidence that the safety certification of the devices has been performed in accordance to the IEC 60601-1. If you have any questions, please contact Mindray.

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 Mindray authorized 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.

Many settings in the patient monitor are password protected. It is recommended to change the default passwords and keep the passwords safe. Passwords should only be changed by authorized personnel. Contact your department manager or biomedical engineering department for the passwords used at your facility.

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 problems.

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 differences. In this case, never start the system before the condensation evaporates.

CAUTION

Make sure that the equipment operating environment meets the specific requirements. Otherwise un expected consequences, e.g. damage to the equipment, could result.

3.2 Getting Started

3.2.1 Connecting to Power Source

Using DC Power Adapter

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

Using the T1 Docking Station

To connect to the AC power using the T1 docking station:

1. Install the monitor to the T1 docking station as described in section .
2. Connect one end of the supplied power cord with the AC power input on the back of the T1 docking station 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 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 section .

3.2.2 Turning Power On

Once the monitor is installed, before beginning measurements:

1. Check the monitor for any mechanical damage, and make sure that all external cables, plug-ins and accessories are properly connected.
2. Check the power supply specifications are met if mains power is used. Only use a power outlet that is properly grounded.
3. Connect the power source:

   If you are using the DC adapter, plug the DC adapter into the T1.

   If you run the monitor on battery power, install the battery and ensure that the battery is sufficiently charged.

   If you are using the T1 docking station, install the T1 to the docking station and connect the docking station to the AC power.
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.

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.

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.

3.2.3 Starting Monitoring

To start 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 to turn off the monitor. "**System is 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 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.

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 and then remove the battery.

3.4 Using the Touchscreen

Select screen items by touching them directly on the monitor's screen.

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

If the screen is locked, a symbol is shown in the Main Menu QuickKey area. Sliding the lock/unlock key to the right unlocks the screen.

3.5 Using the On-Screen Keyboard

The onscreen keyboard enables you to enter information.

Use the ← key to delete the previously entered character.

Use the ⇪ key to toggle between uppercase and lowercase letters.

Select ↵ to confirm what you have entered and close the onscreen keyboard.

Select @!# to access the symbol keyboard.

Select ⮌ to exit the symbol keyboard.

3.6 Using the External Display

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

The external display displays different information than the T1 because the external display has a larger screen size. You can view or operate the following screens or functions only on the external display:

Minitrends Screen

OxyCRG Screen

View Others Screen

ECG 7-Lead Half-Screen

PAWP Screen

Calculations

To connect the external display:

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

Then you can use the external display to show information from the T1. You can adjust the display by pressing the Auto

3.9 Changing General Settings

3.9.1 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, enter the [**Monitor Name**], [**Department**] and [**Bed No.**].

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

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

[**Protected**]: disables you from changing the Bed No. in the [**Patient Demographics**] menu.

3.9.2 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.

3.9.3 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 then select [**yyyy-mm-dd**], [**mm-dd-yyyy**] or [**dd-mm-yyyy**].
4. Select [**Time Format**] and then select [**24 h**] or [**12 h**].

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.

3.9.4 Setting the Docking Station

To make sure that the T1 can be used with the docking station for the patient transfer, you need to configure the docking station on the T1.

To configure the docking station, select [**Main Menu**] [**Maintenance >>**] [**User Maintenance >>**] enter the required password [**Others >>**] [**Dock Setup >>**].

NOTE

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

Setting the Work Mode

Work mode defines the source of facility, department, bed number, central station IP information, and user authentication service setup (alarm setup, Arrh. alarm settings, user maintenance, local alarm password) when the T1 is connected with the docking station.

The Dock mode and host mode have the following features:

In Dock mode, the T1 uses the settings of the T1 when the T1 is connected, and the settings on the docking station remain unchanged whether the T1 is connected or removed.

In host mode, the T1 uses the settings of the docking station when the T1 is connected, and the settings of the T1 when the T1 is removed from the docking station.

NOTE

The Work mode is from the perspective of the docking station. When [Dock Mode] is selected, the docking station works only as a Dock. When [Host Mode] is selected, the docking station acts as the Host.

Setting Network Type

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

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

If [**Use Current Dock Net Setting**] is selected, the T1's network setting is the current network setting of the docking station, and the setting is restored to the previous T1's settings when the T1 is removed from the docking station.

Setting the IP for CMS

The IP of the CMS defines the IP address of the CMS to which the T1 is connected. The T1 can only be connected to the specified CMS.

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

3.10 Setting Parameters

3.10.1 Switching the Parameters On/Off

To switch the parameters on or off, select [**Main Menu**] [**Screens**] [**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 cannot switch it off.

3.10.2 Accessing the Parameters Menu

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

3.11 Operating Modes

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

3.11.1 Monitoring Mode

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

3.11.2 Night Mode

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

To activate the Night mode:

1. Select [**Main Menu**] [**Screen Setup >>**] [**Night Mode >>**].
2. In the pop-up menu, set the desired brightness, alarm volume, QRS volume, key volume, NIBP end tone, and 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 [**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.

3.11.3 Privacy Mode

The Privacy mode is available only 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 the 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. B-13.4 (a>18.7 (ly)8.4 (v)5 TJEMC /Span </MCID 24 >>BDC 0 Tc 0 Tw 1.88 0 Td1(ti)-4 (v)3 (4-0.00uTf-2

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

The T1 is connected to a host monitor.

The strength of ambient light is lower than the threshold for more than 5 seconds and the [**Outdoor Mode**] is set to [**Auto**].

3.11.5 Module Mode

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

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

Insert the T1 in the module rack of the host monitor

To use the T1 with the host monitor, insert the T1 into the host monitor's internal module rack or satellite module rack. Firmly push the T1 until you hear that the clip engages the module rack. To ensure that the T1 is properly connected, try to pull the T1 outward. The T1 is properly engaged in the module rack if you cannot pull the T1 out.

CAUTION

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

To remove the T1 from the host monitor, lift the latch (refer to) at the bottom of the T1 and pull the T1 out.

Connect the T1 with the host monitor through the docking station

To connect the T1 docking station to the host monitor:

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

To disconnect the T1 docking station from the host monitor:

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

WARNING

Do not unplug the T1 dock data cable during normal use. It may result in unknown problems.

Make sure that the T1 dock data cable is disconnected from the host monitor when the T1 docking station is not in use with the host monitor.

3.11.6 Standby Mode

In the Standby mode, you can temporarily stop patient monitoring without turning off the monitor.

To enter the Standby mode:

1. Select [**Main Menu**] [**Standby**]
2. Select [**Yes**] in the pop-up menu.

FOR YOUR NOTES

4 Managing Patients

4.1 Admitting a Patient

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

To admit a patient:

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

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

   If no patient has been previously admitted, you can choose either:

   [**Yes**] to apply the data saved in the monitor to the new patient, or

   [**No**] to clear the data saved in the monitor.
3. 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 to your patient.

   [**Paced**] determines whether to show pace pulse marks on the ECG waveform. When the [**Paced**] is set to [**No**], pace pulse marks are not shown in the ECG waveform.
4. Select [**Ok**].

WARNING

Make sure the [Patient Cat.] and [Paced] fields always contain a value, regardless of whether the patient is fully admitted or not.

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].

For details about patient paced status, refer to section .

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.

To quick admit a patient:

1. Select [**Main Menu**] [**Patient Setup >>**].
2. Select [**Quick Admit**]. If a patient has previously been admitted, select [**Ok**] to discharge the current patient. If no patient has previously been 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 Setting the Monitor Location

To set the monitor location, follow this procedure:

1. Select [**Main Menu**] [**Maintenance >>**] [**User Maintenance >>**] enter the required password .
2. Input the following location of the monitor:

   [**Facility**]: your facility name.

   [**Department**]: your department name.

   [**Room No.**]: room number.

   [**Bed No.**]: bed number.

4.4 Querying and Obtaining Patient Information

The monitor can obtain patient information from the 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 [**Server 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 onthe monitor. The patient's physiological data is not changed and the patient is not discharged.

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

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

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

4.8 Discharging a Patient

To discharge a patient:

1. Select [**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.

If you need to print the end case report, refer to section for instructions.

NOTE

After discharging an admitted patient, you can review the historical data of this patient by selecting [Main Menu] [Patient Data >>] [Historical Data>>] When the SD card is full, the oldest patient data will be deleted automatically. Therefore, you cannot always view all the historical data.

4.9 Transferring Patient Data

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

You can use a USB drive to transfer data between two monitors. You can also connect the T1 with the host monitor to implement patient transfer. Refer to the operator manual of the host monitor.

WARNING

Do not discharge a patient before the patient is successfully transferred.

After a patient is successfully transferred, check if the patient settings (especially patient category, paced status and alarm limits settings, etc.) on the monitor are appropriate for this patient.

NOTE

The system automatically enables the HR alarm and lethal arrhythmia alarm after transferring the patient data.

4.9.1 Transferring Patient Data via a USB Drive

To transfer patient data to a USB drive:

1. Select [**Others >>**] from the [**User Maintenance**] menu.
2. In the pop-up menu, set [**Data Transfer Method**] to [**USB Drive**].

You can also set [**Transferred Data Length**]. The default is [**4 h**].

4.9.1.1 Transferring Data from the Monitor to a USB Drive

To transfer data from the monitor to a USB drive:

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

4.9.1.2 Transferring Data from a USB Drive to the Monitor

To transfer data from a USB drive to the monitor:

1. Connect a USB Drive to the T1 docking station's USB connector.
2. Select [**Main Menu**] [**Maintenance >>**] [**User Maintenance >>**] enter the required p assword → [**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, or

   Select [**Unload USB Drive**] to keep the patient data and 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 content that need to be transferred. [**Patient Demographics**] must be selected. After selecting [**Ok**], the monitor compares the patient information stored in both the storage medium and monitor and manages the patient data based on the following:

   Different Patients: The monitor erases all the current patient data, transfers the patient data from the storage medium, and loads the configuration according to the patient category.

   Same Patient: In the pop-up dialog box, you can:

   Select [**Yes**] to merge the patient data in the monitor and storage medium.

   Select [**No**] to erase all the current patient data in the monitor and to transfer the patient data from the storage medium.

4. Wait until the 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 the data transfer process. Otherwise, data files may be damaged.

Check that the USB drive is removed before disconnecting the T1 from the T1 docking station.

The normal monitoring function will be affected during data export. Do not perform any monitoring activity during data export.

4.9.2 Transferring Patient Data via the T1 to a Host Monitor

The T1 can be used with a host monitor to implement patient transfer. For patient transfer via the host monitor, refer to the host monitor's operating manuaa27 (r)-27 (')79.7 (s)2 so8The n

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**]. For the configuration items and their default values and user maintenance items, see Appendix .

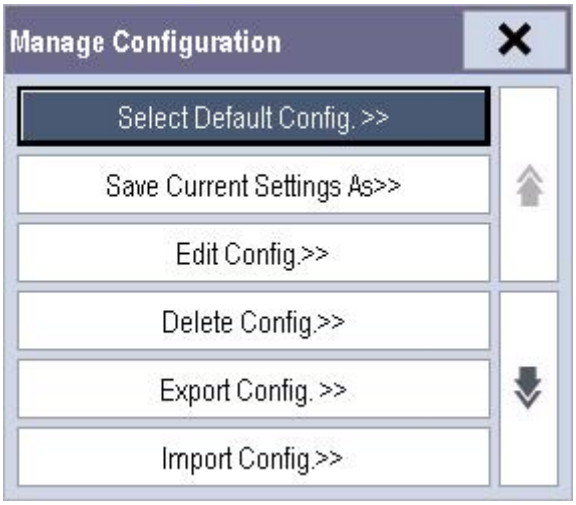
NOTE

The configuration management function is password protected. The configuration management tasks must be performed by authorized personnel. Please contact your department manager or biomedical engineering department for the password used at your facility.

5.2 Accessing the [Manage Configuration] Menu

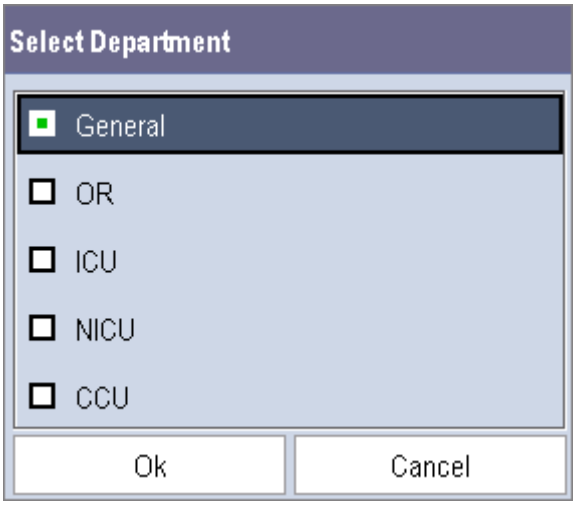
To access the [**Manage Configuration**] menu:

1. Select [**Main Menu**] [**Maintenance >>**] [**Manage Configuration >>**].
2. 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 desired department 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 toggle between [**Defaults**] or user configuration(s).

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

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.

5.5 Saving Current Settings

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

To save current settings:

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

5.6 Editing Configurations

To edit an existing configuration:

1. Select [**Edit Config. >>**] in the [**Manage Configuration**] menu. The pop-up menu shows the existing configurations on the monitor. Selecting [**Config. on USB drive >>**] will show the existing configurations on the USB drive.
2. Select the desired configuration and then select the [**Edit**] button.
3. Select [**Alarm Setup >>**], [**Screen Setup >>**] or [**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**

. (on)-7ot5 7oki u-3ec0 s07 4tD¤…Cfr q)s• p@“Ñ @ Ñ

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. Select [**Config. on USB drive >>**] to show the existing configurations on the USB drive.
2. Select a desired configuration.
3. Select [**Load**].

NOTE

The monitor may configure some settings by default when you load a configuration of different software version with current configuration.

5.10 Restoring the Latest Configuration Automatically

During operation, you may make changes to some settings. However, these changes may not be saved as 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.

FOR YOUR NOTES

6 User Screens

6.1 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.

   1 to 10. 10 is the brightest, and 1 is the dimmest.

   Auto: Screen brightness will be adjusted automatically.

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.

6.2 Adjusting Volume

Alarm Volume

To adjust the alarm volume:

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

Key Volume

When you press the touchscreen, the monitor prompts you by making a sound of the key volume you have set.

To adjust the key volume:

1. Select [**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 pitch of the tone 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 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.

6.3 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

CAUTION

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

6.3.1 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 then select [**Thick**], [**Med**] or [**Thin**].

6.3.2 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.

6.3.3 Choosing a Screen

To choose a screen, select [**Main Menu**] [**Screens >>**] [**Choose Screen**]. You can choose either:

Normal Screen

Big Numerics screen

ECG 7-Lead Full-Screen if 5-lead or 12-lead ECG is selected

ECG 12-Lead Full-Screen if 12-lead ECG is selected

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

ECG 7-Lead Half-Screen if 5-lead or 12-lead ECG is selected

Minitrends Screen

OxyCRG Screen

View Others Screen

PAWP Screen

6.3.4 Changing the T1 Screen Layout

To change screen layout, select [**Main Menu**] [**Screens**] to enter the [**Screens**] menu.

You can choose the desired screen type in the [**Choose Screen**] window.

You can select the parameters and waveforms you want to view in the [**Screen Setup**] window. For details, please refer to section .

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.

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

In Area A, you can choose to display the parameters (having waveforms) and their waveforms. Each parameter and the associated waveform are displayed in the same row.

In Area B, you can choose to display all the parameters except ECG. Associated waveforms will not be displayed.

WARNING

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

6.3.5 Changing Screen Layout on the External Display

NOTE

The keys mentioned in this section refer to the keys on the external display.

To change the screen layout on the external display:

Select the [**Screens**] QuickKey

6.4 Understanding the Big Numerics Screen

To enter the big numerics screen:

1. Select [**Main Menu**] [**Screen Setup >>**] [**Screen Layout >>**].
2. In the [

Minitrend View

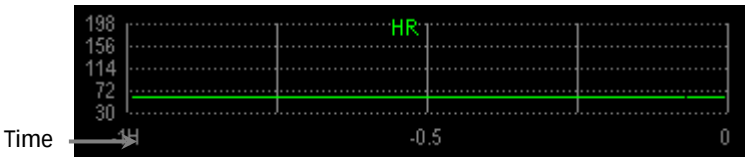
The split-screen view provides minitrends for multiple parameters. In each field, the label and scale are respectively displayed at the top and left. The time is displayed at the bottom of the minitrends view as shown below.

6.5.2 Setting Minitrends

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

Select the parameters to be displayed, or

Select [**Minitrend Length**] and then select the appropriate setting.



6.6 Viewing OxyCRG (only available with the external display)

NOTE

The keys mentioned in this section refer to the keys on the external display.

To have a split screen view of OxyCRG, select [**Main Menu**] [**Scr Scr Scrí**

0.Bt(1.2D.vB1À1 g)2c ÷ @3007 T70466.4 I‡u ¬dSan2.547 <

6.7 Viewing Other Patients (Only Available with the

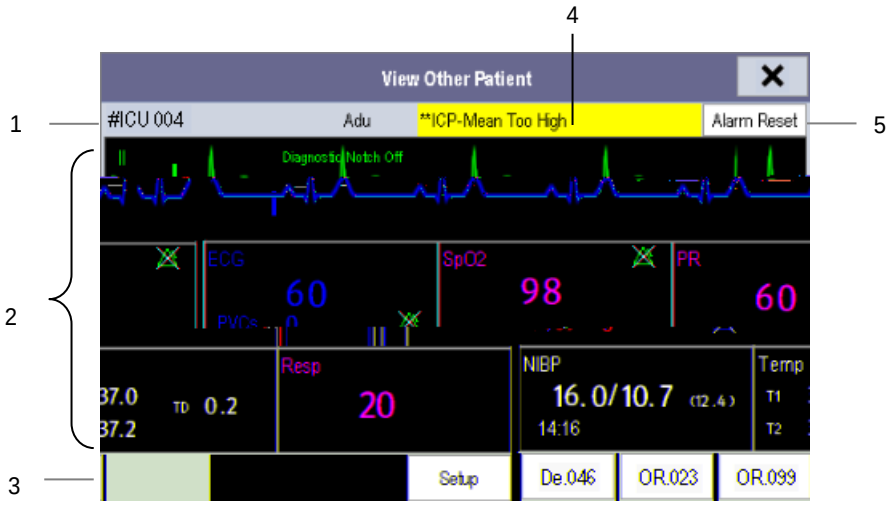
You can view a care group bed's alarms by selecting it from the care group, and you can select the [**View This Patient**] button to view the bed in the [**View Other Patient**] window.

For more details about care group alarms, refer to chapter

Alarms.

6.7.3 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.), and network status symbol.
2. View Area: shows physiological waveforms and parameters. You can switch a waveform area to a parameter area by selecting your desired waveform area and then selecting [**Switch to Parameter Area**], or switch a parameter area to a waveform area by selecting your desired parameter area and then selecting [**Switch to Waveform Area**].
3. Care Group Overview Bar. For details, refer to section .
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

   .

   When the [**Reset Other Bed's Alarms**] is disabled, there is no button appearing 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 real time data.

The **icon indicates disconnection to the viewed monitor. You cannot view the monitor when this icon is 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 *A a M,,, a.,,*.

7.1 Alarm Categories

The monitor's alarms are 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. Refer to section *2.4 D, a S ,,,* for details.

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. Refer to section *2.4 D, a S ,,,* for details.

   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 seerity categories: high level, medium level and low level.

	Physiological alarms	Technical alarms
High level	Indicatess that the patient is in a life threatening situation, such as Asystole, Vfib/Vtac and so forth, and emergency treatment is required.	Indicates a severe device malfunction or an improper operation which could make it possible that the monitor cannot detect

Additionally, the alarm message has a different background color which corresponds to 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. Refer to *2.4 D, a S ,,,* for details.

7.3.3 Flashing Numeric

If an alarm triggered by an alarm limit violation occurs, the numeric portion 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 the 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 scroll 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 message 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 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 [**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 is the maximum volume.
3. Select [**High Alarm Volume**] to set the volume of the high priority alarm as [**Alm Volume+0**], [**Alm Volume+1**] or [**Alm Volume+2**].
4. Select [**Reminder Vol**oin0 Tw 9.ume, d4oin TJ/C0emum vd te (p)15 (ro)8.4 (e m.006 Tc 0.004 Tw 3.013 0.3 m [2<0046>-1.3 C<0048

7.4.3 Setting the Interval between Alarm Sounds

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

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

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

Mode 1:

Interval between high level alarm tones:	continuously
Interval between medium level alarm tones:	5 s
Interval between low level alarm tones:	20 s

Mode 2:

Interval between high level alarm tones:	1 s
Interval between medium level alarm tones:	5 s
Interval between low level alarm tones:	20 s

WARNING

When the alarm sound is switched off, the monitor does not provide any audible alarm tones even if a new alarm occurs. Therefore the user should be very careful about switching off the alarm sound.

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 choose [**ISO**], [**Mode 1**], or [**Mode 2**].

NOTE

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

7.4.5 Setting the Reminder Tones

When the reminder tone is switched on and a physiological or technical alarm condition exists, the monitor gives a periodic reminder tone in the following cases:

When the alarm volume is set to zero, a high, medium, low, or technical audible alarm indication will be generated

7.5.1 Setting Alarm Properties for All Parameters

In the [**Main Menu**], select [**Alarm Setup >>**] enter the required password [**Parameters**]. You can review and set alarm limits, alarm switches, and alarm level for all parameters.

WARNING

Make sure that the alarm limits settings are appropriate for your patient before monitoring.

Setting alarm limits to extreme values may cause the alarm system to become ineffective. For example, high oxygen levels may predispose a premature infant to retrolental fibroplasia. If this is a consideration, do NOT set the high alarm limit to 100%, which is equivalent to switching the alarm off.

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 >>**] enter the required password [**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**] menu. If not, you can adjust them manually. These alarm limits will remain unchanged until you select auto limits again or adjust them manually.

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

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

Module	Parameter	Low alarm limit		High alarm limit		Auto alarm limits range
		Adult/ pediatric	Neonate	Adult/ pediatric	Neonate	
	NIBP-D	(Dia × 0.68 + 6) mmHg	(Dia – 15) or 20 mmHg (whichever is greater)	(Dia × 0.86 + 32) mmHg	(Dia + 15) or 80 mmHg (whichever is smaller)	Adult: 25 to 210 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 230 Pediatric: 30 to 165 Neonate: 25 to 105
Temp	T1	(T1 – 0.5) °C	(T1 – 0.5) °C	(T1 + 0.5) °C	(T1 + 0.5) °C	1 to 49 °C
	T2	(T2 – 0.5) °C	(T2 – 0.5) °C	(T2 + 0.5) °C	(T2 + 0.5) °C	1 to 49 °C
	TD	Same as the default alarm limit	Same as the default alarm limit	Same as the default alarm limit	Same as the default alarm limit	Same as the measurement range

IBP: ART/

Ao/

UAP/

BAP/

FAP/

Module	Parameter	Low alarm limit		High alarm limit		Auto alarm limits range
		Adult/ pediatric	Neonate	Adult/ pediatric	Neonate	
		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	>48mmHg: remains the same	>48mmHg: remains the same	>48mmHg: remains the same	
	FiCO2	N/A	N/A	Same as the default alarm limit	Same as the default alarm limit	Same as the measurement range
	awRR	awRR × 0.5 or 6 rpm (whichever is greater)	(awRR – 10) or 30 rpm (whichever is greater)	awRR × 1.5 or 30 rpm (whichever is smaller)	(awRR+25) or 85 rpm (whichever is smaller)	Adult/pediatric: 6 to 55 Neonate: 10 to 90

7.5.3 Setting Alarm Delay Time

You can set the alarm delay time for 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

HR over alarm limits

Measurements of noncontinuous parameters over alarm limits

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

To set the [**Apnea Delay**], select [**Main Menu**] [**Alarm Setup >>**] [**Others**].

To set the [**ST Alarm Delay**]:

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

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 deparment to [**OR**]:

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

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

To enter CPB mode:

1. 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

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

For physiological alarms, no alarm indication is shown. New physiological alarms will not be presented.

The remaining alarm pause time is displayed in the physiological alarm area.

For technical alarms, alarm sounds are paused, but alarm lamps and alarm messages remain presented.

The alarms pause symbol is displayed in the sound symbol area. If a new technical alarm is triggered in the alarm paused period, the alarm message will be displayed.

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

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

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

7.7 Switching Off All Alarms

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

As for physiological alarms: no alarm lamps flash and no alarms are sounded.

As for physiological alarms: no numerics or alarm limits flash.

No physiological alarm messages are shown.

[**Alarm Off**] is displayed in the physiological alarm area with red background.

As for technical alarms: no alarms are sounded.

The alarm off symbol is displayed in the alarm symbol area.

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

WARNING

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

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 *T. , . a* Alarm Messages.

7.9 Latching Alarms

The latching setting for physiological alarms defines how alarm indicators behave if you do not reset the alarms.

If you do not “latch” the physiological alarms, their alarm indications disappear when the alarm condition ends.

If you “latch” physiological alarms, all visual and audible alarm indications remain until you reset the alarms. For latched alarms the time when the alarm is last triggered is displayed beside the alarm message.

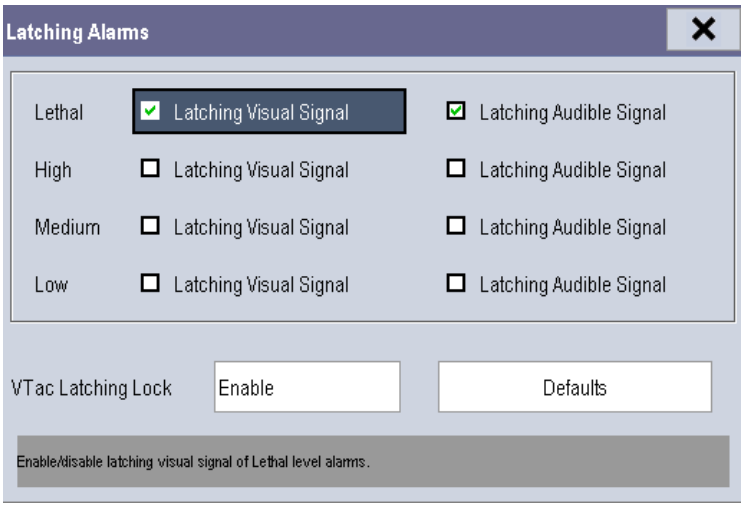
You can separately latch the visual indications or simultaneously latch the visual and the audible indications.

When the visual indications are latched, the visual indications, including alarm lamp, alarm message and its background remains when the alarm condition ends.

When the audible indications are latched, the monitor issues alarm sounds when the alarm condition ends.

To latch a physiological alarm:

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



The rules for latching the alarms are:

You can separately select [**Latching Visual Signal**].

Selecting [**Latching Audible Signal**] simultaneously latches the visual signal.

Selecting alarms of lower priority simultaneously latches the alarms of higher priority.

The lethal alarms are latched by default. High, medium, and low priority alarms are unlatched by default.

NOTE

Changing of alarm priority may affect the latching status of corresponding alarms. Please determine if you need to adjust the latching status for the specific alarm when you have changed its alarm priority.

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

You can separately configure the latching of the Vtac alarm. To do so, follow this procedure:

1. Select [**Main Menu**] [**Maintenance >>**] [**User Maintenance >>**] enter the required p assword.
2. Select [**Alarm Setup** >>] [**Latching Alarms>>**].
3. Set [**Vtac Latching Lock**] to [**Disable**].
4. Select [**Alarm Setup** >>] quick key to enter [**Alarm Setup**] menu.
5. Select [**Others**] tab.
6. Set [**Vtac Latching**] as desired.

NOTE

If the visual signal of lethal alarms is not latched, [Vtac Latching Lock**] is not configurable and is automatically set to [Enable].**

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 behaviour is observed.

7.11 Using Care Group Alarms (Only Available with the External Display)

NOTE

The keys mentioned in this section refer to the keys on the external display.

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 symbols. 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 issue 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. To enable this function:

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

When your monitor is viewed by other monitors and [**Alarm Reset By Other Bed**] is switched on, alarms on your monitor can be reset by other monitors.

WARNING

Resetting care group alarms may cause a potential hazard.

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. ECG monitoring provides the following algorithms:

Advanced ECG algorithm

The Advanced ECG algorithm provides 3-, 5- and 12-lead ECG monitoring, ST-segment analysis, and extended arrhythmia analysis.

Glasgow algorithm

Glasgow algorithm provides an interpretation of the resting 12-lead ECG.

You can select algorithms at the time of purchase or as upgrades post sale:

The equipment incorporating the Advanced ECG algorithm is labeled with an ST/ARR label.

The equipment incorporating the Glasgow algorithm is labeled with the Glasgow logo.

8.2 Safety

WARNING

This equipment is not intended for direct cardiac application.

Use only ECG electrodes and cables specified by Mindray.

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 metal devices connected to the patient during defibrillation.

To reduce the hazard of burns during high-frequency surgical procedure, ensure that the monitor's cables and transducers never come into contact with the electrosurgery unit (ESU).

The neutral electrode of the HF surgical unit shall properly contact the patient. Otherwise, burns may result.

CAUTION

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

NOTE

After defibrillation, the screen display recovers within 10 seconds if the correct electrodes are used and applied in accordance with the 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 follow this procedure:

   Shave hair from skin at chosen sites.

   Gently rub skin surface at sites to remove dead skin cells.

   Thoroughly cleanse the site with a mild soap and water solution. We do not recommend using ether or pure alcohol, because this dries the skin and increases the resistance.

   Dry the skin completely before applying the electrodes.

2. Attach the clips or snaps to the electrodes before placing them.
3. Place the electrodes on the patient.
4. Attach the electrode cable to the patient cable and then plug the patient cable into the ECG connector.

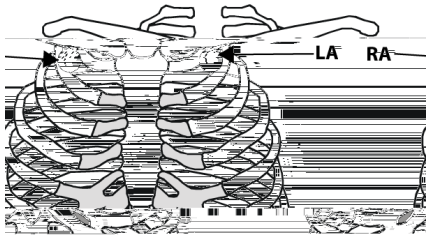
8.3.2 Choosing AHA or IEC Lead Placement

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**], [**12-lead**] or [**Auto**] according to the applied electrodes.
3. Select [**Main Menu**] [**Maintenance >>**] [**User Maintenance >>**] enter the required password .
4. Select [**Others >>**] [**ECG Standard**] and then select [**AHA**] or [**IEC**] according to the 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.

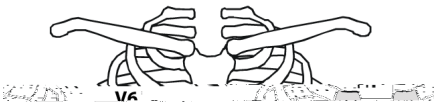
LA placement: directly below the clavicle and near the left shoulder.

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.

12-Leadwire Electrode Placement

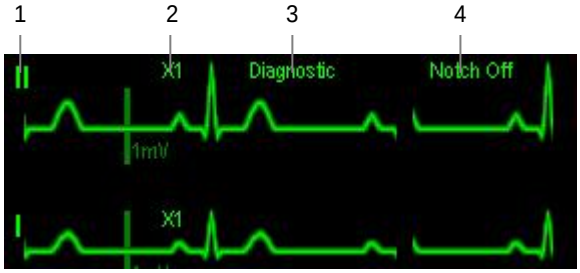
12-lead ECG uses 10 electrodes, which are placed on the patient's four limbs and chest. The limb electrodes should be placed on the soft skin and the chest electrodes placed according to the physician's preference.

Lead Placement for Surgical Patients

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

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

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

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

For 12-lead ECG display screen, refer to section .

8.5 Changing ECG Settings

8.5.1 Accessing ECG Menus

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

8.5.2 Choosing the Alarm Source

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

[**HR**]: if you want the HR to be the alarm source for HR/PR.

[**PR**]: if you want the PR to be the alarm source for HR/PR.

[**Auto**]: If the [**Alm Source**] is set to [**Auto**], the 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.

8.5.5 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.

8.5.6 Choosing an ECG Display Screen

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

[**Normal**]: The ECG waveform area shows 2 ECG waveforms.

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

[**12-Lead**]: The whole waveform ares displays 12 ECG waveforms (for 12-lead set only).

When monitoring with a 3-lead set, the screen type can only be set to [**Normal**].

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

To cascade ECG waveforms:

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

8.5.7 Setting the Notch Filter

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

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 [**50 Hz**] or [**60 Hz**] according to the power line frequency.

8.5.8 Changing the Pacer Reject Settings

To change 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 inactivated.

8.5.9 Enabling Smart Lead Off

When the smart lead off function is enabled and there is a "lead off" in the lead of the first ECG wave, if another lead is available, the monitor will automatically select the available 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

NOTE

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

8.5.13 About the Defibrillator Synchronization

A synchronization pulse (100 ms, +5 V) is output through the multifunctional connector each time the monitor detects an R-wave.

To use the defibrillator synchronization function, connect the monitor and the defibrillator with a synchronization cable.

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.

8.6 About ST Monitoring

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 deviation can be set to mV or mm. You can set the unit in the [**Unit Setup**] menu from the [**User Maintenance**] menu.

Measurement range of the ST segment deviation: -2.0 mV to +2.0 mV (-20.0 mm to +20.0 mm).

NOTE

The monitor gives the message "Cannot Analyze ST" when the monitor cannot generate a valid ST value. In this case, check the ECG signal quality and ST measurement points. If the message persists, check the patient condition as per section , and decide whether to continue ST monitoring.

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 Monitoring On and Off

To switch ST monitoring on or off:

1. In the [**ECG Setup**] menu, select [**ST Analysis >>**].
2. Next to the **ST Analysis** setting, select [**On**] or [**Off**].

Reliable ST monitoring cannot 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 Understanding the ST Display

8.6.2.1 ST Numerics

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

To change the ST numerics display:

1. Enter the [**ST Analysis**] menu. Set **ST Analysis** to [**On**].
2. Set [**Display Leads**] to:

   [**All**]: ST numercis of all ECG leads are displayed.

   [**Selected**]: ST numercis of ECG1 and ECG2 leads set in the [**ECG Setup**] menu are displayed.

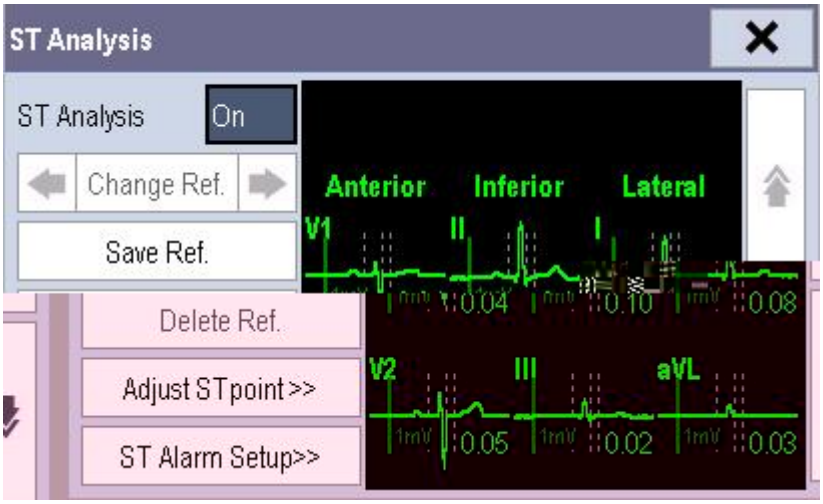
8.6.2.2 ST Segment

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

To display the ST segment on normal screen:

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

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



8.6.3 Saving the Current ST Segment as Reference

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

NOTE

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

8.6.4 Changing the Reference Segment

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

8.6.5 Deleting a Reference Segment

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

8.6.6 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.

8.6.7 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**].

To manually adjust the ST measurement points, follow this procedure:

1. Use the left and right arrows beside [**ISO**] and [**J**] to adjust the position of ISO point and J 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.

2. Set [**ST Point**]. The ST-point is positioned a fixed distance from the J-point. Move the J-point to position the ST-point at the midpoint of the ST segment. Position the ST-point relative to the J-point at either [**J+60/80 ms**], [**J+40 ms**], [**J+60 ms**] or [**J+80 ms**]. When [**J+60/80 ms**] is selected, the ST-point will be positioned 80 ms (heart rate 120 bpm or less) or 60 ms (heart rate more than 120 bpm) from the J-point.

NOTE

Only Advanced ECG algorithm has the function of automatic J point detection.

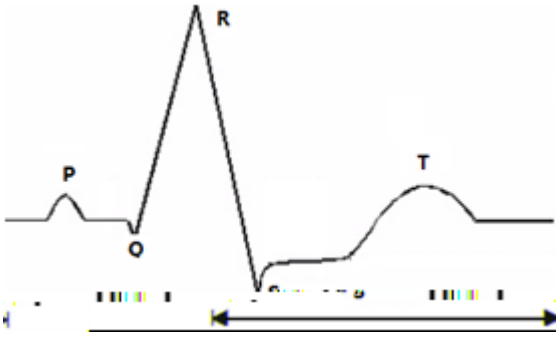
The ISO point, J point, and ST point displayed in the [Adjust ST Point] window are positioned with reference to the R-wave peak.

8.7 QT/QTc Interval Monitoring (For Advanced ECG Algorithm Only)

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

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

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



QT interval

CAUTION

For QT interval monitoring to be effective, basic or enhanced arrhythmia monitoring should be turned on.

8.7.4 Accessing the QT View

QT View shows the current and reference QT parameter values and waveforms.

To access the QT View:

1. Select the QT pa

8.7.5.2 Selecting the QT Analysis Lead

To select the QT analysis lead:

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

When [**Analysis Lead**] is set to [**All**]:

For 12-lead ECG, leads I, II, III, V2 and V5 are displayed.

For 5-lead ECG, leads I, II, III, and V are displayed.

8.7.6 Changing QTc Formula

The monitor uses as a default the Hodges correction formula to correct the QT interval for heart rate. To change the QTc formula:

1. Select the QT parameter area or waveform area to enter the [**QT Analysis**] menu.
2. Set [**QTc Formula**].

Hodges: $= +1.75\times(\quad -60)$

Bazett: $= \times\left(\frac{\quad}{60}\right)^{\frac{1}{2}}$

Fridericia: $= \times\left(\frac{\quad}{60}\right)^{\frac{1}{3}}$

Framingham: $= +154\times\left(1-\frac{60}{\quad}\right)$

8.8 About Arrhythmia Monitoring

Arrhythmia analysis provides information about the patient's cardiac parameters like heart rate, PVC rate, and rhythm.

WARNING

Arrhythmia analysis program is intended to detect ventricular arrhythmias and atrial fibrillation. It is not designed to detect all the atrial or supraventricular arrhythmias. It may incorrectly identify the presence or absence of an arrhythmia. Therefore, a physician must analyze the arrhythmia information with other clinical findings.

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 arrhythmias. Always keep these patients under close surveillance.

Atrial fibrillation (Afib) detection function is not intended for pediatric and neonatal patients.

8.8.1 Understanding the Arrhythmia Events

Advanced ECG algorithm

Arrhythmia message	Description	Category
Asystole	No QRS detected within the set time threshold in absence of ventricular fibrillation or chaotic signal.	Lethal arrhythmia
Vfib/Vtac	A fibrillatory wave for 6 consecutive seconds. A dominant rhythm of adjacent Vs and a HR > the V-Tac HR limit.	
Vtac	The consecutive PVCs ≥ Vtac PVCs limit, and the HR ≥ the Vtac rate limit.	
Vent. Brady	The consecutive PVCs ≥ the Vbrd threshold and the ventricular HR < the Vbrd Rate threshold.	
Extreme Tachy	The heart rate is equal to or greater than the extreme tachycardia limit.	
Extreme Brady	The heart rate is equal to or less than the extreme bradycardia limit.	
PVCs	PVCs/min exceeds high limit	Nonlethal arrhythmia
Pacer Not Pacing	No pace pulse detected for 1.75 x average R-to-R intervals following a QRS complex (for paced patients only).	
Pacer Not Capture	No QRS complex detected for 300 milliseconds following a pace pulse (for paced patients only).	
PVC	One PVC detected in normal heartbeats.	
Couplet	Paired PVCs detected in normal heartbeats.	
Run PVCs	More than 2 consecutive PVCs.	
Bigeminy	A dominant rhythm of N, V, N, V, N, V.	
Trigeminy	A dominant rhythm of N, N, V,N, N, V, N, N, V.	
R on T	R on T detected in normal heartbeats.	
Missed Beats	No beat detected for 1.75 x average R-R interval for HR <120, or No beat for 1 second with HR > 120 (for non-paced patients only), or No beat detected for more than the set pause threshold.	
Brady	The average heart rate is equal to or less than the bradycardia limit.	
Tachy	The average heart rate is equal to or greater than the tachycardia limit.	
Vent. Rhythm	The consecutive PVCs ≥ the Vbrd PVCs limit, and the HR ≥ Vbrd Rate limit but < the Vtac Rate limit.	
Multif. PVC	Multiform PVCs detected in Multif. PVC's Window (which is adjustable).	
Nonsus. Vtac	The consecutive PVCs < the Vtac PVCs limit but > 2, and HR ≥ the Vtac Rate limit.	
Pause	No QRS detected within the set time threshold of pause.	
Irr. Rhythm	Consistently irregular rhythm.	
Afib	Absence of P-waves and/or variable RR intervals between normal beats.	

8.8.2 Changing Arrhythmia Alarm Settings

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

WARNING

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

NOTE

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

8.8.3 Changing Arrhythmia Threshold Settings

Select the ECG parameter window or waveform area [**Arrh. Analysis >>**] [**Arrh. Threshold**], and you can then change threshold settings for some arrhythmia alarms. When an arrhyen

8.8.4 Setting the Extended Arrhythmia (For Advanced ECG Algorithm Only)

The following arrhythmia events are defined as extended arrhythmia:

Extreme Tachy

Extreme Brady

Vent. Brady

Nonsus. Vtac

Multif. PVC

Irr. Rhythm

Pause

Afib

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

8.8.5 Reviewing Arrhythmia Events

Please refer to chapter .

8.9 ECG Relearning

8.9.1 Initiating an ECG Relearning Manually

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

Incorrect arrhythmia alarms

Loss of ST measurement, and/or

Inaccurate heart rate

ECG relearning allows the monitor to learn the new ECG template so as to correct arrhythmia alarms and HR value, and restore ST measurements. To initiate relearning manually, select the ECG parameter window or waveform area [**Relearn**]. When the 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.

8.9.2 Automatic ECG Relearning

ECG relearning is initiated automatically whenever:

The ECG lead or lead label is changed.

The ECG lead is re-connected.

A new patient is admitted.

After ECG calibration is completed and [**Stop Calibrating ECG**] is selected.

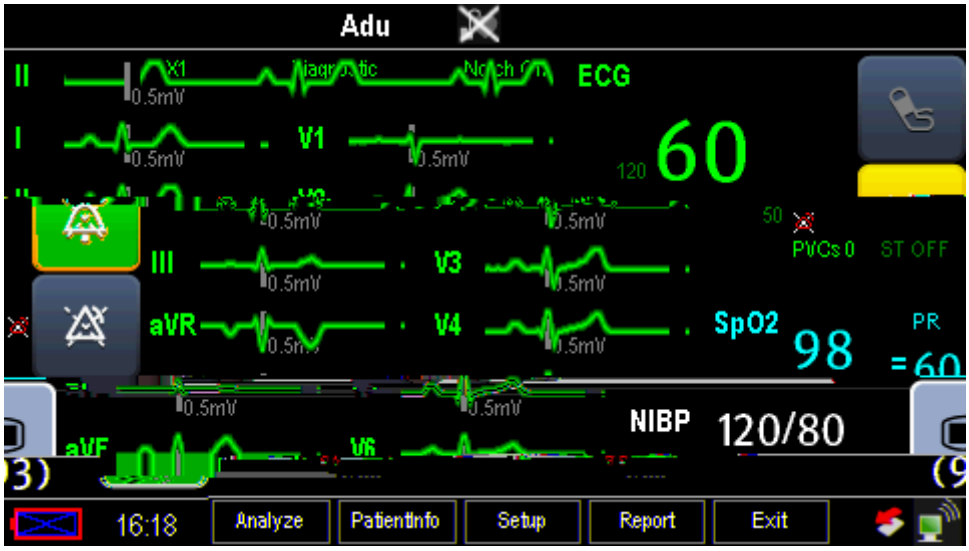
Switch between normal screen and 12-lead full screen for 12-lead ECG monitoring.

The paced status of the patient is changed.

8.10 12-Lead ECG Monitoring

To access the 12-lead ECG monitoring screen:

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



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

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

8.10.1 Setting ECG Waveform Sequence

You can select the sequence of ECG waveforms on the 12-lead ECG scr

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

[**Analyze**]: starts resting 12-lead analysis.

[**Patient Info**]: enters the patient information.

[**Setup**]: enters the 12-lead setup menu.

[**Report**]: prints the latest resting 12-lead report.

[**Exit**]: exits the 12-lead sceen.

8.11.2 Entering Patient Information

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

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

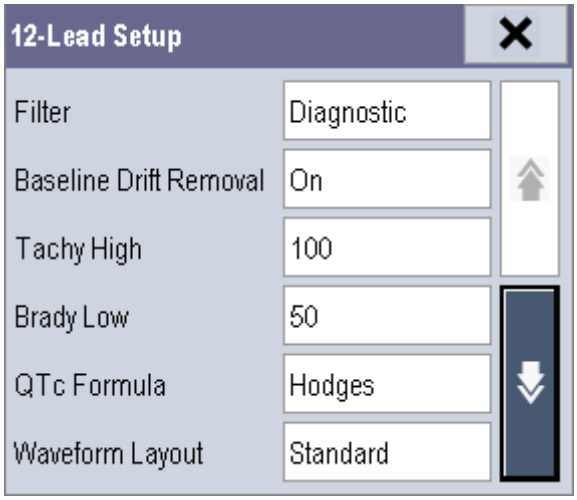
NOTE

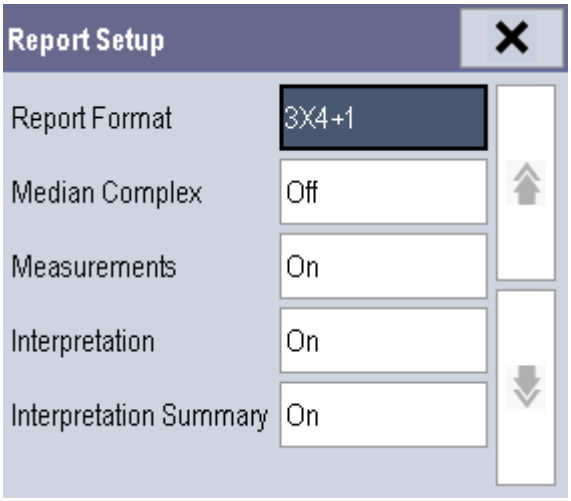
Check that patient information is correct before resting 12-lead analysis.

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

8.11.3 12-Lead Setup

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





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

Report Format	12 1, 6 2, 3 4+1	3 4+1	Selects the format of the 12-lead ECG report. [**12×1**]: ECG waveforms are displayed in 12 lines. [**6×2**]: ECG waveforms are displayed in 6 lines and 2 columns. [**3×4+1**]: ECG waveforms are displayed in 3 lines and 4 columns followed by the rhythm lead waveform.
Median Complex	On, Off	Off	Selects whether Median Complex is included on the 12-lead ECG report. Median Complex displays a median complex waveform for each lead and a rhythm lead waveform of 10 seconds in 3x4+1 format. For each waveform, short vertical lines are used to mark the start of the P-wave and QRS complex, and the end of the P-wave, QRS complex, and T-wave.
Measurements	On, Off	On	Selects whether the measurement result is included on the 12-lead ECG report. Measurement result includes Vent. Rate, PR Interval, QRS Duration, QT/QTc Interval, and P/QRS/T Axes.
Interpretation	On, Off	On	Selects whether diagnoses are included on the 12-lead ECG report.
Interpretation Summary	On, Off	On	Selects whether interpretation summary is included on the 12-lead ECG report. Note: If the [**Interpretation**] option is not enabled, interpretation summary is not included on the report even if [**Interpretation Summary**] is enabled.

8.11.4 Setting the 12-lead Order

To set whether to send the order of 12-lead interpretation report to the hospital information system while saving the report, follow this procedure:

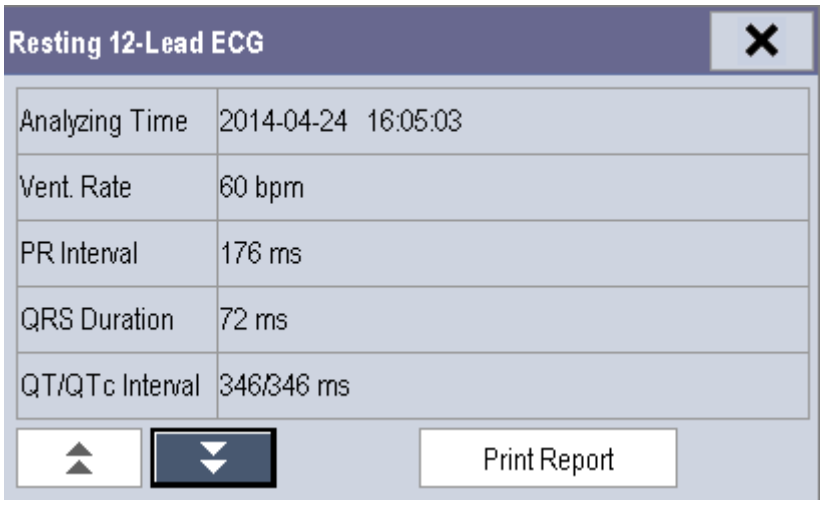
1. elect [**Main Menu**] → [**User Maintenance**] → [**Others >>**].
2. et [**12-Lead Order**].

8.11.5 Resting 12-lead ECG Analysis

Before 12-lead ECG interpretation, check that all electrodes are correctly connected to the lead wires and the ECG trunk cable is properly connected. Check that patient information is correct.

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

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



CAUTION

During the resting 12-

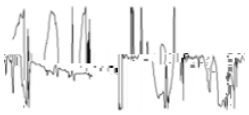
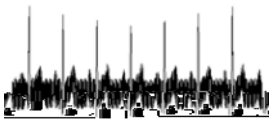
1. Patient information
2. Time of resting 12-lead ECG analysis
3. Measurements
4. Diagnosis statement
5. Waveform amplitude
6. Paper speed
7. Frequency range
8. System software version/algorithm version

8.12 Troubleshooting

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

CAUTION

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

Symptoms	Possible Cause	Correction Action
Noisy ECG traces 	Loose or dry electrodes	Apply fresh and moist electrodes.
	Defective electrode wires	Replace wires if necessary.
	Patient cable or leads are routed too close to other electrical devices	Move the patient cable or leads away from the electrical device.
Excessive Electro-surgical Interference	Wrong ECG cable used	Use ESU-proof ECG cables. For details, refer to section .
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 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 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 and apply fresh, moist electrodes.

Symptoms	Possible Cause	Correction Action
	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 .
	Electrodes dry / old	Apply fresh and moist electrodes.
	Skin improperly prepared	Repeat skin preparation as described in section .
	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 .

Lead wires and >>BD1 0.4.2 0.48 .16 2.1 (he2 (r)-2.3 (e)-1.7 (s a)9.6-(s)1310.48 1 (he2tmu)10.)-1.7 (ta)1rtS 22

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.

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

.

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

NOTE

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

9.4.3 Abdominal Breathing

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 .

9.8 Changing Resp Wave Settings

WARNING

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

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

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

Select [**Sweep**] and then select an appropriate setting. The faster the wave sweeps, the wider the wave is.

9.9 Setting Respiration Rate (RR) Source

To set RR source:

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

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

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

Option	Description
Auto	RR source is automatically selected according to the priority.
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.

FOR YOUR NOTES

10 Monitoring PR

10.1 Introduction

The pulse numeric counts the arterial pulsations that result from the mechanical activity of the heart. You can display a pulse from any measured SpO_2 or any arterial pressure (see chapter). The displayed pulse numeric is color- t 3

10.3 Selecting the Active Alarm Source

In most cases the HR and pulse numerics are identical. In order to avoid simultaneous alarms on HR and PR, the monitor uses either HR or PR as its active alarm source. To change the alarm source, select [**Alm Source**] in the [**ECG Setup**] or [**SpO_2 Setup**] menu and then select either:

[**HR**]: The monitor will use the HR as the alarm source for HR/pulse.

[**PR**]: The monitor will use the PR as the alarm source for HR/pulse.

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

10.4 QRS Tone

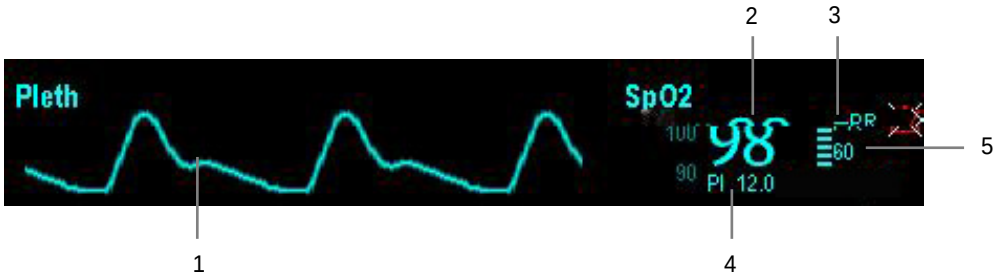
When PR is used as the alarm source, the PR source will be used as a source for the QRS tone. You can change the QRS volume by adjusting [**Beat Vol**] in the [**SpO2 Setup**] menu. When a valid SpO_2 value exists, the system will adjust the pitch tone of QRS volume according to the SpO_2 value.

11 Monitoring SpO_2

11.1 Introduction

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

This device is calibrated to display functional oxygen saturation.



1. Pleth waveform (Pleth): visual indication of patient's pulse. The waveform is not normalized.
2. Oxygen saturation of arterial blood (SpO_2): percentage of oxygenated hemoglobin in relation to the sum of oxyhemoglobin and deoxyhemoglobin.
3. Perfusion indicator: the pulsatile portion of the measured signal caused by arterial pulsation.
4. Perfusion index (PI): gives the numerical value for the pulsatile portion of the measured signal caused by arterial pulsation. PI is an indicator of the pulsatile strength. You can also use it to assess the quality of SpO_2 measurement.

   Above 1 is optimal.

   Between 0.3 and 1 is acceptable.

   Below 0.3 indicates low perfusion. When PI is below 03, a question mark (?) is displayed to the right of the SpO_2 value, indicating that SpO_2 value may be inaccurate. Reposition the SpO_2 sensor or find a better site. If low perfusion persists, choose another method to measure oxygen saturation if possible.

PI is available for Masimo SpO_2 module.

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 connector and the company logo located at the right upper corner. 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 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 monitor.
5. Connect the sensor cable to the adapter cable.

WARNING

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

11.5 Changing SpO_2 Settings

11.5.1 Accessing SpO2 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 SpO2 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**

11.5.5 Monitoring SpO2 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.

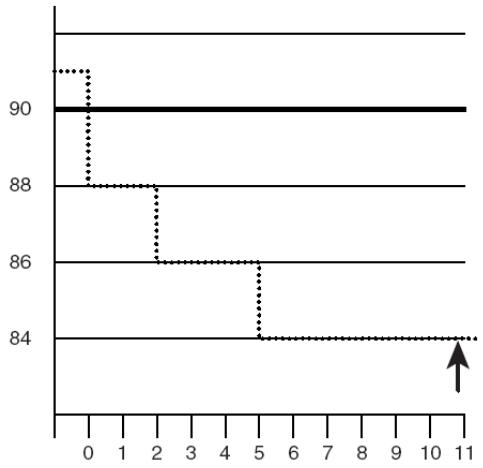
With Sat-Seconds alarm management, high and low alarm limits are set in the same way as traditional alarm management. A Sat-Seconds limit is also set. The Sat-Seconds limit controls the amount of time that SpO_2 saturation may be outside the set limits before an alarm sounds. The method of calculation 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 "SpO_2 Too Low" or "SpO_2 Too High" alarm is presented in the case that SpO_2 value violates the alarm limits for 3 times within one minute even if the setting of Sat-Seconds is not reached.

11.5.7 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 (Only Available with the External Display)

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 on the external display.

11.5.9 Setting the Alarm Level for SpO2 Sensor Off Alarm

Select [**Alarm Setup >>**] from the [**User Maintenance**] menu. You c,0867.96 Tm8(2)Tj989 152.888267.96 T8213 0 Td8-3 <0046-9 ( )1(el)2

WARNING

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

11.6 Measurement Limitations

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

Ambient light

Physical movement (patient and imposed motion)

Diagnostic testing

Low perfusion

Electromagnetic interference, such as MRI environment

Electrosurgical units

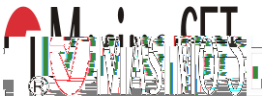
Dysfunctional haemoglobin, such as carboxyhemoglobin (COHb)and methemoglobin (MetHb)

Presence of certain dyes, such as methylene and indigo carmine

Inappropriate positioning of the SpO_2 sensor, or use of incorrect SpO_2 sensor

Drop of arterial blood flow to immeaurable level caused by shock, anemia, low temperature or vasoconstrictor.

11.7 Masimo Information



Masimo Patents

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11.8 Nellcor Information

Nellcor Patents

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11.9 Troubleshooting

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

CAUTION

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

Symptoms	Possible Cause	Correction Action
Dashes "- -" display in place of numerics.	Measurement is invalid.	Check that the sensor is properly applied. Change the application site if necessary.
Do not see SpO_2 parameter tiles in display.	Parameter not configured to display.	Switch the SpO_2 monitoring function on as described in section S , - 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 connections, switch cable
	Ambient light	Check if the [**SpO2 Too Much Light**] alarm is reported. If so, move the sensor to a place with lower level of ambient light or cover the sensor to minimize the ambient light.
No SpO2 waveform	Waveform not selected to display	Switch the SpO_2 monitoring function on as described in section S , - 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 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.

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

12.4 Measurement Methods

There are three methods of measuring NIBP:

Manual: measurement on demand.

Auto: continually repeated measurements at set intervals.

STAT: continual 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, arm and feet supported

Middle of the cuff at the level of the right atrium of the heart

NOTE

It is recommended that the patient relaxes as much as possible before performing measurement and that the patient does not talk during measurement.

To avoid unnecessary motion artifact, it is recommended to have the patient sit quietly for several minutes before taking the measurement.

The operator shall not touch the cuff or tubing during NIBP measurement.

Other factors that have been shown to result in an overestimation of blood pressure are labored breathing, full bladder, pain etc.

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 [**Main Menu**] [**Patient Setup**] [**Patient Demographics**] [**Patient Cat.**] and set the patient category to [**Adu**], [**Ped**] or [**Neo**].
3. Plug the air tubing into the NIBP connector on the monitor.
4. Select a correct sized cuff and then wrap it directly over the patient's skin 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. The cuff should fit snugly, but with enough room for two fingers to be placed between the cuff and the patient's arm (on adults), and loosely on neonates with little or no air present within the cuff. Otherwise, it may cause discoloration, and ischemia of the extremities. Make sure that the cuff edge falls within the marked range. If it does not, use a cuff that fits better.

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

12.5.4 Correcting the Measurement if Limb is not at Heart Level

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

Add 0.75 mmHg (0.10 kPa) for each centimetre higher, or

Deduct 0.75 mmHg (0.10 kPa) for each centimeter lower.

12.5.5 Enabling NIBP Auto Cycling and Setting the Interval

To enable the NIBP auto cycling and set and 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 Enabling Measurement on Clock

In auto measurement mode, if the clock is enabled, the monitor automatically synchronizes NIBP automatic measurements with the real time clock. For example, if [**Interval**] is set to [**20 min**], and you start NIBP auto measurement at 14: 03, the next measurement will be taken at 14: 20, and then at 14:40, 15:00, and so on.

To enable measurement on clock:

1. Select the NIBP parameter window to enter the [

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

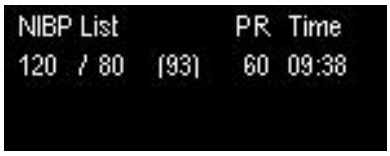
For known hypertensive patients, you need to set initial cuff pressure to a higher value to reduce the measurement time.

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 pop-up menu.

12.7.3 Displaying NIBP List

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



You can display NIBP list only in normal screen.

12.7.4 Setting the Pressure Unit

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

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

FOR YOUR NOTES

13 Monitoring Temp

13.1 Introduction

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

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 Taking a Temp Measurement

To take a Temp measurement:

1. Select an appropriate probe for your patient according to the patient type and measuring site.
2. If you are using a disposable probe, connect the probe to the temperature cable.
3 Plug the probe or temperature cable to the temperature connector.
4. Correctly attach the probe to the patient.
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 monitor can monitor two invasive blood pressures and displays the systolic, diastolic and mean pressures and a waveform for each pressure.

14.2 Safety

WARNING

Use only pressure transducers specified in this manual. Never reuse disposable pressure transducers.

Make sure that the applied parts never contact other conductive parts.

To reduce the hazard of burns during high-frequency surgical procedure, ensure that the monitor's cables and transducers never come into contact with the high-frequency surgical units.

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

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.

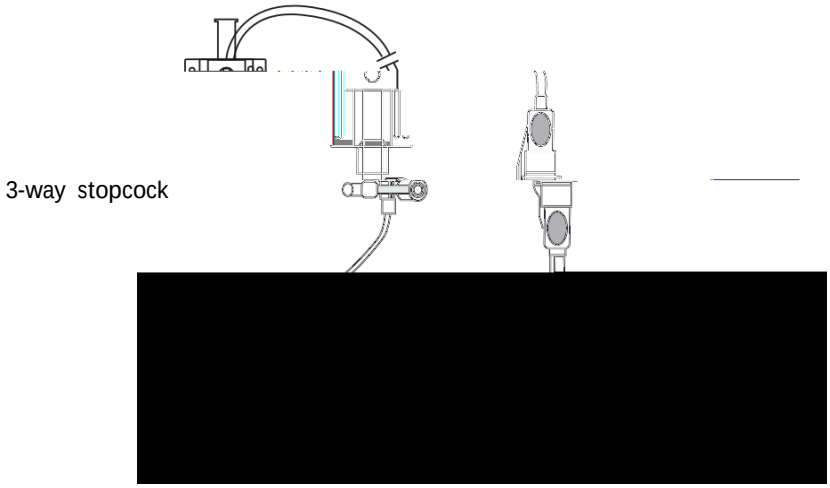
You reconnect the transducer cable to the monitor.

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.
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

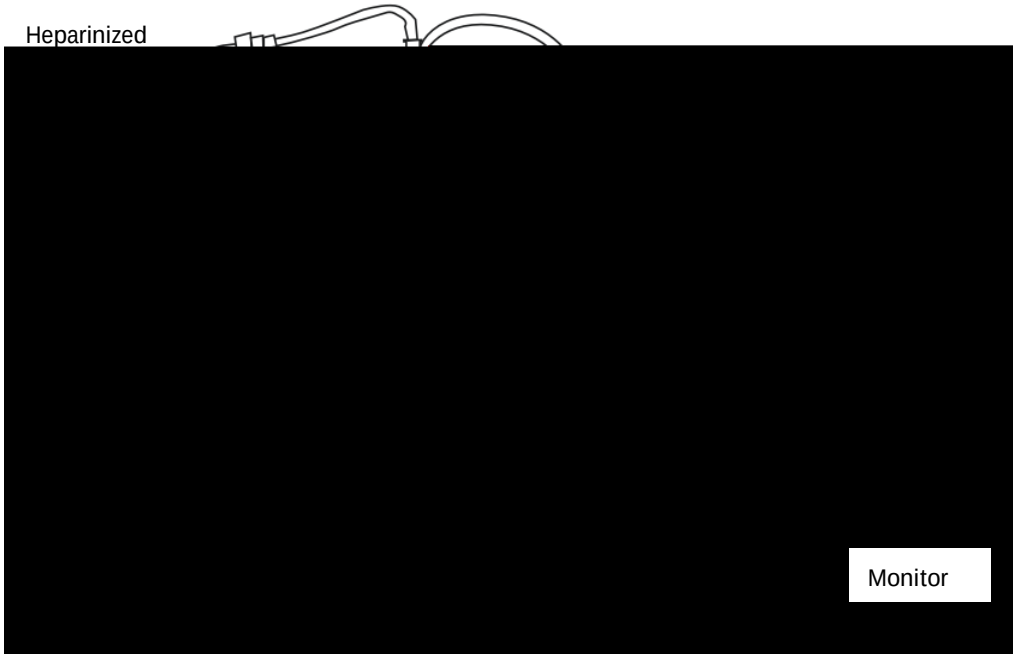
To set up the pressure measurement:

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 bubbles may lead to incorrect pressure readings.

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

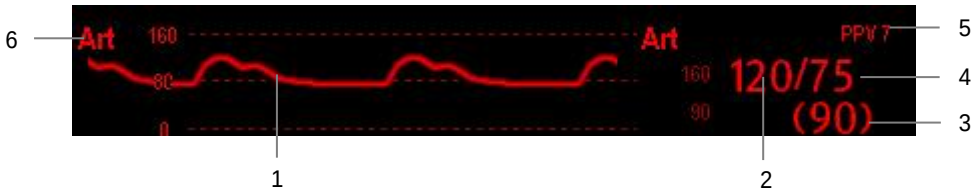


WARNING

If measuring intracranial pressure (ICP) with a sitting patient, level the transducer with the top of the patient's ear. Incorrect leveling may give incorrect values.

14.5 Understanding the IBP Display

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



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

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 automatically 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

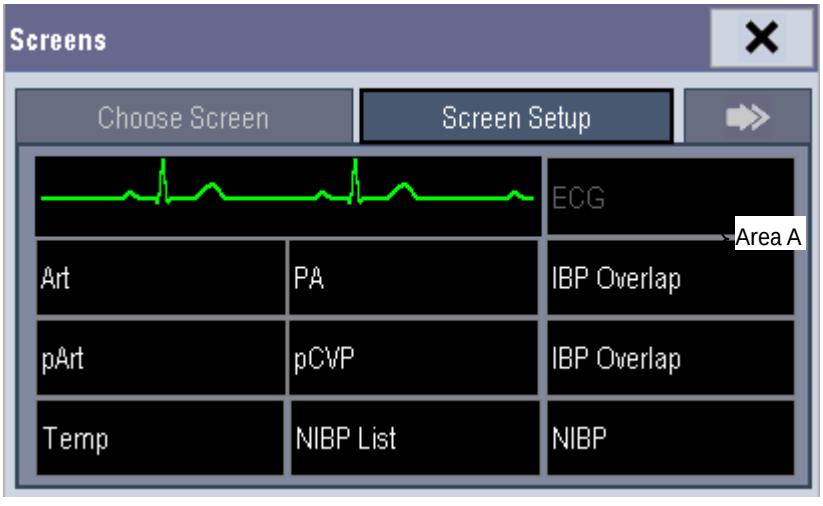
for patients with acute right ventricular dysfunction ("cor pulmonale").

The PPV measurement has been validated only for adult patients.

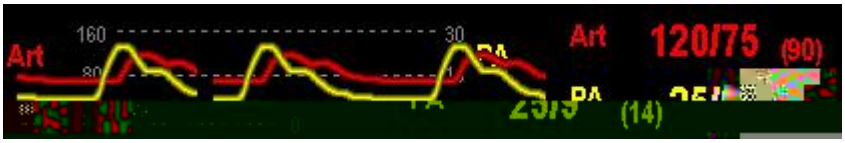
14.7 Overlapping IBP Waveforms

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.

Note

The CVP scale changes simultaneously with the right scale. The unit of CVP scale is consistent with CVP parameter unit.

14.8 Measuring PAWP (Only Available with the External Display)

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

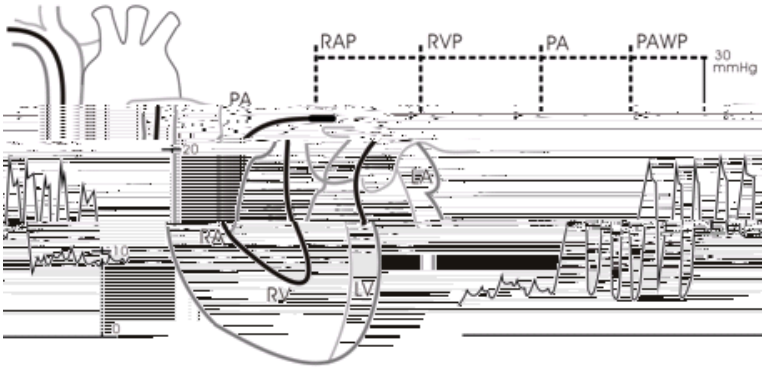
Obtain the measurement by introducing a balloon-tipped pulmonary artery flotation catheter into the pulmonary artery. When the catheter is in one of the smaller pulmonary arteries, the inflated balloon occludes the artery allowing the monitor to record changes in the intrathoracic pressures that occur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

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

14.8.2 Setting Up the PAWP Measurement

To set up 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 .
	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 .
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 section

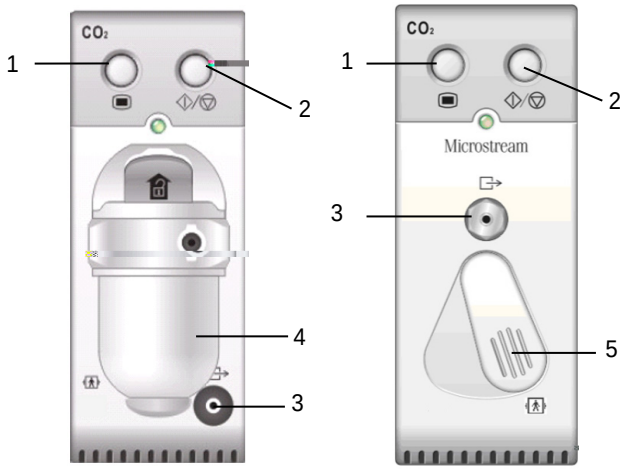
15 Monitoring CO_2

15.1 Introduction

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

15.2 Identifying CO_2 Modules

This monitor uses an external module with the T1 handle to perform CO_2 monitoring. From left to right are sidestream CO_2 module and microstream CO_2 module.



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

15.3 Preparing to Measure CO_2

WARNING

Check that the alarm limit settings are appropriate before taking measurement.

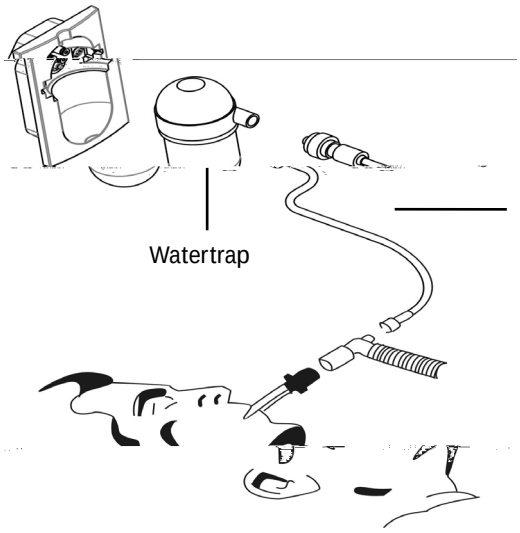
Eliminate the exhausted gas before performing the measurement.

NOTE

Perform the measurement in a well-ventilated environment.

15.3.1 Making a Sidestream CO_2 Measurement

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



CAUTION

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

The watertrap collects water drops condensed in the sampling line and therefore prevents them from entering the module. To avoid blocking the airway, empty the watertrap container whenever half full. Dispose of accumulated fluids in accordance with hospital policy or your local regulations.

The watertrap has a filter preventing bacterium, water and secretions from entering the module. After a long-term use, dust or other substances may compromise the performance of the filter or even block the airway. In this case, replace the watertrap. It is recommended to replace the watertrap once a month, or when the watertrap is found leaky, damaged or contaminated.

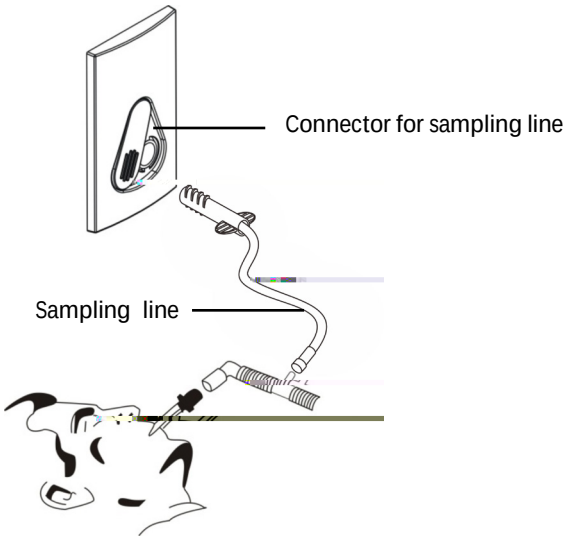
Performing CO_2 measurements during warm-up may compromise the measurement accuracy.

NOTE

To extend the life of the watertrap and module, disconnect the watertrap and set the CO_2 operating mode to standby when CO_2 monitoring is not required. Refer to section .

15.3.2 Making a Microstream CO_2 Measurement

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



15.4 Changing CO_2 Settings

15.4.1 Accessing CO_2 Menus

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

15.4.2 Setting the CO_2 Unit

To set the CO_2 unit, select [**Main Menu**] → [**Maintenance >>**] → [**User Maintenance >>**] → enter the required password → [**Unit Setup >>**] from the [**User Maintenance**] menu. In the [**Unit Setup**] menu, select [**CO_2 Unit**] and then select [**mmHg**], [**%**] or [**kPa**].

15.4.3 Setting Up Gas Compensations

WARNING

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

For the sidestream CO_2 module:

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

   [**O2 Compen**]

   [**N2O Compen**]

   [**Des Compen**]

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

15.4.4 Setting Up Humidity Compensation

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

1. ATPD: $P_{CO_2}(H) = CO_2(\%) \times P_a /100$
2. BTPS: $P_{CO_2}(H) = CO_2(\%) \times (P_a - 47)/100$

Where, P_{CO_2} = partial pressure, $\%$ = CO_2 concentration, P_a = 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.

15.4.5 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.

15.4.6 Choosing a Time Interval for Peak-Picking

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

To set the time interval:

1. Select the CO_2 parameter window to access the [**CO2 Setup**] menu.
2. select [**Max Hold**] and then select [**Single Breath**], [**10 s**], [**20 s**] or [**30 s**] (for microstream CO_2 module only).

   [**Single Breath**]: $EtCO_2$ and $FiCO_2$ are calculated for every breath.

   [**10 s**], [**20 s**], or [**30 s**]: $EtCO_2$ and $FiCO_2$ are calculated using 10, 20 or 30 seconds of data.

15.4.7 Setting the Flow Rate

For the sidestream CO_2 module, you can change the sampling rate of respiratory gas in the patient's airway by setting the flow rate.

To set the flow rate:

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

WARNING

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

15.4.8 Setting Up the CO2 Waveform

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**].

15.4.9 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 and CO_2 modules. For details, refer to section *9.9 S, , - R, a , ,* Rate (RR) Source.

15.4.10 Barometric Pressure Compensation

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

15.4.11 Entering the Standby Mode

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

1. Select the CO_2 parameter window to access the [**CO2 Setup**] menu.
2. Select [**Operating Mode**] and then select [**Standby**] or [**Measure**].

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

If the monitor enters the Standby mode, the CO_2 module will also enter the Standby mode.

If the monitor exits the Standby mode, the CO_2 module will also exit the Standby mode.

If the CO_2 module enters or exits the Standby mode, it will not affect the monitor.

When you set the 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 the 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 since the CO_2 module is powered on or the CO_2 module switches to the measuring mode or the automatic Standby time is re-set. To set the standby time, in the [**CO_2 Setup**] menu, select [**Auto Standby**] and then select the appropriate setting.

15.5 Measurement Limitations

Some adverse effects can influence CO_2 performance.

CAUTION

The following factors may influence the accuracy of measurement:

Leaks or internal venting of sampled gas

Mechanical shock

Cyclic pressure up to 10 kPa (100 cmH_2O)

Other sources of interference, if any

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

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

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

Measurement accuracy is unspecified for breath rate larger than 60 bpm.

15.6 Leakage test

When the sidestream CO_2 modules need 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.

15.7 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 it should be replaced with a new one. Otherwise, the sampling line is blocked and should be replaced with a new one.

15.8 Removing Exhaust Gases from the System

WARNING

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

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

15.9 Zeroing the Sensor

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.

WARNING

15.11 Oridion Information

Microstream

Oridion Patents

This posting serves as notice under 35 U.S.C. 287(a). For a listing of Covidien/Medtronic patents applicable to this device and its accessories, please refer to http://www.covidien.com/patents.

No Implied License

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

16 Review

16.1 Accessing Respective Review Windows

To access the review windows:

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

16.2 Reviewing Graphic Trends

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

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

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

In this review window:

Select [**Trend Group**] and you can select a trend group for viewing in the pop-up menu. If [**Custom 1**] or [**Custom 2**] is selected, you can 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 review window.

Select [**Waves**] to set the number of waves displayed in one page.

To browse the graphic trends, select or to move the cursor one page to the left or right to navigate through the graphic trends.

A time indicating your current position 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 [**Print**] button to set and print the graphic trends report with the printer. For how to set the graphic trends report, refer to chapter *18 P , , -*.

16.3 Reviewing Tabular Trends

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

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

In this review window:

Select [**Trend Group**] and you can select a trend group for viewing in the pop-up menu. If [**Custom 1**] or [**Custom 2**] is selected, you can further select [**Define Trend Group**]. Then you can select the parameters for viewing in the pop-up menu.

Select [**Interval**] to change the resolution of the trend data and then select the appropriate setting:

[**5 s**] or [**30 s**]: select to view up to 4 hours of tabular trends at 5- or 30-seconds resolution.

[**1 min**], [**5 min**], [**10 min**], [**15 min**], [**30 min**], [**1 h**], [**2 h**] or [**3 h**]: select to view up to 120 hours of tabular trends at your selected resolution.

[**NIBP**]: select to view the tabular trends when NIBP measurements were acquired.

To browse the tabular trends, you can select or to scroll left or right to navigate through the trend database. The measurement value that triggered 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 [**Print**] button to set and print the tabular trends report to the printer. For how to set the tabular trends report, refer to chapter*18 P , , -*.

16.4 Reviewing Events

16.4.1 Marking Events

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

Select [**Main Menu**] [**Mark Event >>**]. In the pop-up menu, you can select the waves to store after triggering a manual event. You can select [**Trigger Manual Event**] from the [**Mark Event**] menu or the [**Manual Event**] from the [**Main Menu**] to trigger a manual event and store it at the same time.

When you are reviewing graphic trends, tabular trends or full-disclosure waveforms, the manual event symbol is displayed at the time the event is triggered.

16.4.2 Reviewing Events

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

In the [**Review**] menu, select [**Events**] to access the following window. You can review the parameter alarm events, arrhythmia alarm events and manual events. When an event occurs, the system stores all the measurement numerics at the event triggering time and related waveforms 4 seconds, 8 seconds or 16 seconds before and after the event triggering time, as per the setting of recording length.

In the [**Events**] window:

Select [**Event**] to view the desired events.

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

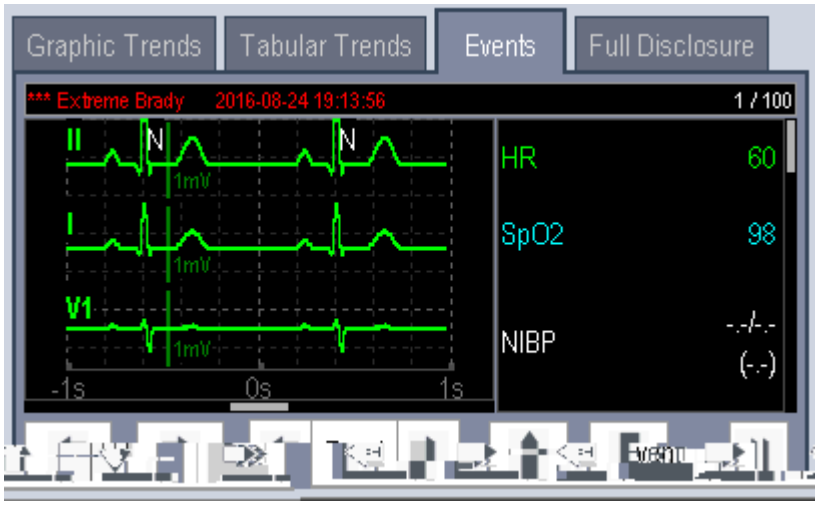
After selecting the desired event, you can select [**Details**] to access the following window. In this window, the waveform area displays the waveforms related to the event, and the parameter area displays the parameter values happened at the event trigger time.

NOTE

Pausing or switching off alarms will not be recorded as events. The time of these operations will not be recorded in the system log.

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

Earlier-recorded events might be overwritten by later ones if it reaches capacity.



You can select the button or the button to navigate through the waveforms.

You can select the button or the button beside the [**Event**] button to switch between events.

You can select the button to go to the next page and select the desired button.

You can set the desired [**Gain**] for ECG waveform.

You can set the desired [**Sweep**].

Select the [**Events List**] button to view the events list.

Select the [**Print**] button to print the displayed alarm events to the preconnected laser printer.

By selecting the [**Beat Annotation**] button, you can display or hide beat labels above the first ECG waveform on the screen. The white beat labels indiate how the monitor is classifying beats and may help explain suspected, missed, or false arrhythmia calls.

N = Normal

V = Ventricular Ectopic

S = Supraventricular Premature

P = Paced

L = Learning

? = Insufficient information to classify beats

I = Inoperative (for example, Lead Off)

M = No beat detected

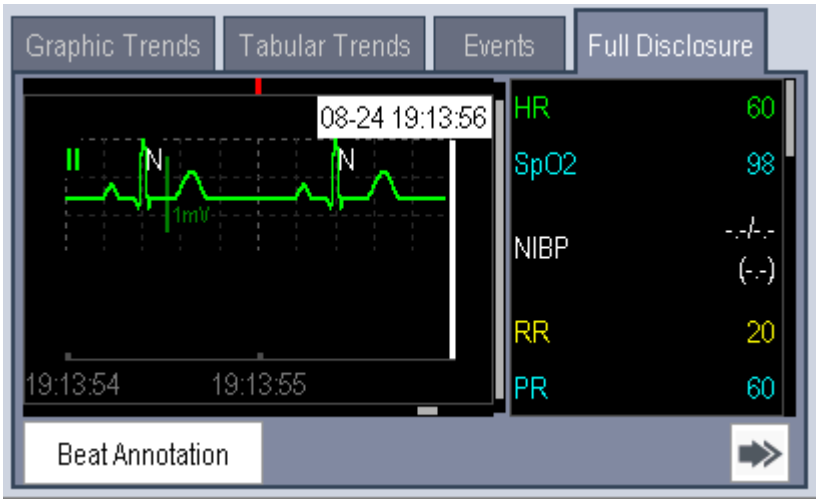
When beat labels are displayed above the ECG waveform, they can be printed via the recorder or a laser printer. If you select [**Beat Annotation**] in the [**Events**] tab to display or hide beat labels, these beat labels will also be displayed or hidden in the [**Full Disclosure**] tab, and vise versa.

CAUTION

Ensure that you have selected the optimal leads with the best waveform amplitude and the highest signal-to-noise ratio. Selecting the optimal leads is important for beat detection, beat classification, and V-Fib detection.

16.5 Reviewing Waveforms

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



In the **Full Disclosure** window:

You can select the button to go to the next page and select the desired button.

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.

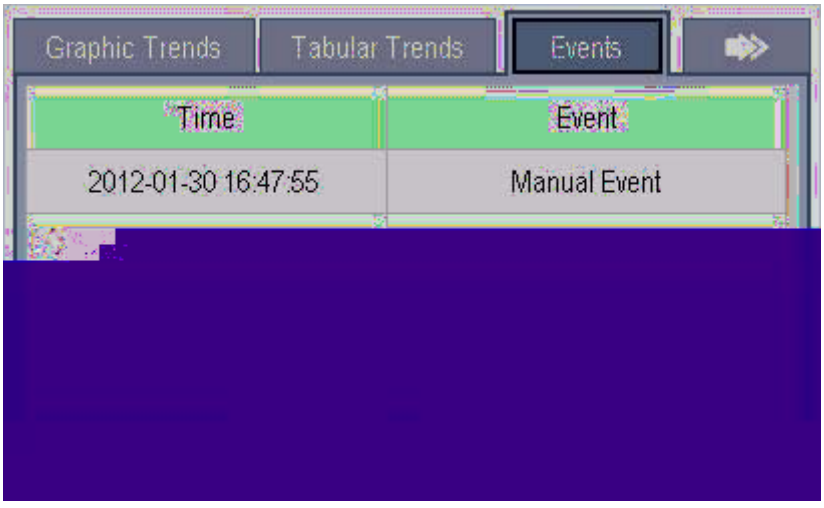
Select the [**Beat Annotation**] button to display or hide beat labels above the first ECG waveform. For more information on the beat annotation function, refer to the section .

16.6 Reviewing OxyCRG (Only Available with the External Display)

NOTE

The keys mentioned in this section refer to the keys on the external display.

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



In this window:

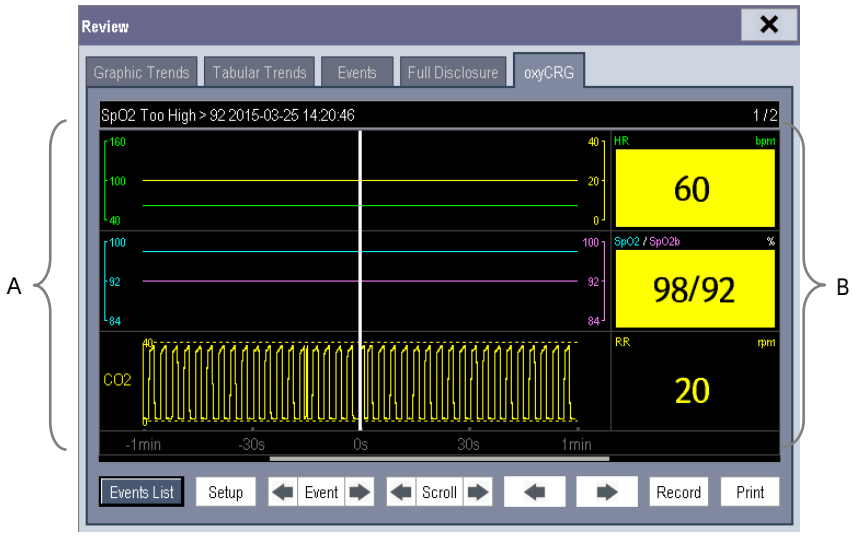
Select [**Details**] to view the trends, waveform and measurement numerics of selected parameters.

Select or beside the [**Scroll**] button to switch between events.

Select or to switch between pages.

Select the button at the lower right corner of this window to change the parameter events to be displayed.

After selecting the [**Details**] button, you can access the following window. In this window, the waveform area displays the trends and waveform of the OxyCRG, and the parameter area displays the parameter values at the event trigger time.



A. Waveform area B. Parameter area

In this window:

Select [**Events List**] to switch to the OxyCRG events list.

Select [**Setup**] to change the displayed parameters.

Select or beside the [**Event**] button to adjust the position of the cursor between events.

Select or beside the [**Scroll**] button to move the cursor one step left or right to navigate through the trends and waveform.

Select or to navigate through the parameter trends and waveform.

Select the [**Record**] button to print out the currently displayed trends, waveform, and measurement numerics by the recorder.

Select the [**Print**] button to print to the independent printer.

17 Calculations (

17.2 Dose Calculations

17.2.1 Performing Calculations

To perform a dose calculation:

1. Select [**Main Menu**] [**Calculations >>**] [**Dose >>**], or select [**Calculations**

17.2.3 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.

17.2.4 Drug Calculation Formulas

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.

Review the previously performed calculations by selecting [**Review**].

17.3.2 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

17.3.3 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	$FiO_2 / 100 \times (ATMP - 47) - PaCO_2 \times [FiO_2 / 100 \cdot (1 - FiO_2 / 100) / RQ]$
$AaDO_2$	mmHg	alveolar-arterial oxygen difference	$PAO_2 - PaO_2$
CcO_2	ml/L	capillary oxygen content	$Hb \times 1.34 \cdot 0.031 \times PAO_2$
Qs/Qt	%	venous admixture	$100 \times [1.34 \times Hb \times (1 - SaO_2/100) \cdot 0.031 \times (PAO_2 - PaO_2)] / [1.34 \times Hb \times (1 - SvO_2/100) \cdot 0.031 \times (PAO_2 - PvO_2)]$
C.O. calc	L/min	calculated cardiac output	$VO_2 / (CaO_2 - CvO_2)$

17.4 Ventilation Calculations

17.4.1 Performing Calculations

To perform a ventilation calculation:

1. Select [**Main Menu**] [**Calculations >>**] [**Ventilation >>**], or select [**Calculations**] QuickKey [**Ventilation >>**].
2. Enter values for calculation. If the patient monitor is connected to an anesthesia machine or a ventilator, the system automatically loads the supported parameter values to the [**Ventilation Calculation**] window.
3. Select the [**Calculate**] button. The system performs a calculation per the current settings and displays the calculated values.

   If a calculated value is outside the range, its background will highlight in yellow. You can select [**Range**] to view its normal range in the unit field.

   Invalid values are displayed as [**---**].

In the [**Ventilation Calculation**] window, you can:

Change the pressure unit by selecting [**Press. Unit**] and then selecting the appropriate setting. Corresponding pressure values shall convert and update automatically.

Review the previously performed calculations by selecting [**Review**].

17.4.2 Entered Parameters

Abbreviation	Unit	Full spelling
FiO_2	%	percentage fraction of inspired oxygen
RR	rpm	respiration rate
$PeCO_2$	a	

ulated Parameters and Formulas

	Unit	Full spelling	Formula
	mmHg	partial pressure of oxygen in the alveoli	(ATMP É 47) × FiO_2 /100 É $PaCO_2$ × [FiO_2 /100 · (1 É FiO_2 /100) / RQ]
	mmHg	alveolar-arterial oxygen difference	PAO_2 É PaO_2
Pa/FiO_2	mmHg	oxygenation ratio	100 × PaO_2 / FiO_2

17.5.2 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

17.5.3 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 É 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 É 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

17.6 Renal Calculations

17.6.1 Performing Calculations

To perform a renal calculation:

1. Select [**Main Menu**] [**Calculations >>**] [**Renal >>**], or select [**Calculations**] QuickKey [**Renal >>**].
2. Enter values for calculation.
3. Select the [**Calculate**] button. The system performs a calculation per the current settings and displays the calculated values.

   If a calculated value is outside the range, its background will highlight in yellow. You can select [**Range**] to view its normal range in the unit field.

   Invalid values are displayed as [**---**].

In the [**Renal Calculation**] window, you can review the previously performed calculations by selecting [**Review**].

17.6.2 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

17.6.3 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
CIcr	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 ÉUosm / 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.

17.7 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

18 Printing

18.1 Printer

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

HP LaserJet 1505n

HP LaserJet P2035n

HP LaserJet P4015n

HP LaserJet Pro 400 M401n

HP LaserJet 600 M602

HP LaserJet Enterprise M605

HP LaserJet Enterprise M608n

The reports specifications are:

Paper: A4, Letter

Resolution: 300 dpi

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

18.2 Connecting a printer

To print the reports or the trend data of a patient, you can connect the T1 to a printer via the T1 docking station through the network.

18.3 Setting the Printer

To set the printer's properties, select [**Main Menu**] [**Print Setup >>**] [**Printer Setup >>**]. In the [**Printer Setup**] menu, you can:

- Select a connected printer

  Select [**Printer**] and then select a connected printer as the monitor's printer.

- Search for a printer

  If your selected printer is not in the list or a new printer is added into the network, you can set the [**Printer Search TTL**], and then select the [**Search Printer**] to search for all printers in the network.

- Set up the paper size

  Select [**Paper Size**] and then select [**A4**] or [**Letter**].

18.4 Starting Report Printouts

Reports	Contents	Procedures
ECG reports	ECG waveforms and relevant parameter values	Select [**Main Menu** **Print Setup >>** **ECG Reports >>** **Print**]
QT report	QT parameter values and waveforms	Select [**ECG Setup**] [**QT Analysis >>**] [**QT View >>**] [**Print**] Note: [**QT Analysis**] must be set to [**On**].
Tabular trends	Depends on the selected parameter group, resolution and time period	Select [**Main Menu**] [**Print Setup >>**] [**Tabular Trends Reports >>**] [**Print**], or select [**Main Menu**] [**Review >>**] [**Tabular Trends**] [**Print**] [**Print**]
Graphic trends	Depends on the selected parameter group, resolution and time period	Select [**Main Menu**] [**Print Setup >>**] [**Graphic Trends Reports >>**] [**Print**], or select [**Main Menu**] [**Review >>**] [**Graphic Trends**] [**Print**] [**Print**]
Arrh. events	ECG waveforms and relevant parameter values	Select [**Main Menu**] [**Review >>**] [**Events**] [**Arrh. Events**] [**Details**] [**Print**].
Parameter alarm review	Depends on the selected alarms	Select [**Main Menu**] [**Alarm Setup >>**] [**Parameters**] [**Print**]
Realtime waves	Depends on the selected waveforms	Select [**Main Menu**] [**Print Setup >>**] [**Realtime Reports >>**] [**Print**]

18.5 Stopping Report Printouts

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

18.6 Setting Up Reports

18.6.1 Setting Up ECG Reports

You can print ECG reports only from the 7-lead or12-lead full screen. To set up ECG reports, select [**Main Menu**] [**Print Setup >>**] [**ECG Reports >>**].

[**Amplitude**]: set the amplitude of the ECG waveforms.

[**Sweep**]: set the wave print speed to 25 mm/s or 50 mm/s.

[**Auto Interval**]: if [**Auto Interval**] is set to [**On**], the system will automatically adjust the space between waveforms to avoid overlapping.

[**Gridlines**]: choose whether to show gridlines.

18.6.2 Setting Up Tabular Trends Reports

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

[**Start time**]: set a time period whose trend data will be printed out by setting [**From**] and [**Back**]. For example, if you set [**From**] as 2014-4-2 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 [**ReportFormat**] is set to [**Time Oriented**], the report will be printed by time. If [**ReportFormat**] 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.

[**ReportFormat**]: 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.

18.6.3 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
for details.

18.6.4 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.

18.7 End Case Reports

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

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

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

18.8 Printer Statuses

18.8.1 Printer Out of Paper

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

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

18.8.2 Printer Unavailable

If the monitor prompts that selected printer is not available, check that the printer is switched on, correctly connected, and installed with paper.

19 Other Functions

19.1 Analog Output

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

19.2 Exporting the Log

The monitor stores system status information, including failures, abnormity, and technical alarms, into the log. You can export the log to a USB drive.

To export the log:

1. Connect a USB drive to the monitor's USB connector. See section *2.2.1.4 B , V* for the proper location of the USB connector.
2. Select [**Main Menu**] [**Maintenance >>**] [**User Maintenance >>**] enter the required password [**Others >>**].
3. Select [**Export Log**].

19.3 Using the Storage Card

A storage card is used to prevent data loss in case of a sudden power failure. The patient data such as trend data, waveform data, etc., will be automatically saved into the storage card during patient monitoring. In case of a sudden power failure, the patient data can be retrieved from the storage card after the patient monitor restarts.

To browse the data saved in the storage card, follow this procedure:

1. Select [**Main Menu**] [**Patient Data >>**] [**Historical Data >>**].
2. Select a patient whose data you want to view from the [**Patient Data List**] and then select [**Review**].
3. Select [**Data Review**].

Reviewing the patient data history is just like reviewing the current patient's data, you can refer to the *R* for details

NOTE

The oldest data stored in the storage card is automatically deleted when the remaining space is insufficient.

19.4 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.

19.4.1 Data Export System

You must install the data export system (PN: G-6800-30-51205) on the intended PC before performing the data transfer operation. Refer to the document accompanying the data export system installation CD-ROM for installation instructions.

The data export system supports patient management, data review, data format conversion, print, etc. in addition to data transfer. Refer to the help file of the data export system software for more details.

19.4.2 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 the T1 to the T1 docking station.
2. Connect one end of the crossover network cable to the T1 docking station and the other end to the PC.
3. Set the IP address of the PC. This IP address must be in the same network segment with that of the monitor.
4. Make sure that the data export system is active on the PC.

Then, follow this procedure to transfer data:

1. Select [**Main Menu**] [**Patient Data >>**] [**Transfer Data**].
2. Select [**Yes**] from the pop-up message box.
3. Input the IP address already set on the PC.
4. Select [**Start**] to start transferring data.

Transfer data within a LAN

Before transferring data within a LAN, do as follows:

1. Connect the patient monitor and the intended PC into the same LAN and acquire the PC's IP address.
2. Make sure that the data export system is active on the PC.

Follow the same procedure as via a crossover network cable to transfer data.

19.5 Network Setup

CAUTION

Disconnecting from the network may result in loss of transmitted 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.

19.5.1 Setting the Network Type

The monitor supports both wired and wireless network.

To set the network type:

1. Select [**Main Menu**] [**Maintenance>>**] [**User Maintenance>>**] enter the required password select [**Ok**]
2. Select [**Network Setup** >>].
3. Select [**Monitor Network Setup** >>].
4. Set [**Network Type**] to [**LAN**] or [**WLAN**].

19.5.2 Wireless Network Connection

19.5.2.1 Requirements for Wireless Network

To set up the wireless network, the following requirements should be met:

The Cisco AIR-AP2802I-A-K9, AIR-CAP2602I-A-K9, or AIR-AP1242AG-A-K9, is the recommended wireless Access Point (AP). Performance cannot be guaranteed if any other wireless APs are used.

Support the 802.11a/b/g/n wireless protocol.

The channel bandwidth should be 20 MHz.

WPA2-PSK security method is recommended for authentication and encryption.

Support WPA-PSK, WPA2-PSK , WPA-Enterprise, and WPA2-Enterprise.

The throughput capacity of each T1 monitor is 2.98 Mbps for the BeneVision CMS. The total throughput of the wireless devices connected to a wireless AP should be less than the effective transmitting capability of the wireless AP. Refer to the AP manufacturer for the AP effective transmitting capability.

Where the monitor is located, the wireless AP signal strength should be no less than -65 dBm.

Where the monitor is located, the signal strength of other Wi-Fi devices of the same channel should be no greater than -85 dBm.

Where the monitor is located, the signal strength of other Wi-Fi devices

CAUTIONS

Always configure the wireless network according to local wireless regulations.

Authentication and encryption other than WPA2-PSK or WPA/WPA2 Enterprise may expose sensitive data and allow a malicious attack on the system.

Keep network authentication information, for example passwords, safe to protect the network from being accessed by unauthorized users.

Disconnecting from the network may result in data loss, including waveforms, numerics, alarm events, trends and patient data, or function failure. Check the patient in case of network disconnection and solve the network problem as soon as possible.

Do not connect non-medical devices to the wireless network.

19.5.2.2 Setting the Wireless Network

To set the wireless network:

1. Select [**Main Menu**] [**Maintenance>>**] [**User Maintenance>>**] enter the required password select [**Ok**]
2. Select **[Network Setup** >>].
3. Select [**Monitor Network Setup** >>].
4. Set [**Network Type**] to [**WLAN**].
5. Set the desired [**Address Type**].

   [**Manual**]: Indicates that the operator will manually enter network settings including IP Address, Subnet Mask, Gateway.

   [**DHCP**]: Indicates that the monitor will automatically acquire network settings from a DHCP server.
6. Select [**WLAN Setup >>**] to enter the [**WLAN Setup**] menu.
7. Enter a network name (**SSID**).
8. Select a security mode from the [**Security**] drop-down list and configure the items.

   [**WEP_OFF**], [**WPA-PSK**], [**WPA2-PSK**]: When you select one of these security modes, you need to enter a password for the wireless network.

   [**WEP_ON**] : When you select this security mode, you need to configure [**Password**], [**Key Index**], and[**AUT. Type**].

   [**WPA_TKIP**], [**WPA2_AES**], [**CCKM_TKIP**], [**CCKM_AES**], [**WPA_PSK_AES**], [**WPA_AES**]: These security modes are Wi-Fi Protected Access (WPA/WPA2) enterprise encryption modes. When you select one of these security modes, you need to configure additional items such as [**EAP Method**], [**AUT. Protocol**], [**Identity**], [**Anonymity**], and [**CA Certificate**]. You need to import the desired certificate to the monitor before you can select a certificate. For how to manage certificates, see .
9. Select [**Ok**].

NOTE

The [Security] option is available only for the monitor that supports both 2.4GHz and 5GHz bands.

19.5.2.3 Setting the WLAN Band and Channels

The monitor supports 2.4 G and 5 G WLAN. To set WLAN band rate and channels:

1. Select [**Main Menu**] [**Maintenance>>**] [**User Maintenance>>**] enter the required password select [**Ok**]
2. Select **[Network Setup** >>].
3. Select [**WLAN Setup** >>].
4. Set [**WLAN Band**] to [**Auto**], [**5G**], or [**2.4G**] according to the band you are using. Auto is the default, indicating that the monitor can automatically identify the WLAN band.
5. Select [**AUT. Server Type**] to set the type of authentication server. The options are ACS and SBR.
6. Select [**BG Channel**] to set the type of B and G channels. The options are All, Specified, and None. When you select [**Specified**], you need to enter the desired channel.
7. Select [**A Channel**] to set the type of A channel. The options are All, Specified, and None. When you select [**Specified**], you need to enter the desired channel.

19.5.2.4 Wireless Network Related Problems

Symptoms	Correction Action
Unable to connect the network.	1. Verify that the network is available. 2. Check if the network type is correctly set. For example, if LAN is used, set the network type to LAN and connect the T1 to the network; if WLAN is used, set the network type to WLAN and connect the T1 to the wireless network. 3. Check that the SSID and password of the monitor are consistent with those of the wireless AP. 4. Check for IP address conflicts. If any are found, change the IP addresses to remove the conflict. 5. Check if the Mindray recommended wireless AP is used. If not, verify the AP effective transmission rate meets the throughput requirements of the connected devices. 6. Verify the AP channel bandwidth is 20 MHz. 7. Verify that where the monitor is located, the wireless AP signal strength is no less than -65 dBm. 8. Verify that where the monitor is located, the signal strength of other Wi-Fi devices on the same channel is no greater than -85 dBm. 9. Verify that where the monitor is located, the signal strength of other Wi-Fi devices on adjacent channels is no greater than -50 dBm. 10. Verify that the recommended distance between the monitor and other non-Wi-Fi wireless devices, including wireless devices at the frequency of 2.4GHz, cellular mobile communication networks, microwave ovens, intercoms, cordless phones and electro-surgical units, is no less than 20 cm.

Symptoms	Correction Action
The monitor is frequently off line or disconnects from the network. The transmission delay is too long.	1. Check if the Mindray recommended wireless AP is used. If not, verify the AP effective transmission rate meets the throughput requirements of the connected devices. 2. Verify the AP channel bandwidth is 20 MHz. 3. Verify that where the monitor is located, the wireless AP signal strength is no less than -65 dBm. 4. Verify that where the monitor is located, the signal strength of other Wi-Fi devices on the same channel is no greater than -85 dBm. 5. Verify that where the monitor is located, the signal strength of other Wi-Fi devices on adjacent channels is no greater than -50 dBm. 6. Verify that the recommended distance between the monitor and other non-Wi-Fi wireless devices, including wireless devices at the frequency of 2.4GHz, cellular mobile communication networks, microwave ovens, intercoms, cordless phones and electro-surgical units, is no less than 20 cm. 7. Verify that no unauthorized devices are connected to the wireless AP.

19.5.3 Viewing the MAC Address

You can get the MAC address from the monitor for network management.

To view the MAC address:

1. Select [**Main Menu**] [**Maintenance>>**] [**User Maintenance>>**] enter the required password select [**Ok**].
2. Select [**Network Setup** >>].
3. Select [**Monitor Network Setup** >>].
4. Scroll down to the next page.

19.5.4 Enabling the Data Encryption

If you enable the data encryption, the patient's MRN (Medical Record Number), visit number, first name and last name are encrypted when transferring data to the CMS or eGateway.

To enable the data encryption:

1. Select [**Main Menu**] [**Maintenance>>**] [**User Maintenance>>**] enter the required password select [**Ok**].
2. Select [**Network Setup** >>].
3. Scroll down to the next page.
4. Set [**Network Encrypt Switch**] to [**On**].

19.5.5 Setting DNS

You can set DNS for connecting the server using domain name. Only ADT and MLDAP services support the domain name method.

To set DNS:

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

2 Select [**Network Setup** >>] [**Monitor Network Setup** >>].

5. Scroll down to the next page.

3 Select [**DNS Setup** >>].

4 Set the desired [**Address Type**].

[**Manual**]: the address of the DNS server must be manually entered.

[**DHCP**]: the monitor will automatically acquire the address of the DNS server. This is only avaliable when [**Address Type**] is set to [**DHCP**] in the [**Monitor Network Setup** >>] menu.

5. If [**Manual**] was selected in Step 4, set [**Preferred DNS Server**] and [**Alternate DNS Server**].

19.5.6 Certificates Maintenance

WPA)/WPA2 Enterprise can deliver a higher level of security compared with other security encryption modes such as WPA2 PSK. You need to import the desired certificates to the monitor before implementing WPA/WPA2 Enterprise encryption on your WLAN. If you do not need to use certificates, you can also delete them from the monitor.

NOTE

Certificates maintenance is available only when the monitor is equipped with the Laird Wifi module.

19.5.6.1 Importing Certificates

To import certificates to the monitor:

1. Create a folder named “cert” in the USB drive
2. .Copy the certificates to the “cert” folder.
3. Insert the USB drive into the monitor’s USB port.
4. Select [**Main Menu**] [**Maintenance>>**] [**User Maintenance>>**] enter the required password . [**Network Setup >>**] [**Certificates Maintenance >>**] [**Import certificates>>**].
5. Select the desired certificates and then select [**Import**].

19.5.6.2 Deleting Certificates

To delete certificates from the monitor:

1. Select [**Main Menu**] [**Maintenance>>**] [**User Maintenance>>**] enter the required password . [**Network Setup >>**] [**Certificates Maintenance >>**] [**Delete certificates>>**].
2. Select the certificates you want to delete. If you want to deselect certificates, select [**Reset**] and reselect the desired items.
3. Select [Delete]. The certificates selected will be deleted from the monitor and will disappear from the [**CA Certificate**] drop-down list.

19.5.7 Connecting the Monitor to the CMS

The T1 monitors can be connected to the central station (CMS) through the network. When connected with the CMS,

The monitor transmits waveforms and numerics of parameters (e.g. ECG, Resp, Temp, SpO_2, CO_2, NIBP), related alarms and alarm settings, patients' information, operating mode, and and historical data, including trends and events, to the central station. The waveforms, numerics, alarms, alarm settings, patients' information, operating mode, and historical data displayed on the central station are consistent with the monitor.

When so configured, the central station can transmit alarm settings, patients' information, and operating mode settings to the monitor. The alarm settings, patients' information, and operating mode settings of the monitor are consistent with the central station.

19.5.8 Setting the Central Stations

You can configure up to 30 central stations (CMS) for your monitor. To set the CMSs:

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

2. Set CMS names and corresponding IP addresses.

19.5.8.1 Selecting a CMS

If there is no CMS in the network where your monitor is located, you need to set [**Select CMS**] to [**Off**]. Otherwise, the "???" three question marks will be displayed at the bottom of the screen.

If there is a CMS in the network where your monitor is located, you need to set [**Select CMS**] to [**On**]. You can select the desired CMS for the current monitoring.

To select a CMS, select the CMS status area at the bottom of the screen. Then the selected CMS name will display.

19.5.8.2 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.

19.5.9 Setting the Network Set

19.5.10 Setting the Multicast Parameters

Multicast parameters must be configured before use on a network.

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.

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19.8 Settting DNS

You can set DNS for connecting the server using domain name. Only ADT and MLDAP services support the domain name method.

To set DNS:

1. Select [**Main Menu**] [**Maintenance>>**] [**User Maintenance>>**] enter the required password select [**Ok**].
2. Select [Network Setup >>] [Monitor Network Setup >>].
3. Scroll down to the next page.
4. Select [DNS Setup >>].
5. Set the desired [**Address Type**].

19.9 MLDAP

MLDAP refers to Mindray LDAP (Lightweight Directory Access Protocol). It is an independent process which can be installed on eGateway or other application server (Windows). MLDAP provides user authorization and authentication. The MLDAP server is connected to the hospital's LDAP or ADT server. All monitoring devices are connected to the MLDAP server to perform authorization and authentication for the following operations:

Changing alarm settings

Changing arrhythmia settings

Accessing the [**User Maintenance**] menu

19.9.1 Setting MLDAP

To access the MLDAP server, you should set your monitor as follows:

1. Select [**Main Menu**] [**Maintenance**>>] [**User Maintenance**>>] enter the required password. [**Network Setup** >>] [**User Authentication Service Setup** >>].
2. Set server address and port of the MLDAP server.

19.9.2 Selecting Password for User Authentication

You can select what password is used when changing alarm settings, arrhythmia settings, and accessing the Maintenance menu. To select the passwords:

1. Select [**Main Menu**] [**Maintenance**>>] [**User Maintenance**>>] enter the required password. [**Password Protection** >>].
2. Select [**Alarm Setup**] to set password for changing alarm settings.

   [**No Password**]: changing alarm settings is not password protected.

   [**Local Password**]: changing alarm ON/OFF switch, alarm limit, and alarm priority is password protected. The monitor's local password is required to change alarm settings.

   [**User Password**]: changing alarm ON/OFF switch, alarm limit, and alarm priority is password protected. The user name and password saved in the MLDAP server are required to change alarm settings.

3. Select [**Arrh. Alarm Settings**] to set password for changing arrhythmia settings.

   [**No Password**]: changing arrhythmia settings is not password protected.

   [**Local Password**]: changing arrhythmia ON/OFF switch, alarm priority, and arrhythmia threshold is password protected. The monitor's local password is required to change arrhythmia settings.

   [**User Password**]: changing arrhythmia ON/OFF switch, alarm priority, and arrhythmia threshold is password protected. The user name and password saved in the MLDAP server are required to change arrhythmia settings.

4. Select [**User Maintenance**] to set password for changing user maintenance settings.

   [**Local Password**]: changing user maintenance settings is password protected. The monitor's local password is required to change user maintenance settings.

   [**User Password**]: changing user maintenance settings is password protected. The user name and password saved in the MLDAP server are required to change user maintenance settings.

To change the monitor's local password for changing alarm settings and arrhythmia settings, select [**Modify Local Alarm Password>>**], enter the new password, and select [**OK**].
To change the monitor's local password for accessing the [**User Maintenance**] menu, select [**Modify Local User Maintenance Password>>**], enter the new password, and select [**OK**].

FOR YOUR NOTES

20 Battery

20.1 Overview

This monitor is designed to operate from rechargeable Lithium-ion battery power when an external power supply is not available. It is recommended to always install a fully charged battery in the monitor to ensure normal monitoring in case of accidental power failure. . If the external power supply is interrupted during patient monitoring, the monitor automatically runs from the battery.

On-screen battery symbols indicate the battery status as follows:

Indicates full battery capacity.

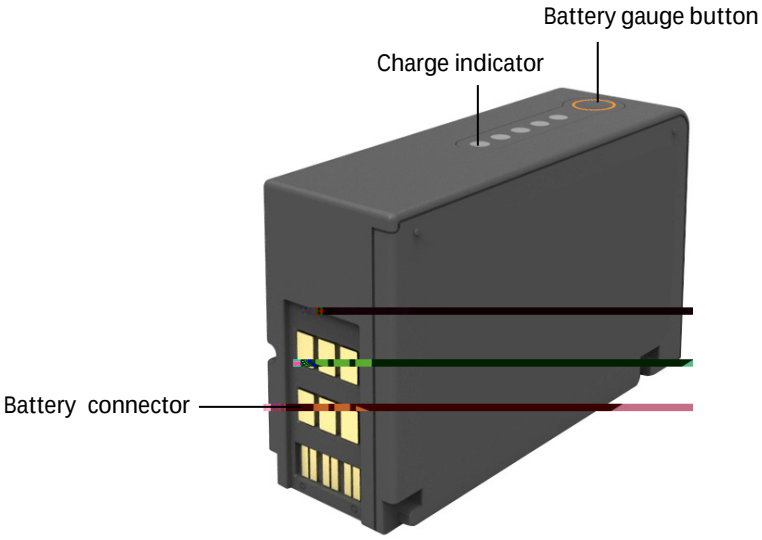
Indicates that battery works correctly. The solid portion represents the current charge level.

Indicates that the battery has low power and needs to be charged.

Indicates that the battery is almost depleted and needs to be charged immediately.

Indicates that no battery is installed.

You can also check the battery's charge status by pressing the battery gauge button at the top of the battery to illuminate the charge indicators. The charge indicators consist of 5 LEDs, each representing 20% of the total power.



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

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

20.2 Safety

CAUTION

Keep the battery out of children's reach.

Use only specified batteries.

Keep the batteries in their original package until you are ready to use them.

Do not expose batteries to liquid.

High ambient temperature shortens battery run time.

Extremely high ambient temperature may cause battery overheat protection, resulting the monitor power off.

If the battery shows signs of damage or signs of leakage, replace it immediately. Do not use a faulty monitor battery.

Do not crush, drop or puncture the battery. Mechanical abuse can lead to internal damage and internal short circuits. If a battery has been dropped or banged against a hard surface, whether damage is externally visible or not, remove the battery from use and dispose of it properly.

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.

NOTE

Charge the batteries in the monitor or in the lithium-ion battery charger specified in the accessories list in .

20.3 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 2 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 2 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 poor battery performance is suspected.

Condition the batteries regularly to maintain their useful life. For details, refer to ..

Remove the battery before the monitor is shipped or will not be used for more than two weeks. Leaving the battery in a monitor that is not in regular use will shorten the life of the battery.

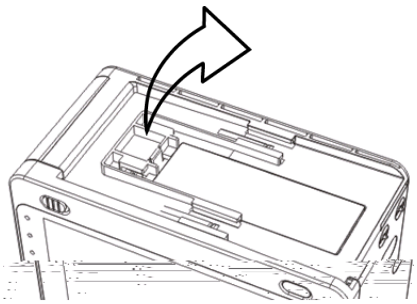
The shelf life of a lithium Ion battery is about 6 months when the battery is stored with the battery power being 50% of the total power. In 6 months the battery power must be depleted before the Lithium Ion battery is fully charged. Then run the monitor on this fully charged battery .When its battery power becomes 50% of the total power, take out the battery from the monitor and store it.

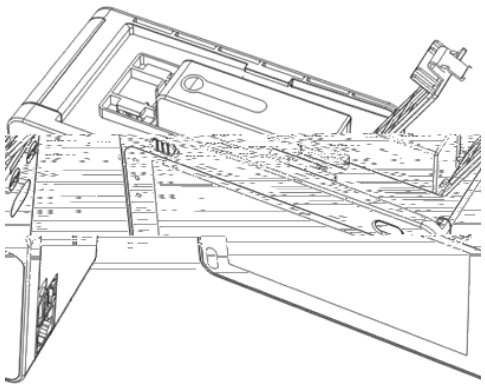
Store batteries properly. For details, refer to .

20.4 Installing or Replacing a Battery

To install or replace a battery:

1. Pull the battery door latch rightwards and lift it to open the battery door.
2. Insert the battery into the battery compartment as indicated.





3. Close the battery door.

To replace a battery, remove the battery as per the instructions on the battery door, and then insert a new battery into the battery compartment.

20.5 Charging a Battery

To optimize performance, a fully (or nearly fully) discharged battery should be charged as soon as possible. The batteries can be charged in either of the following methods:

Install the battery in the T1 monitor and then connect the T1 monitor with the external DC adapter or T1 docking station.

Install the battery in the T1 monitor and then plug the T1 monitor into a host monitor. The host monitor must be powered on before the T1 monitor can be charged.

Use the battery charger specified in the accessories list in *23.8 M*

Plug the T1 monitor to a satellite module rack that is connected to a powered host monitor.

For these methods, the battery is charged whenever the T1 monitor is connected to an external power supply regardless of whether or not the T1 monitor is currently turned on.

20.6 Conditioning a Battery

The performance of rechargeable batteries may deteriorate over time. If the battery is not conditioned for a prolonged time, its charge indication may not be accurate and you may wrongly evaluate the remaining battery runtime. Keeping the battery continuously fully charged without conditioning will speed up battery aging and shorten its life time. You should condition the batteries every three months, before it is used for the first time, or when its run time becomes noticeably shorter.

A battery conditioning cycle is one uninterrupted charge of the battery, followed by an uninterrupted battery discharge and charge.

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 when the battery charge level indicates the battery is fully charged. Please replace the battery if its operating time is significantly lower than the specified time.

To condition a battery:

1. Disconnect the T1 monitor from the patient and stop all monitoring and measuring procedures.
2. Turn off the T1 monitor. Disconnect the T1 monitor from the external power supply if a DC adapter or T1 docking station is connected.
3. Install the battery to be conditioned in the T1 monitor. Connect the external power supply and allow the battery to charge uninterruptedly for 7 hours.
4. Disconnect the external power supply. Remove the battery from the T1 monitor. Keep the battery in room temperature for two hours.
5. Reinstall the battery to be conditioned into the T1, power on the T1, and allow the T1 monitor to run from the battery until the battery is completely depleted and the T1 monitor automatically shuts off.
6. Fully charge the battery again for use or charge it to 40 – 60% for storage.

CAUTION

Do not use the T1 monitor to monitor the patient during battery conditioning.

NOTE

Do not interrupt battery conditioning.

You can also use the specified battery charger for the charging portions of the conditioning process.

20.7 Checking Battery Performance

The performance of a rechargeable battery will deteriorate over time. You should check the battery performance every two months or if you doubt the battery may fail.

1. Disconnect the monitor from the patient and stop all monitoring and measuring procedures.
2. Turn off the monitor, and connect the monitor to the external power source.
3. Allow the battery to be charged uninterruptedly until it is fully charged.
4. Disconnect the monitor from the external power source, and turn on the monitor.
5. Allow the monitor to run on the battery until the battery is completely depleted and the monitor automatically shuts down.
6. Record the battery operating time.

The operating time of the batteries reflects their performance directly. If the operating time of a battery is noticeably shorter than that stated in the specifications, discard the batteries or contact your service personnel.

If the battery performance meets the requirement, fully charge the battery again for use or charge it to 40 – 60% for storage.

NOTE

Battery operating time depends on the device configuration and operation. For example, high display brightness or measuring NIBP repeatedly will shorten the battery operating time.

20.8 Storing a Battery

When storing batteries, make sure that the battery terminals do not come into contact with metallic objects. If batteries are stored for an extended period of time, place the batteries in a cool place with a partial charge of 40% to 60% capacity (3 LEDs illuminated).

Stored batteries should be conditioned every 2 months. Refer to section for details.

NOTE

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

Storing batteries at high temperature for an extended period of time will significantly shorten their life expectancy.

Storing batteries in a cool place will slow the aging process. Ideally the batteries should be stored at 15 °C. Do not store the batteries in an environment above 60 °C or lower than -20 °C.

20.9 Recycling Batteries

Discard the battery in the following situations:

The battery has visual signs of damage.

The battery fails.

The battery is aged and its runtime significantly less than the specification.

The battery has been used longer than the expected life defined in section

Properly dispose of batteries according to local regulations.

WARNING

Do not open batteries, heat above 60 °C, incinerate batteries, or short the battery terminals. They may ignite, explode, leak, or heat up, causing personal injury.

21 Care and Cleaning

21.1 General Points

In this chapter we only describe cleaning and disinfection of the main unit, modules, T1 handle, docking station, and certain accessories. For the cleaning and disinfection of other reusable accessories, refer to instructions for use of the corresponding accessories.

Keep your equipment and accessories free of dust and dirt. To avoid damage to the equipment, follow these guidelines:

Always follow the manufacturer's instructions for each cleaning / disinfecting agent.

Do not immerse any part of the equipment into liquid.

Do not pour liquid onto the equipment or accessories.

Do not allow liquid to enter the case.

Never use abrasive materials (such as steel wool or silver polish), or erosive cleaners (such as acetone or acetone-based cleaners).

WARNING

Be sure to 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.

Avoid wetting the pins and metal parts of the main unit or accessories during cleaning and disinfection.

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.

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21.2 Cleaning and Disinfecting the Main Unit/Module/Handle/Docking Station

21.2.1 Approved Cleaning and Disinfecting Agents

The following table lists approved cleaning and disinfecting agents:

Product Name	Product Type	Active Ingredients
Sodium hypochlorite bleach*	Liquid	Sodium hypochlorite bleach 0.5%
Hydrogen peroxide*		Hydrogen peroxide 3%
Isopropanol*		Isopropanol 70%
1-Propanol*		1-Propanol 50%
Metrex CaviCide1™		Diisobutylphenoxyethoxyethyl dimethyl benzyl ammonium chloride 0.28%, Isopropanol 17.2% n-Alkydimethyl benzyl ammonium chloride 8.190%

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Product Name	Product Type	Active Ingredients
Germicidal Disposable Wipe		n-Alkyl dimethyl benzyl ammonium chlorides 0.14%
PDI Sani-Cloth® Bleach Germicidal Disposable Wipe		Sodium Hypochlorite 0.63%,other ingredients 99.37%
PDI Sani-Cloth® HB Germicidal Disposable Wipe	Wipes	n-Alkyl dimethyl ethylbenzyl ammonium chlorides 0.07%, n-Alkyl dimethyl benzyl ammonium chlorides 0.07%
PDI Sani-Cloth® Plus Germicidal Disposable Cloth		n-Alkyl dimethyl ethylbenzyl ammonium chlorides 0.125%, n-Alky dimethyl benzyl ammonium chlorides 0.125%
PDI Super Sani-Cloth® Germicidal Disposable Wipe		n-Alkyl dimethyl ethylbenzyl ammonium chlorides 0.25%, n-Alkyl dimethyl benzyl ammonium chlorides 0.25%, Isopropyl Alcohol 55.0%,
VIRAGUARD Hospital Surface Disinfectants		Isopropanol 70%,Other ingredients 30%

NOTE

For equipment with the symbol , all the listed cleaning and disinfecting agents are available for use.

For equipment without the symbol , only the cleaning and disinfecting agents marked with "*" are available for use.

21.2.2 Cleaning the Main Unit/Module/Handle/Docking Station

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

To clean your equipment, follow this procedure:

1. r i m c d l 1 (l . 0 2 7 A C < / M 8 .

21.3 Cleaning and Disinfecting the Accessories

For the NIBP air hose, Masimo SpO_2 cable, and Nellcor SpO_2 cable, you should clean and disinfect them using the cleaners and disinfectants and methods listed in this section. For other accessories, you should consult the instructions delivered with the accessories.

CAUTION

Fluids entering the NIBP air hose can damage the equipment. When cleaning and/or disinfecting the NIBP air hose, prevent liquid from entering the hose.

Periodically inspect the NIBP air hose and connector for signs of wear or deterioration. Replace the NIBP air hose if you detect a leak. Dispose of damaged NIBP air hose according to local laws for disposal of hospital waster.

Never immerse or soak the accessories in any liquid.

Never clean or disinfect the metallic connectors at either end of the accessories.

Use only Mindray approved cleaners and disinfectants and methods listed in this section to clean or disinfect the accessories. Warranty does not cover damage caused by unapproved substances or methods.

To avoid long term damage, the accessories should be disinfected only when necessary as determined by your hospital's policy.

21.3.1 Approved Accessories Cleaning and Disinfecting Agents

The following table lists approved NIBP air hose cleaning and disinfecting agents:

Product Name	Product Type	Active Ingredients
Isopropanol	Liquid	Isopropanol 70%
1-Propanol		1-Propanol 50%
Metrex CaviCide1™		Diisobutylphenoxyethoxyethyl dimethyl benzyl ammonium chloride 0.28%, Isopropanol 17.2%
Virex® TB		n-Alkyl dimethyl benzyl ammonium chlorides 0.105%, n-Alkyl dimethyl ethylbenzyl ammonium chlorides 0.105%
Rely+On™ Virkon® Powder (Used as 1% solution)	Powder	Used as 1% solution Biocidal active: Pentapotassium bis (peroxymonosulphate) bis (sulphate) (500g/kg), Contains dipotassium peroxodisulphate 1%
Alpet® D2 Surface Sanitizing Wipes	Wipes	Isopropyl Alcohol 58.6000% ¨ Octyl Decyl Dimethyl Ammonium chloride 0.0075%, Dioctyl Dimethyl Ammonium Chloride 0.0030%

Product Name	Product Type	Active Ingredients
Clorox Dispatch® Hospital Cleaner Disinfectant Towels with Bleach	[illegible]	[illegible]

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D.-7.742i..1( )s.-11J in.-12J fe.0.7 <c.-25.7 <t7-9 ( )a.-5>-n.-12 <t7-9 4J W ï TGG ‰tys ™sf l'% H -8 7 en.0 9(5 P)

Product Name	Product Type	Ingredients
PDI Super Sani-Cloth® Germicidal Disposable Wipe	Wipes	n-Alkyl dimethyl ethylbenzyl ammonium chlorides 0.25%, n-Alkyl dimethyl benzyl ammonium chlorides 0.25%, Isopropyl Alcohol 55.0%,
VIRAGUARD Hospital Surface Disinfectants		Isopropanol 70%, Other ingredients 30%

21.3.2 Cleaning the Accessories

You should clean the accessories (NIBP air hose, Masimo SpO_2 cable, and Nellcor SpO_2 cable) on a regular basis. Before cleaning the accessories, consult your hospital's regulations for cleaning the accessories.

To clean the accessories (NIBP air hose, Masimo SpO_2 cable, and Nellcor SpO_2 cable), follow this procedure:

1. Clean the accessories with wipes or a soft cloth moistened with one of the cleaning agents listed in only.
2. Wipe off all the cleaning agent residue with a dry cloth.
3. Allow the accessories to air dry.

21.3.3 Disinfecting the Accessories

We recommend that the accessories (NIBP air hose, Masimo SpO_2 cable, and Nellcor SpO_2 cable) should be disinfected only when necessary as determined by your hospital's policy, to avoid long term damage to the accessories. Cleaning the accessories before disinfecting is recommended.

21.4 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.

22 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 service 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.

22.1 General Inspection

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

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.

Make sure that the alarm system functions correctly.

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.

enance and Testing Schedule

maintenance and tests, except for visual inspection, power on test, touchscreen calibration, battery check, n, NIBP Leakage test, and CO_2 Leakage test, should be carried out by the service personnel only. Ensure safe and the performance tested by qualified service personnel before initial installation, after upgrade, or scheduled maintenance. Contact your service personnel if any maintenance is required. Make sure to nfect the equipment before any test and maintenance.

g the settings in [User Settings >>] and [Factory Maintenance >>] menus may cause data loss.

ersonnel should acquaint themselves with the test tools and make sure that the test tools and e applicable.

ce Item	Recommended Frequency
s	
	1. When first installed or reinstalled.

any^ airsr

22.3 Checking Monitor and Module Information

To view the information about system start time, self-test, etc., select [**Main Menu**] → [**Maintenance >>**] → [**Monitor Information >>**]. The information will not be saved after the monitor is shut down.

You can also view the information about the monitor configuration and system software version by selecting [**Main Menu**]→[**Maintenance >>**]→[**Software Version >>**].

22.4 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.

To perform ECG verification:

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 verification 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.

22.5 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

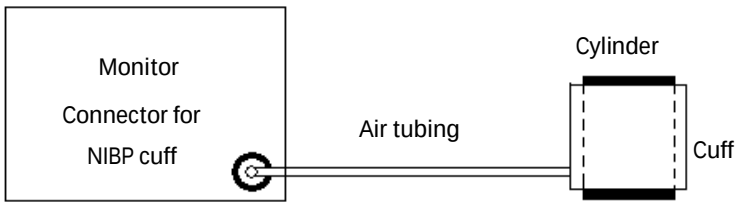
Air tubing

A correct sized cylinder

To perform a 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 determine 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.

22.6 CO_2 Leakage Test

For sidestream and microstream CO_2 modules, leakage test is needed every year or when you suspect the measurement.

To perform a CO_2 leakage 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.

22.7 Calibrating the Touchscreen

To calibrate the touchscreen:

1. Select [**Main Menu**] [**Maintenance >>**] [**Cal. Touchscreen**]. The symbol will appear at different positions of the screen.
2. Select, in turn the middle of the symbol. After the calibration is completed, the message [**Screen Calibration Completed!**] is displayed.
3. Select [**Ok**] to confirm the completion of the calibration.

NOTE

You cannot calibrate the touchscreen if it is locked.

FOR YOUR NOTES

23 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. <</MCID10MCI(o6)>BDd

12-PinTrunk Cables

Model	PN	Description	Applicable patient
EV6222	040-000754-00	ECG cable, 12-pin, 3-lead, defibrillation-proof, DIN connector	Neonate, infant
EV6201	0010-30-42719	ECG cable,12-pin, 3/5-lead, defibrillation-proof, AHA/IEC	Adult, pediatric
EV6202	0010-30-42720	ECG cable,12-pin, 3-lead, defibrillation-proof, AHA/IEC	Neonate, infant
EV6203	0010-30-42721	ECG cable, 12-lead, defibrillation-proof, AHA	Adult
EV6211	0010-30-42723	ECG cable, 12-pin, 3/5-lead, ESU-proof, AHA/IEC	Adult, pediatric
EV6212	0010-30-42724	ECG cable, 12-pin, 3-lead, ESU-proof, AHA/IEC	Neonate, infant
EV6206	009-005266-00	ECG cable, defibrillation-proof, 3.1 m, T/N series	Adult, pediatric
EV620	009-005267-00	ECG cable, defibrillation-proof, 6.2 m, T/N series	Adult, pediatric
EV6216	009-005268-00	ECG cable, defibrillation-proof, 3.1 m, T/N series	Adult, pediatric
EV6217	009-005269-00	ECG cable, defibrillation-proof, 6.2 m, T/N series	Adult, pediatric
/	040-001416-00	ECG cable, 12-pin 3/5-lead defibrillation-proof	Adult, pediatric
/	009-003652-00	ECG cable, 12-pin 3/5-lead, ESU-proof	Adult, pediatric
EV6208	040-003528-00	ECG cable, 12-lead, defibrillation-proof, AHA	Adult, pediatric

ECG Leadwires

3-Electrode Leadwires			
Model	**PN**	**Description**	**Applicable patient**
EL6305A	0010-30-42896	ECG leadwires, 3-lead, AHA, pinch	Neonate, infant
EL6301A	0010-30-42726	ECG leadwires, 3-lead, AHA, pinch	Adult, pediatric
EL6303A	0010-30-42731	ECG leadwires, 3-lead, AHA, pinch, long	Adult, pediatric
EL6301B	0010-30-42734	ECG leadwires, 3-lead, AHA, snap	Adult, pediatric
/	0012-00-1503-05	ECG Leadwires, 3-lead, Snap, 24" (61.0 cm), AAMI	Adult, pediatric
/	0012-00-1503-06	ECG Leadwires, 3-lead, Snap, 36" (101.6 cm), AAMI	Adult, pediatric
/	0012-00-1503-14	ECG Leadwires, 3-lead, Snap, 24" (61.0 cm), IEC	Adult, pediatric
/	0012-00-1503-15	ECG Leadwires, 3-lead, Snap, 36" (101.6 cm), IEC	Adult, pediatric
/	0012-00-1514-05	ECG Leadwires, 3-lead, Pinch, 24" (61.0 cm), AAMI	Adult, pediatric
/	0012-00-1514-06	ECG Leadwires, 3-lead, Pinch, 36" (101.6 cm), AAMI	Adult, pediatric
/	0012-00-1514-14	ECG Leadwires, 3-lead, Pinch, 24" (61.0 cm), IEC	Adult, pediatric
/	0012-00-1514-15	ECG Leadwires, 3-lead, Pinch, 36" (101.6 cm), IEC	Adult, pediatric
/	040-000748-01	Disp leadwires, 3-L snap, AAMI, 20 pk	Adult, pediatric
EY6316B	009-004765-00	3-lead, new telemetry, AHA, snap, 24"	Adult, pediatric
EY6305B	009-004766-00	3-lead, new telemetry, AHA, snap, 36"	Adult, pediatric
EY6316A	009-004771-00	3-lead, new telemetry, AHA, pinch, 24"	Adult, pediatric
EY6305A	009-004772-00	3-lead, new telemetry, AHA, pinch, 36"	Adult, pediatric
EY6310B	009-004777-00	3-lead, new telemetry, disposable, AHA, snap, 24"	Adult, pediatric

5-Electrode Leadwires			
Model	**PN**	**Description**	**Applicable patient**
EL6501A	0010-30-42727	ECG leadwires, 5-lead, AHA, pinch	Adult, pediatric
EL6503A	0010-30-42729	ECG leadwires, 5-lead, AHA, pinch, long	Adult, pediatric
EL6501B	0010-30-42735	ECG leadwires, 5-lead, AHA, snap	Adult, pediatric
/	0012-00-1503-02	ECG Leadwires, 5-lead, Snap, 24" (61.0 cm), AAMI	Adult, pediatric
/	0012-00-1503-03	ECG Leadwires, 5-lead, Snap, 36" (101.6 cm), AAMI	Adult, pediatric
/	0012-00-1503-11	ECG Leadwires, 5-lead, Snap, 24" (61.0 cm), IEC	Adult, pediatric
/	0012-00-1503-12	ECG Leadwires, 5-lead, Snap, 36" (101.6 cm), IEC	Adult, pediatric
/	0012-00-1514-02	ECG Leadwires, 5-lead, Pinch, 24" (61.0 cm), AAMI	Adult, pediatric
/	0012-00-1514-03	ECG Leadwires, 5-lead, Pinch, 36" (101.6 cm), AAMI	Adult, pediatric
/	0012-00-1514-11	ECG Leadwires, 5-lead, Pinch, 24" (61.0 cm), IEC	Adult, pediatric
/	0012-00-1514-12	ECG Leadwires, 5-lead, Pinch, 36" (101.6 cm), IEC	Adult, pediatric
/	040-000746-01	Disp leadwires, 5-L snap, AAMI, 20 pk	Adult, pediatric
EY6511B	009-004782-00	5-lead, new telemetry, AHA, snap, 24"	Adult, pediatric
EY6512B	009-004783-00	5-lead, new telemetry, AHA, snap, 36"	Adult, pediatric
EY6511A	009-004786-00	5-lead, new telemetry, AHA, pinch, 24"	Adult, pediatric
EY6512A	009-004787-00	5-lead, new telemetry, AHA, pinch, 36"	Adult, pediatric
EY6507B	009-004790-00	5-lead, new telemetry, disposable, AHA, snap, 24"	Adult, pediatric

23.2 SpO_2 Accessories

Extension Cable

Model	Part No.	Description	Applicable patient
/	115-020768-00	8-pin, purple connector, 2.1 m, Masimo	All
572A	0010-20-42712	8-pin, 2.5 m, Nellcor	All
4089	040-003381-00	RD to LNC Adapter Cable	All
/	040-003310-00	8-pin Masimo Cable	All
4080	040-003378-00	RD SET MD 14-05, PC 5 ft	All
4081	040-003379-00	RD SET MD 14-12, Patient Cable 12 ft	All
583A	040-003310-00	8pin masimo Cable (RD SET)	All
4092	040-003370 0.00006 Tc00>>BBT/P5 >>BDC 20.549 01 06ID tTJB3 0 Tl(		3

Masimo SpO2 Module				
Model	**PN**	**Description**	**Applicable patient**	**Application site**
			Neonate (< 3 kg)	Foot
LNCS Inf	0600-00-0158	Disposable SpO2 sensor	Infant Neonate (3 - 20 kg)	Toe Foot
LNCS Pdtx	0600-00-0122	Disposable SpO2 sensor	Pediatric	Finger
LNCS Adtx	0600-00-0121	Disposable SpO2 sensor	Adult	Finger
4050	040-003376-00	RD SET DCI, Adult reusable sensor	Adult (> 30 kg)	Finger
4051	040-003377-00	RD SET DCI-P, Pediatric reusable sensor	Pediatric (10 to 50 kg)	Finger
4053	040-003380-00	RD Set TC-I SpO_2 reusable Tip-Clip ear sensor, 3ft	Adult (> 30 kg)	Ear
4000	040-003382-00	RD SET adhesive disposable sensor	Adult (> 30 kg)	Finger
4001	040-003383-00	RD SET PDT adhesive disposable sensor	Pediatric (10 to 50 kg)	Finger
4002	040-003384-00	RD Set infant adhesive disposable sensor		

Model	Part No.	Description	Applicable patient
CM1500D	001B-30-70695	NIBP cuff, single patient use, size 4, 7.1 to 13.1 cm arm circumference, 20 pcs/box	Neonate
/	115-027563-00	Disposable bladderless cuff, 10 - 19 cm, 10 pcs/box	Child
/	115-027564-00	Disposable bladderless cuff, 18 – 26 cm, 10 pcs/box	Small adult
/	115-027565-00	Disposable bladderless cuff, 24 – 35 cm, 10 pcs/box	Adult
/	115-027566-00	Disposable bladderless cuff, 33 – 47 cm, 10 pcs/box	Large adult
/	115-027567-00	Disposable bladderless cuff, 46 – 66 cm, thigh, 115-	

23.5 IBP Accessories

IBP Accessories

Model	Part No.	Description	Applicable patient
IM2202	001C-30-70757	12-pin IBP cable, BD	All
IM2201	001C-30-70759	12-pin IBP cable, Abbott	All
/	040-001029-00	IBP extended cable with dual-receptacle	All
/	0010-20-42795	IBP cable adapter (12 pin to 6 pin)	/
/	0010-21-12179	12 Pin IBP Cable for Edwards	/
/	0010-21-43082	12 Pin IBP Cable for Memscap (SP844 82031 transducer)	/

ICP Accessories

Model	Part No.	Description	Applicable patient
/	0010-30-42742	12-pin ICP cable, Gaeltec	All
ICT/B	0010-10-12151	Disposable ICP transducer, Gaeltec	All

23.6 CO_2 Accessories

Sidestream CO_2 module

Model	Part No.	Description	Applicable patient	Applicable for
4000	M02A-10-25937	Nasal CO_2 sample cannula	Adult	One-slot CO_2 module
4100	M02A-10-25938	Nasal CO_2sample cannula	Pediatric	
4200	M02B-10-64509	Nasal CO_2 sample cannula	Neonate	
60-15200-00	9200-10-10533	Sampling line, 2.5m, disposable	Adult, pediatric	
60-15300-00	9200-10-10555	Sampling line, 2.5m, disposable	Neonate	
60-14100-00	9000-10-07486	Airway adapter, disposable, straight	Adult, pediatric	
040-001187-00	040-001187-00	Airway adapter, disposable, elbow	Neonate	
100-000080-00	115-058733-00	DRYLINE II Watertrap, 10pcs/box	Adult, pediatric	
100-000081-00	115-058734-00	DRYLINE II Watertrap, 10pcs/box	Neonate	

23.7 Mount and Mounting Accessories

Part No.	Description
045-003428-00	iPM/iMEC rolling stand with quick release mount
045-000934-00	T8 keyboard wall-mount bracket
045-001228-00	T1 docking station wall-mount (for LCD)
045-003427-00	Wall mount with quick release – M series
045-001229-00	LCD wall-mount bracket
045-001230-00	Pole mounting kit
115-021120-00	Hook (Folding)
115-028320-00	Monitor handle
115-021237-00	Bedrail hook kit
115-023296-00	T1 docking station
115-028322-00	T1 docking station, without VGA connector
115-028440-00	T1 handle

FOR YOUR NOTES

24 Part Numbers for Canadian Use

All the part numbers listed in the table below are modules that are compatible with the T1 Patient Monitor.

Part No.	Description	Contents
115-021056-00	Sidestream CO_2 module (1X) with neonatal accessory kit	Module Part Number 115-020189-00 Accessory Kit: 115-021055-00 which contains: 9200-10-10555 - Neonate Sampling Line 100-000081-00 - Dryline II water trap M02B-10-64509 - Neonate Nasal Cannula 040-001187-00 - Airway Adapter
115-021055-00	Sidestream CO_2 module (1X) neonatal accessory kit	9200-10-10555 - Neonate Sampling Line 100-000081-00 - Dryline II water trap, neonate M02B-10-64509 - Neonate Nasal Cannula 040-001187-00 - Airway Adapter
115-020919-00	Sidestream CO_2 module with adult/pediatric accessory kit	Module Part Number 115-020189-00 Accessory Kit: 115-021054-00 which contains: 9200-10-10533 Adult Sampling Line 100-000080-00 - Dryline II water trap, adult M02A-10-25937 - Adult Nasal Cannula M02A-10-25938 - Pediatric Nasal Cannula 9000-10-07486 - Airway Adapter
115-021054-00	Sidestream CO_2 module (1X) adult/pediatric accessory kit	9200-10-10533 Adult Sampling Line 100-000080-00 - Dryline II water trap, adult M02A-10-25937 - Adult Nasal Cannula M02A-10-25938 - Pediatric Nasal Cannula 9000-10-07486 - Airway Adapter

FOR YOUR NOTES

T1 handle, T1 docking station		
Item	**Operating conditions**	**Storage conditions**
Temperature (°C)	0 to 40	-20 to 60
Relative humidity (noncondensing)	15% to 95%	10% to 95%

A.4 Physical Specifications

	Size	Weight
Patient monitor (with battery)	143 mm×77 mm×102 mm (5.6 inch×3.0 inch×4.0 inch)	0.93 kg (2.0 pound)
Battery	74 mm×47 mm×24 mm (2.9 inch×1.8 inch×0.9 inch)	0.12 kg (0.3 pound)
T1 handle	164 mm×128 mm×164 mm (6.4 inch×5.0 inch×6.4 inch)	0.6 kg (1.3 pound)
T1 docking station	186 mm×121 mm×153 mm (7.3 inch×4.7 inch×6.0 inch)	0.89 kg (1.9 pound)
Sidestream CO_2 module	136.5×80.5×102 mm (5.4 inch×3.2 inch×4.0 inch)	<0.48 kg (1.0 pound)
Microstream CO_2 module	136.5×40×102 mm (5.4 inch×1.6 inch×4.0 inch)	<0.37 kg (0.8 pound)

A.5 Hardware Specifications

A.5.1 Display

T1 display	
Screen type	Color TFT LCD
Screen Size	5 inch
Resolution	480 272 pixels
External display	
Screen type	Color TFT LCD
Screen Size	19 inch
Resolution	800 600 pixels

A.5.2 Equipment connector

Main unit

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

T1 handle

T1 handle multi-pin connector 1	1
T1 handle multi-pin connector 2	1
Infrared filter	1
Contact	2
Pogo pin	3

T

A.5.3 LEDs

Main unit

Alarm lamp	1 (two colors: yellow and red)
Power on LED	1 (green)
External power LED	1 (green)
Battery LED	1 (green)

T1 docking station

Connection status indicator	1 (green)
External power supply indicator	1 (green)

A.5.4 Audio Indicator

Speaker	Give alarm tones (45 to 85 dB), key tones, QRS tones; support PITCH TONE and multi-level tone modulation; alarm tones comply with IEC60601-1-8.

A.5.5 Outputs

Analog Output		
Standard	Meets the requirements of IEC60601-1 for short-circuit protection and leakage current	
ECG Analog Output		
Bandwidth (-3dB; reference frequency: 10Hz)	Diagnostic mode: Monitor mode: Surgical mode: ST mode:	0.05 to 150 Hz 0.5 to 40 Hz 1 to 20 Hz 0.05 to 40 Hz
QRS delay	≤ 25 ms (in diagnostic mode, and non-paced)	
Sensitivity	1V/mV ±5%	
PACE rejection/enhancement	Pace enhancement Signal amplitude: Voh≥2.5 V Pulse width: 10 ms±5% Signal rising and falling time: ≤100 μs	
IBP Analog Output		
Bandwidth (-3dB; reference frequency:1Hz)	DC to 40 Hz	
Max transmission delay	≤ 30 ms	
Sensitivity	1 V/100 mmHg ±5%	
Defib Sync Pulse		
Output impedance	≤ 100 Ω	
Max time delay	35 ms (R-wave peak to leading edge of pulse)	
Amplitude	High level: 3.5 to 5 V, providing a maximum of 10 mA output current; Low level: < 0.5 V, receiving a maximum of 5 mA input current.	
Pulse width	100 ms ±10%	
Rising and falling time	≤1 ms	

Alarm output (RJ45 connector)	
Alarm delay time from patient monitor to remote equipment	The alarm delay time is equal to or smaller than 2 s, measured from the time of the patient monitor alarm signal generation to the time of the remote equipment alarm signal generation.

A.6 Data Storage

Trends	Trends: 120 hours, at 1 min resolution Mid-length trends: 4 hours, at 5 s resolution Minitrends: 1 hour, at 1 s resolution
Alarm events	100 physiological alarms and manual events and related parameter waveforms.
OxyCRG events	100 OxyCRG events
Arrh. events	100 arrhythmia events and relate waveforms and parameters.
NIBP measurements	1000 sets
Full-disclosure waveforms	48 hours at maximum. The specific storage time depends on which types of waveforms are stored and the number of waveforms stored.

A.7 Wireless Network

Network standard	IEEE 802.11a/b/g/n
Modulation mode	DSSS and OFDM
Operating frequency	Frequency Bands(FCC):2.4 GHz to 2.483GHz (only use channel 1 to channel 11) 5G Frequency Bands(FCC): 5.15 GHz to 5.35GHz, 5.47GHz to 5.725GHz, 5.725GHz to 5.85GHz (DFS channels disabled)
Channel spacing	IEEE 802.11a: 20MHz IEEE 802.11b/g: 5MHz IEEE 802.11n at 2.4 GHz: 5MHz IEEE 802.11n at 5 GHz: 20MHz
Wireless baud rate (data rate)	IEEE 802.11a: 6 to 54 Mbps IEEE 802.11b: 1to11 Mbps IEEE 802.11g: 6 to 54 Mbps IEEE 802.11n (at both 2.4GHz and 5GHz): 6.5 to 72.2 Mbps
Output power (transfer power)	< 30 dBm (FCC requirement: detection mode – peak power) < 20 dBm (CE requirement: detection mode – RMS)
Operating mode	Infrastructure
Data security	Security standards: WPA-PSK, WPA2-PSK, WPA-Enterprise/WPA2-Enterprise EAP methods: PEAP-MsCHAPv2, EAP-FAST, EAP-TLS, EAP-TTLS, PEAP-GTC, PEAP-TLS, EAP-LEAP Encryption modes: TKIP and AES
Communication with the central station	1. The monitor transmits waveforms and numerics of parameters (e.g. ECG, Resp, Temp, SpO_2, CO_2, NIBP), related alarms and alarm settings, patients' information, operating mode, and historical data, including trends and events, to the central station. The waveforms, numerics, alarms, alarm settings, patients' information, operating mode, and historical data displayed on the central station are consistent with the monitor. 2. When so configured, the central station transmits alarm settings, patients'

A.8 Measurement Specifications

The adjustable range for alarm limits is the same as the measurement range for the parameter unless otherwise specified.

A.8.1 ECG

ECG	
Standards	Meet standards of IEC60601-2-27 and IEC60601-2-25
Lead set	3-lead: I, II, III 5-lead: I, II, III, aVR, aVL, aVF, V 12-lead: I, II, III, aVR, aVL, aVF, V1 to V6
ECG standard	AHA, IEC
Display sensitivity	1.25 mm/mV (×0.125), 2.5 mm/mV (×0.25), 5 mm/mV (×0.5), 10 mm/mV (×1), 20 mm/mV (×2), 40 mm/mV (4) Accuracy: ±5%
Sweep speed	6.25 mm/s, 12.5 mm/s, 25 mm/s, 50 mm/s Accuracy: ±10%
Bandwidth (-3dB)	Diagnostic mode: 0.05 to 150 Hz Monitor mode: 0.5 to 40 Hz Surgical mode: 1 to 20 Hz ST mode: 0.05 to 40 Hz
Common mode rejection ratio (with Notch off)	Diagnostic mode: >90 dB Monitor mode: >105 dB Surgical mode: >105 dB ST mode: >105 dB
Notch filter	50/60 Hz
Differential input impedance	≥5 MΩ
Input signal range	±8 mV (peak-to-peak value)
Accuracy of signal reproduction	Use A and E methods based on IEC 60601-2-25 to determine frequency response.
Electrode offset potential tolerance	±500 mV
Lead-off detection current	Measuring electrode: <0.1 μA Drive electrode: <1 μA
Input offset current	Measuring electrode: ≤0.1 μA Drive electrode: ≤1 μA
Baseline recovery time	<5 s (after defibrillation)
Patient leakage current	<10 μA
Calibration signal	1mV (peak-to-peak value) Accuracy: ±5%
ESU protection	Cut mode: 300 W Coagulate mode: 100 W Recovery time: ≤10 s In compliance with the requirements in clause 202.6.2.101 of IEC60601-2-27

Sampling rate	500 samples/s (A/D) 500 samples/s (ECG algorithm)
Accuracy	2.44μV/LSB

Pace Pulse	
Pace pulse markers	Pace pulses meeting the following conditions are labeled with a PACE marker: Amplitude: ±2 to ±700 mV Width: 0.1 to 2 ms Rise time: 10 to 100 μs
Pace pulse rejection	When tested in accordance with the IEC60601-2-27: 201.12.1.101.13, the heart rate meter rejects all pulses meeting the following conditions. Amplitude: ±2 to ±700 mV Width: 0.1 to 2 ms Rise time: 10 to 100 μs
Pacer pulse detector rejection of fast ECG signals	2.9 V/s RTI when measured in accordance with IEC60601-2-27 Section 4.1.4.3.
HR	
Measurement range	Neonate: 15 to 350 bpm Pediatric: 15 to 350 bpm Adult: 15 to 300 bpm
Resolution	1 bpm
Accuracy	±1 bpm or ±1%, whichever is greater.
Sensitivity	200μV (lead II)
Minimum QRS detection threshold (for Advanced ECG algorithm)	Adult and pediatric: 0.16 – 0.48 mV Neonate: 0.12 – 0.40 mV
HR averaging method (for Advanced ECG algorithm)	In compliance with the requirements in IEC60601-2-27: Clause 201.7.9.2.9.101 b) 3) b r in inn (in) Tc -0.013)i1 (t) R the (h)9 0.0065307 -1.733.7 (in)12 (A) 0.00t in inhhBT0 ((in)Tw 074.3 of, the following method ie(et)m[(A) 0.007 Tw 078 (l)2 ()102 (ie(etl)-10419.4 5.16 078 (l)22002 Tc 0

	Waveform 4ah - range: < 11 s 4a - range: < 11 s 4ad - range: < 11 s 4bh - range: < 11 s 4b - range: < 11 s 4bd - range: < 11 s	
Tall T-wave rejection capability	When the test is performed based on IEC60601-2-27: Clause 201.12.1.101.17, the maximum T-wave amplitude that can be rejected is 1.2mV.	
Arrhythmia alarms (for Advanced ECG algorithm)	Asystole, VFib/VTac, Vtac, Vent. Brady, Extreme Tachy, Extreme Brady, PVC, Couplet, Bigeminy, Trigeminy, R on T, Run PVCs, PVCs, Tachy, Brady, Missed Beats, Vent. Rhythm, Pacer Not Pacing, Pacer Not Capture, Multif. PVC, Nonsus. Vtac, Pause, Irr. Rhythm, Afib	
ST Segment Analysis		
Measurement range	-2.0 to +2.0 mV RTI	
Accuracy	-0.8 to +0.8 mV: ±0.02 mV or ±10%, whichever is greater Beyond this range: Not specified	
Refreshing rate	10 s (Advanced ECG algorithm)	
Resolution	0.01 mV	
QT/QTc Interval Monitoring (for Advanced ECG algorithm)		
Measurement range	QT: 200 – 800 ms QTc: 200 – 800 ms QT-HR: 15 – 150 bpm for adult, 15 – 180 bpm for pediatric and neonate	
Accuracy	QT: ± 30 ms	
Resolution	QT: 4 ms QTc: 1 ms	
HR alarm limit	**Range (bpm)**	**Step**
HR High	(low limit + 2) to 300 bpm	HR 04 0: 1bpm HR>40: 5 bpm
HR Low	15 to (high limit – 2) bpm	
ST High	(low limit +0.2) to 2.0 mV	0.1 mV
ST Low	-2.0 to (high limit – 0.2) mV	
QT/QTc alarm limit	**Range (bpm)**	**Step (ms)**
QTc High	200 – 800 ms	10
QTc High	30 – 200 ms	

A.8.2 Resp

Technique	Trans-thoracic impedance	
Lead	Options are lead I and II. The default is lead II.	
Respiration excitation waveform	<300 μA RMS, 62.8 kHz (±10%)	
Baseline impedance range	200 to 2500 Ω (using an ECG cable with 1kΩ resistance)	
Bandwidth	0.2 to 2.5 Hz (-3 dB)	
Sweep speed	3 mm/s, 6.25 mm/s, 12.5 mm/s, 25 mm/s, or 50 mm/s Accuracy: ±10%	
Respiration Rate		
Measurement range	Adult: 0 to 120 rpm Pediatric, neonate: 0 to 150 rpm	
Resolution	1 rpm	
Accuracy	7 to 150 rpm: ±2 rpm or ±2%, whichever is greater 0 to 6 rpm: Not specified	
Apnea alarm time	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s	
Alarm limit	**Range (rpm)**	**Step (rpm)**
RR High	Adult, pediatric: (low limit + 2) to 100 Neonate: (low limit + 2) to 150	1
RR Low	0 to (high limit – 2)	

A.8.3 SpO_2

Alarm limit	Range (%)	Step (%)
SpO2 High	(low limit + 2) to 100	1
SpO2 Low	Masimo: Desat to (high limit – 2) Nellcor: Desat or 20 (whichever is greater) to (high limit – 2)	
Desat	0 to (high limit – 2)	

Masimo SpO_2 Module

Standards	Meet standards of ISO9919
Measurement range	1 to 100%
Resolution	1%
Response time	≤ 20 s (PR 75 bpm, average time 8 s, SpO_2 value rises from 60% to 95%)
Accuracy[1]	70% to 100%: ±2% (measured without motion in adult/pediatric mode) 70% to 100%: ±3% (measured without motion in neonate mode) 70% to 100%: ±3% (measured with motion) 1% to 69%: Not specified.
Refreshing rate	≤ 2 s
SpO_2 averaging time	2-4 s, 4-6 s, 8 s, 10 s, 12 s, 14 s, 16 s
Low perfusion conditions	Pulse amplitude: > 0.02% Light penetration: > 5%
Low perfusion SpO_2 accuracy[2]	±2%
PI measurement range	0.02 to 20%

[1] The Masimo pulse oximeter with sensors have been validated for no motion accuracy in human blood studies on healthy adult volunteers in induced hypoxia studies in the range of 70% to 100% SpO_2 against a laboratory co-oximeter and ECG monitor. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population. One percent was added to the accuracies for neonatal sensors to account for accuracy variation due to properties of fetal hemoglobin.

The Masimo pulse oximeter with sensors has been validated for motion accuracy in human blood studies on healthy adult volunteers in induced hypoxia studies while performing rubbing and tapping motions at 2 to 4 Hz. At an amplitude of 1 to 2 cm and non-repetitive motion between 1 to 5 Hz. At an amplitude of 2 to 3 cm in induced hypoxia studies in the range of 70% to 100% SpO_2 against a laboratory co-oximeter and ECG monitor. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

[2] The Masimo pulse oximeter has been validated for low perfusion accuracy in bench top testing against a Biotek Index 2 simulator and Masimo's simulator with signal strengths of greater than 0.02% and a % transmission of greater than 5% for saturations ranging from 70 to 100%. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

Nellcor SpO_2 Module

Standards	Meet standards of ISO9919
Measurement range	0 to 100%
Resolution	1%
Response time	≤ 30 s (PI > 0.3, no disturbance, SpO_2 value sudden change within 70% - 100%)
Accuracy	70% to 100%: ±2% (adult/pediatric) 70% to 100%: ±3% (neonate) 0 to 69%: Not specified.
Refreshing rate	≤ 2 s
*: When the SpO_2 sensor is applied for neonatal patients as indicated, the specified accuracy range is increased by ±1%, to compensate for the theoretical effect on oximeter measurements of fetal hemoglobin in neonatal blood.	

Information of the Test Subjects of the Clinical Study Report:

Skin color	Gender	Number	Age (years)	Health
Black	Male	1	28.2 9.19	Healthy
	Female	1		
Yellow	Male	3		
	Female	9		

A.8.4 PR

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

PR from Masimo SpO_2 Module

Measurement range	25 to 240 bpm
Resolution	1 bpm
Response time	≤ 30 s (PI > 0.3, no disturbance, PR value sudden change within 25 – 240 bpm)
Accuracy	±3 bpm (measured without motion) ±5 bpm (measured with motion)
Refreshing rate	1 s
Low perfusion conditions	Pulse amplitude: >0.02% Light penetration: >5%
Low perfusion PR accuracy	±3 bpm

PR from Nellcor SpO_2 Module

Measurement range	20 to 300 bpm
Resolution	1 bpm
Response time	≤ 30 s (PI > 0.3, no disturbance, PR value sudden change within 25 – 250 bpm)
Accuracy	20 to 250 bpm: ±3 bpm 251 to 300 bpm, not specified
Refreshing rate	1 s

PR from IBP Module

Measurement range	25 to 350 bpm
Resolution	1 bpm
Accuracy	±1 bpm or ±1%, whichever is greater
Refreshing rate	1 s

PR from NIBP Module

Measurement range	30 to 300 bpm
Resolution	1 bpm
Accuracy	±3bpm or ±3%, whichever is greater

A.8.5 NIBP

Standards	Meet standards of EN60601-2-30/IEC60601-2-30
Technique	Oscillometry
Mode of operation	Manual, Auto and STAT
Auto mode repetition intervals	1 min, 2 min, 2.5 min, 3 min, 5 min, 10 min, 15 min, 20 653 0 Td[(min)14 (,)]TJ-0.006 Tc 0.006 Tw 20

*Measurement accuracy verification: In adult and pediatric modes, the blood pressure measurements measured with this device are in compliance with the Standard for Non-invasive sphygmomanometers (ISO 81060-2) in terms of mean error and standard deviation by comparing with intra-arterial or auscultatory measurements (depending on the configuration) in a typical patient population. For auscultatory reference, the 5th Korotkoff sound was used to determine the diastolic pressure. In neonatal mode, the blood pressure measurements measured with this device are in compliance with the American National Standard for Non-invasive sphygmomanometers (ISO 81060-2) in terms of mean error and standard deviation by comparing with intra-arterial measurements (depending on the configuration) in a typical patient population.

A.8.6 Temp

Standards	Meet standard of iso 80601-2-56
Technique	Thermal resistance
Operating mode	Direct mode
Measurement range	0 to 50 °C (32 to 122 °F)
Resolution	0.1 °C
Accuracy	±0.1 °C (without probe)
Refreshing rate	1 s
Response time	<5 s
Minimum time for accurate measurement	Body surface: <100 s Body cavity: <80 s
Minimum time between measurements	Body surface probe: <100 s Body cavity probe: <80 s

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

A.8.7 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%
Zero adjustment range	200 mmHg
Sensitivity	5 μV/V/mmHg

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

A.8.8 CO_2

Measurement mode	Sidestream, microstream
Technique	Infrared absorption

Sidestream CO_2 Module

Standard	Meet standard of ISO 80601-2-55
CO_2 Measurement range	0 to 99 mmHg
Accuracy*	0 to 40 mmHg: ±2 mmHg 41 to 76 mmHg: ±5% of the reading 77 to 99 mmHg: ±10% of the reading
Accuracy drift	Meet the requirement for measurement accuracy within 6 hours
Resolution	1 mmHg
Sample flowrate	Adult: 70 ml/min, 100 ml/min, 120 ml/min, 150 ml/min Pediatric, neonate: 70 ml/min, 100 ml/min
Sample flowrate tolerance	15% or 15 ml/min, whichever is greater.
Warm-up time	60 s (maximum)
Rise time	Measured with a neonatal watertrap and a 2.5-meter neonatal sampling line, or an adult watertrap and a 2.5-meter adult sampling line: <400 ms @ 70 ml/min <330 ms @ 100 ml/min <300 ms @ 120 ml/min <240 ms @ 150 ml/min
Gas sampling delay time	Measured with a neonatal watertrap and a 2.5-meter neonatal sampling line: <4 s @ 100 ml/min <4.5 s @ 70 ml/min Measured with an adult watertrap and a 2.5-meter adult sampling line: <4.5 s @ 150 ml/min < 5 s @ 120 ml/min <5.5 s @ 100 ml/min <6.5 s @ 70 ml/min
awRR measurement range	0 to 120 rpm
awRR measurement precision	±2 rpm
Apnea time	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s

Inaccuracy specifications are affected by the breath rate and I:E change. The end-tidal gas reading is within specification for breath rate below 15BPM and I:E ratio smaller than 1:1 relative to the gas readings without breath

Note: The response time is the sum of the rise time and the delay time.

Effect of interference gases on CO_2 measurements		
Gas	**Concentration (%)**	**Quantitive effect***
N_2O	≤60	±1 mmHg
Hal	≤4	
Sev	≤5	
Iso	≤5	
Enf	≤5	
Des	≤15	±2 mmHg
*: means an extra error should be added in case of gas interference when CO_2 measurements are performed between 0-40mmHg.		
Alarm limit	**Range**	**Step**
$EtCO_2$ High (mmHg)	(low limit + 2) to 99	1
$EtCO_2$ Low (mmHg)	1 to (high limit - 2)	
$FiCO_2$ High (mmHg)	1 to 99	
awRR High (rpm)	Adult, pediatric: (low limit + 2) to 100 Neonate: (low limit + 2) to 150	1
awRR Low (rpm)	0 to (high limit - 2)	

Microstream CO_2 Module

Standard	Meet standard of ISO 80601-2-55
CO_2 Measurement range	0 to 99 mmHg
Accuracy*	0 to 38 mmHg: ±2 mmHg 39 to 99 mmHg: ±5% of the reading+0.08% of (the reading-38)
Accuracy drift	Meet the requirement for measurement accuracy within 6 hours
* Accuracy applies for respiration rate up to 80 rpm. For respiration rate above 80 rpm, the accuracy is 4 mmHg or ±12% of the reading, whichever is greater, for $EtCO_2$ exceeding 18 mmHg. For respiration rate above 60 rpm, the above accuracy can be achieved by using the CapnoLine H Set for Infant/Neonatal. In the presence of interfering gases, the above accuracy is maintained to within 4%.	
Resolution	1 mmHg
Sample flow rate	$50^{-7.5}_{+15}$ ml/min
Initialization time	180 s (maximum)
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	
Accuracy (of the measured CO_2 partial pressure) applies for breath rates of up to 80 bpm. For breath rates above 80 bpm, accuracy complies with EN 864/ISO 9918 (4 mmHg or ±12 % of reading whichever is greater) for $EtCO_2$ values exceeding 18 mmHg.		
Alarm limit	**Range**	**Step**
$EtCO_2$ High (mmHg)	(low limit + 2) to 99	1
$EtCO_2$ Low (mmHg)	1 to (high limit - 2)	
$FiCO_2$ High (mmHg)	1 to 99	
awRR High (rpm)	Adult, pediatric: (low limit + 2) to 100 Neonate: (low limit + 2) to 150	1
awRR Low (rpm)	0 to (high limit - 2)	

FOR YOUR NOTES

B EMC and Radio Regulatory Compliance

B.1 EMC

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

CAUTION

Using accessories, transducers and cables other than those specified may result in increased electromagnetic emission or decreased electromagnetic immunity of the monitor.

The monitor or its components should not be used adjacent to or stacked with other equipment. If adjacent or stacked use is necessary, the monitor or its components should be observed to verify normal operation in the configuration in which it will be used.

The monitor 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.

Other devices that have RF transmitter or source may affect this monitor (e.g. cell phones, PDAs, and PCs with wireless function).

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

WARNING

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

If the system is operated within the electromagnetic environment listed in

, the system will remain safe and provide the following essential performance,

Operating mode

Accuracy

Function

Accessories identification

Data stored

Alarm

Detect for connection

Guidance and Declaration - Electromagnetic Immunity			
The device is intended for use in the electromagnetic environment specified below. The customer or the user of the device should assure that it is used in such an environment.			
Immunity test	**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: $=1.2\sqrt{}$
Radiated RF IEC61000-4-3	3V/m 80MHz to 2.5GHz	3V/m	Recommended separation distances: 80 MHz 800 MHz $=1.2\sqrt{}$ 800MHz-2.5GHz $=2.3\sqrt{}$ Where, P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey [a], should be less than the compliance level in each frequency range [b]. Interference may occur in the vicinity of equipment marked with the following symbol:
Note 1: At 80 MHz to 800 MHz, the separation distance for the higher frequency range applies. Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people. Note 3: The device that intentionally receives RF electromagnetic energy at the exclusion band (2395.825MHz-2487.645MHz) is exempt from the essential performance requirements, but remains safe.			

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

WARNING

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

Recommended separation distances between portable and mobile RF communications equipment and the device			
The device is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the device can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the device as recommended below, according to the maximum output power of the communications equipment.			
Rated maximum output power of transmitter (W)	**Separation distance in meters (m) according to frequency of the transmitter**		
	150 kHz ~ 80 MHz $= 1.2\sqrt{\ }$	80 MHz ~ 800 MHz $= 1.2\sqrt{\ }$	800 MHz ~ 2.5 GHz $= 2.3\sqrt{\ }$
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

RF parameters

Type of Radio	IEEE 802.11b/g/n (2.4G)	IEEE 802.11a/n (5G)
Modulation mode	DSSS and OFDM	OFDM
Operating frequency	2412-2462MHz	5150-5350MHz, 5725-5850MHz
Channel spacing	5 MHz	20 MHz
Output power	< 30 dBm (Peak Power) < 20 dBm (Average Power)	

Federal Communications Commission (FCC) Statement

The wireless module has been tested and found to comply with the limits for a class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

Reorient or relocate the receiving antenna.

Increase the separation between the equipment and receiver.

Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

Consult the dealer or an experienced radio/TV technician for help.

CAUTION

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

B.3 Radio Frequency Radiation Exposure Information

For body worn operation, this equipment has been tested and meets the FCC and CE RF exposure guidelines when used with the accessories supplied or those approved for use with this product. Use of other accessories may not ensure compliance with FCC and CE RF exposure guidelines.

C Default Configurations

This chapter lists some of the most important factory default settings in configuration management. You cannot change the factory default configuration itself. However, you can make changes to the settings from the factory default configuration and then save the changed configuration as a user configuration.

C.1 Parameters Configuration

C.1.1 ECG

ECG Setup

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
Alm Source	Yes	Yes	HR
Alarm	Yes	Yes	On

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
screen only)			
ECG Waveform Area (12-lead screen only)	No	Yes	Normal

ST Analysis

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
ST Analysis	Yes	Yes	General, OR, ICU, NICU: Off CCU: On
ST Display	Yes	Yes	All
Alarm	Yes	Yes	Off
Alm Lev	Yes	Yes	Med
ST-X High	Yes	Yes	When ST Unit is mV: 0.20 When ST Unit is mm: 2.0
ST-X Low	Yes	Yes	When ST Unit is mV: -0.20 When ST Unit is mm: -2.0
Auto	Yes	Yes	Off
ISO	Yes	Yes	-80 ms
J	Yes	Yes	48 ms
ST	Yes	Yes	J + 60 ms

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

QT/QTc Analysis

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
QT Analysis	Yes	Yes	Off
QTc Formula	Yes	Yes	Hodges
Analysis lead	Yes	Yes	All
QTc Alarm	Yes	Yes	Off
ΔQTc Alarm	Yes	Yes	Off
QTc Alarm Level	Yes	Yes	Med
ΔQTc Alarm Level	Yes	Yes	Med
QTc Record	Yes	Yes	Off
ΔQTc Record	Yes	Yes	Off

Arrh. Analysis

Arrhythmia Threshold Settings (Mindray)		
Item Name	**Configurable**	**Default'''''**

Arrhythmia Alarm Settings (Mindray)		
Item Name	**Configurable**	**Default**
Pacer Not Pacing Alarm		

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
Beat Vol	Yes	Yes	General, OR: 2 ICU, NICU, CCU: 1

C.1.4 SpO_2

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
Alarm	Yes	Yes	On
Alm Lev	Yes	Yes	SpO_2: Med Desat: High
SpO_2 High	Yes	Yes	Adu, Ped: 100
			Neo: 95
SpO_2 Low	Yes	Yes	90
Desat	Yes	Yes	80
Sensivity ~Mindray ¯	Yes	Yes	Med
Sensitivity (Masimo)	Yes	Yes	Normal
Averaging (Masimo)	Yes	Yes	8 s
Sat-Seconds (Nellcor)	Yes	Yes	0 s
PI Zoom (Mindray)	Yes	Yes	No Ye

C.1.6 NIBP

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
Alarm	Yes	Yes	On
Alm Lev	Yes	Yes	Med
Interval	Yes	Yes	General: 15 min OR: 5 min ICU: 15 min NICU: 30 min CCU: 15 min
NIBP End Tone	Yes	Yes	Off
Clock	Yes	Yes	On
Initial Pressure (mmHg)	Yes	Yes	Adu: 160 Ped: 140 Neo: 90
Cuff Press. (mmHg)	Yes	Yes	Adu: 80 Ped: 60 Neo: 40
Alarm Limit			
NIBP-S High (mmHg)	Yes	Yes	Adu: 160 Ped: 120 Neo: 90
NIBP-S Low (mmHg)	Yes	Yes	Adu: 90 Ped: 70 Neo: 40
NIBP-M High (mmHg)	Yes	Yes	Adu: 110 Ped: 90 Neo: 70
NIBP-M Low (mmHg)	Yes	Yes	Adu: 60 Ped: 50 Neo: 25
NIBP-D High (mmHg)	Yes	Yes	Adu: 90 Ped: 70 Neo: 60
NIBP-D Low (mmHg)	Yes	Yes	Adu: 50 Ped: 40 Neo: 20

C.1.7 IBP

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
Alarm	Yes	Yes	On

PA Alarm Limit			
PA-S High (mmHg)	Yes	Yes	Adu: 35 Ped, Neo: 60
PA-S Low (mmHg)	Yes	Yes	Adu: 10 Ped, Neo: 24
PA-M High (mmHg)	Yes	Yes	Adu: 20 Ped, Neo: 26
PA-M Low (mmHg)	Yes	Yes	Adu: 0 Ped, Neo: 12
PA-D High (mmHg)	Yes	Yes	Adu: 16 Ped, Neo: 4
PA-D Low (mmHg)	Yes	Yes	Adu: 0 Ped, Neo: -4
CVP, LAP, RAP, ICP, UVP, P3-P4 Venous Pressure Alarm Limits			
IBP-M High (mmHg)	Yes	Yes	Adu: 10 Ped, Neo: 4
IBP-M Low (mmHg)	Yes	Yes	0
Art, Ao, BAP, F	**й Ď7 ®> | ® ж Ậ Ă Ą ! ќ √ v , > [lt Ă**		

Auto Standby (min)	Yes	Yes	0	
Alarm Limits			W	

C.2 Routine Configuration

C.2.1 Alarm

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
Alm Volume	Yes	Yes	General: 2 OR: 1 ICU, NICU, CCU: 2
Reminder Vol	Yes	Yes	Low
Recording Length	Yes	Yes	16 s
Apnea Delay	Yes	Yes	Adu, Ped: 20s Neo: 15 s
Alarm Delay	Yes	Yes	6 s
ST Alarm Delay	Yes	Yes	30 s
VTac Latching	No	Yes	On

C.2.2 Screens

Item Name	Configurable	Default

C.2.4 Night Mode

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
Brightness	Yes	Yes	1
Alm Volume	Yes	Yes	2
QRS Volume	Yes	Yes	1
Key Volume	Yes	Yes	0
NIBP End Tone	Yes	Yes	Off

C.2.5 Outdoor Mode

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
Measurement Color	No	Yes	White
Brightness	No	Yes	10
Key Volume	No	Yes	5
Alm Volume	No	Yes	5
Reminder Tone	No	Yes	High
QRS Volume	No	Yes	5

C.2.6 Review

Item Name		Configurable		Default
		In Config Mode	In Monitor Mode	
Tabular Trends	Interval	No	Yes	General: 30 min OR: 5 min ICU, NICU, CCU: 30 min
	Trend Group	No	Yes	Standard
Graphic Trends	Trend Group	No	Yes	Standard
	Zoom	No	Yes	90 min
	Waves	No	Yes	2
Full Disclosure	Save Waves	No	Yes	Save ECG1 by default.
	Gain	No	Yes	x 1
	Sweep	No	Yes	25 mm/s

C.2.7 Event

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
Waveform 1	No	Yes	II
Waveform 2	No	Yes	General, OR, ICU, CCU: I NICU Pleth
Waveform 3	No	Yes	General, OR, ICU, CCU: Pleth NICU Resp

C.2.8 Print

Item Name		Configurable		Default
		In Config Mode	In Monitor Mode	
Paper Size		No	Yes	Letter
Print On Both Sides		No	Yes	Off
ECG Reports	Amplitude	No	Yes	10 mm/mV
	Sweep	No	Yes	25 mm/s
	Auto Interval	No	Yes	Off
	12-Lead Format	No	Yes	12 x 1
Tabular Trends Reports	Set as End Case Report	No	Yes	Unselected
	Back	No	Yes	Auto
	Resolution	No	Yes	Auto
	Report Format	No	Yes	Parameter Oriented
	Currently Displayed Trended Parameters	No	Yes	Selected
	Standard Parameter Group	No	Yes	Unselected
	Custom	No	Yes	Unselected
	Not Print Blank Pages	No	Yes	Selected
Graphic Trends Reports	Set as End Case Report	No	Yes	Unselected

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C.3 User Maintenance Items

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
Changing Pat. Loc.	No	Yes	Protected
Network Encrypt Switch	No	Yes	Off
Barometric Pressure	No	Yes	760 mmHg
Height Unit	No	Yes	cm
Weight Unit	No	Yes	kg
ST Unit	No	Yes	mV
Press. Unit	No	Yes	mmHg
CVP Unit	No	Yes	cmH_2O
CO_2 Unit	No	Yes	mmHg
Temp Unit	No	Yes	°C
Network Type	No	Yes	LAN
Address Type	No	Yes	Manual
Select CMS	No	Yes	Off
ADT Query	No	Yes	On
Latching Alarms	No	Yes	Lethal
Alarm Pause Time	No	Yes	2 min
Minimum Alarm Volume	No	Yes	General, ICU, NICU, CCU: 2 OR: 1
Alarm Sound	No	Yes	ISO
High Alarm Interval (ISO mode)	No	Yes	10 s
Medium (ISO mode)	No	Yes	20 s
Low Alarm Interval (ISO mode)	No	Yes	20 s
Reset Other Bed's Alarms (external display only)	No	Yes	Off
Alarm Reset By Other Bed	No	Yes	On
Other Bed Disconnection Alarm	No	Yes	On
Reminder Interval	No	Yes	3 min
Reminder Tone	No	Yes	On
ECGLeadOff Lev.	No	Yes	Low
SpO_2SensorOff Lev.	No	Yes	Low
IBP SensorOff Lev.	No	Yes	Med
Lethal Arrh. OFF	No	Yes	Disable
Extended Arrh.	No	Yes	Enable
Alarm Light on Alarm Reset	No	Yes	On
Alarm Delay	No	Yes	6 s
ST Alarm Delay	No	Yes	30 s
Vtac Latching Lock	Yes	Yes	Enable
Wave Line	No	Yes	Mediate
Outdoor Mode	No	Yes	Manual
ECG Standard	No	Yes	AHA

Item Name	Configurable		Default
	In Config Mode	In Monitor Mode	
Notch Freq.	No	Yes	50 Hz
Data Transfer Method	No	Yes	Off
Transferred Data Length	No	Yes	4 h
SpO_2 Tone	No	Yes	Mode 1
Clear CMS IP at startup	Yes	Yes	Off
Parameter Switch	Yes	Yes	Selected

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 for details.

The "L" field indicates the alarm level: "H" means high, "M" means medium and "L" means low. "*" means the alarm level is configurable.

XX represents a measurement or parameter label or module, such as ECG, NIBP, HR, ST-I, PVCs, RR, SpO_2, PR, etc.

In the "Cause and Solution" column, corresponding solutions are given instructing you to troubleshoot problems. If the problem persists, contact your service personnel.

D.1 Physiological Alarm Messages

Measurement	Alarm messages	L	Cause and solution
XX	XX Too High	M*	XX value has risen above the high alarm limit or fallen below the low alarm limit. Check the patient's condition and make sure that the patient category and alarm limit settings are correct.
	XX Too Low	M*	
ECG	ECG Weak Signal	H	The ECG signal is 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*	
	Run PVCs	M*	
	Couplet	M*	
	PVC	M*	
	PVCs/min	M*	
	Bigeminy	M*	
	Trigeminy	M*	
	Tachy	M*	
	Brady	M*	

Measurement	Alarm messages	L	Cause and solution
	Missed Beats	M*	
	Afib	M*	
	Irr. Rhythm	M*	
	Vent. Rhythm	M*	
	Multif. PVC	M*	
	Nonsus. Vtac	M*	
	Pause	M*	
	Pacer Not Pacing	M*	The pacer appears abnormal. Check the pacer.
	Pacer Not Capture	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 SpO2 value has fallen below the desaturation alarm limit. Check the patient's condition and check if the alarm limit settings are correct.
	No Pulse	H	The pulse signal was 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.

D.2 Technical Alarm Messages

Measurement	Alar

Measurement	Alarm message	L	I	Cause and solution
	SpO_2 Sensor Incompatible	L	C	sure the sensor is not damaged. Reconnect the sensor or use a new sensor.
	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 No 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 excessive movement.
8	SpO_2 Comm Abnormal			

Measurement	Alarm message	L	I	Cause and solution
	NIBP Timeout	L	A	therefore the monitor cannot perform analysis correctly. Check the patient's condition and NIBP connections, or replace the cuff.
	NIBP Measure Failed	L	A	
	NIBP Illegally Reset	L	A	An illegal reset occurred during NIBP measurement. Check if the airway is occluded.
IBP	YY Sensor Off	M*	A	Check the sensor connection and reconnect the sensor.
	YY Sensor Fault	M	C	Replace the sensor.
	YY Disconnected	H	C	The liquid way is disconnected from the patient, or the three-way valve is open to the air. Check the connection of the liquid way, or check the valve is open to the patient. If the problem remains, contact the Customer Services Dept. for help.
	YY No Pulse (YY represents an IBP label)	L	A	The catheter may be occluded. Please flush the catheter.
CO_2	CO_2 Sensor High Temp	L	C	Check, stop using or replace the sensor.
	CO_2 Sensor Low Temp	L	C	Check, stop using or replace the sensor.
	CO_2 Temp Overrange	L	C	The operating temperature of the CO_2 module goes beyond the specified range. After it restores within the specified range, the module will restart automatically.
	CO_2 Airway High Press.	L	C	An error occurred in the airway pressure. Check the patient connection and patient circuit, and then restart the monitor.
	CO_2 Airway Low Press.	L	C	
	CO_2 High Barometric Press.	L	C	Check the CO_2 connections, make sure that the monitor application site meets the requirements, and check for special sources that affect the ambient pressure. Restart the monitor.
	CO_2 Low Barometric Press.	L	C	
	CO_2 FilterLine Occluded	L	C	The airway or watertrap was occluded. Check the airway and remove the occlusion.
	CO_2 No Watertrap	L	B	Check the watertrap connections.
	CO_2 Check Adapter	L	A	There is a problem with the airway adapter. Check, clean or replace the adapter.
	CO_2 FilterLine Err	L	C	Check if there is a leak in the CO_2 sample line or the CO_2 sample line has been occluded.
	CO_2 Zero Failed	L	A	Check the CO_2 connections. After the sensor's temperature becomes stabilized, perform a zero calibration again.
	CO_2 System Err	L	A	Re-plug the module or restart the monitor.
	CO_2 Check Cal.	L	C	Perform a calibration.
	CO_2 Check Airway	L	C	An error occurred to the airway.
	CO_2 No Filterline	L	A	Make sure that the filterline is connected.
	CO_2 No Sensor	L	A	Make sure that the sensor is connected.
	CO_2 Main Board Err	H	C	There is a problem with the CO_2 module. Re-plug the module or restart the monitor.
	CO_2 Checking Sensor	L	C	
	CO_2 Replace Scrubber&Pump	L	C	

Measurement	Alarm message	L	I	Cause and solution
	CO_2 15V Overrange	H	C	
	CO_2 Hardware Err	H	C	
Power	12V Too High	H	C	There is a problem with the system power supply. Restart the monitor.
	12V Too Low	H	C	
	5V Too High	H	C	
	5V Too Low	H	C	
	3.3V Too High	H	C	
	3.3V Too Low	H	C	
	No Battery	H	C	1. Battery is not installed or poor contact: properly install the battery. 2. Battery circuit failure or battery failed: contact your service personnel.
	Low Battery	M	C	Connect the monitor to an external power source.
	Battery Depleted	H	C	Connect the monitor to an external power source.
	T1 battery to be protected and not work.	H	C	T1 battery will be soon protected and will not supply power. If you are going to use the T1 for patient transport, please replace the battery.
	T1 battery aged. Replace the battery	L	C	T1 battery lifetime is expired. Replace the battery with a new one.
	Power Board Comm Err	H	C	Restart the monitor. If the problem persists, contact your service personnel.
	RT Clock Need Reset	L	C	Internal backup battery cell fails. Contact your service personnel.
	RT Clock Not Exist	H	C	Contact your service personnel.
System	IP Address Conflict	L	A	Set a new IP address.
	No CMS	L	A	The monitor is disconnected from the CMS. Check network connection.
	Other Bed Disconnected	L	A	Check network connection.
	PWR interrupted. Check meas. state	L	A	Power supply failed accidently. Check the measurements when the monitor restarts.
	Restoring Last Config. Failed	L	A	Restart the monitor. If the problem persists,there may be an EEPROM failure. Contact your service personnel.
	Loading Default Config. Failed.	L	A	Restart the monitor. If the problem persists,there may be an EEPROM failure. Contact your service personnel.
	USB Drive Err	M	A	1. Disconnect the USB memory and reconnect it properly. 2. If the problem persists, format the USB memory. 3. If the problem still persists, replace the USB drive.
	Storage Card Err	M	C	Restart the monitor. If the problem persists, format the SD card.
	Storage Card Space Low	L	B	The storage card has abnormal data. Format the storage card.
	USB Drive Space Low	L	A	Delete unnecessary data from the USB memory, or replace the USB memory.

Measurement	Alarm message	L	I	Cause and solution
	Read Dock E2PROM Error	H	C	Disconnect the T1 from the docking station and reconnect it, or replace the external display.
	Unknown Device	L	A	The external device fails, or is not supported by the T1, or is not connected properly. Reconnect the external device properly. If the problem persists, replace the external device.

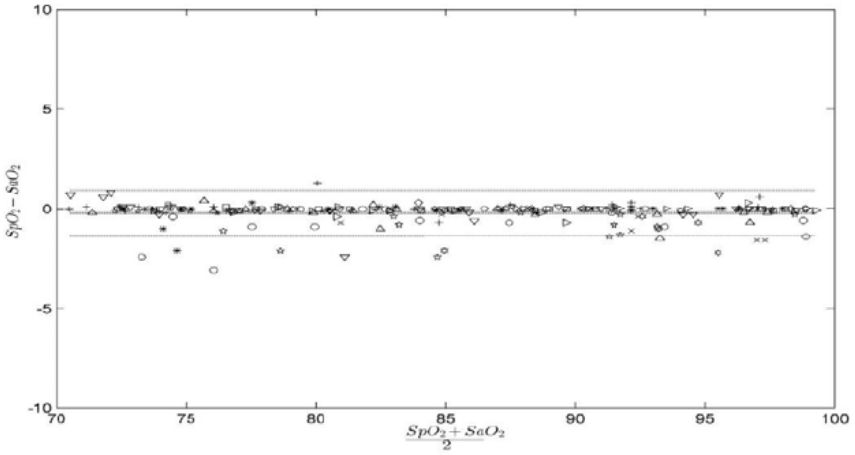
FOR YOUR NOTES

E SpO_2 Sensor Accuracy

A.1 Accuracy of Masimo SpO_2 Sensors

Table information for the plots below show ARMS values measured with Masimo SET Oximetry Technology in a clinical study.

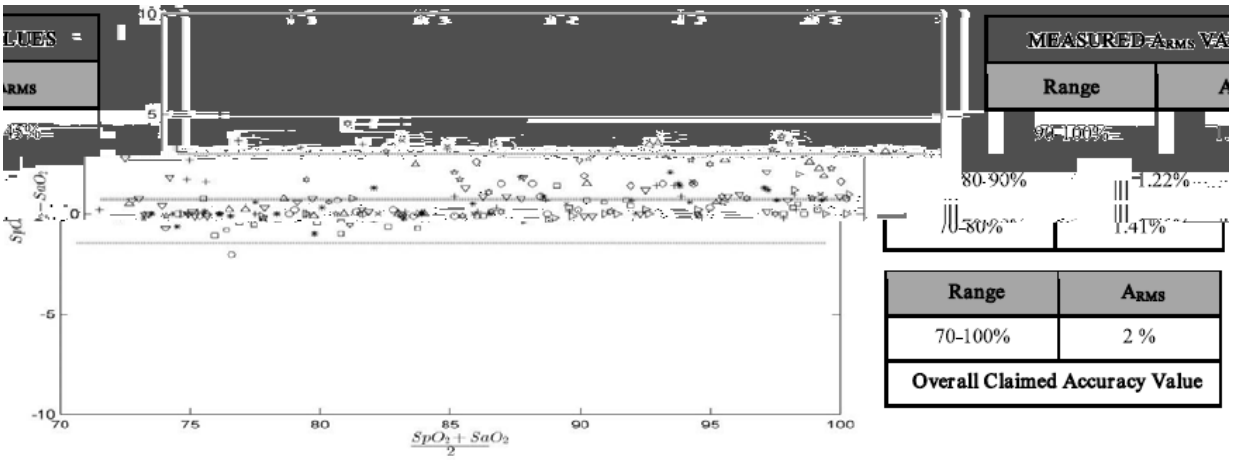
DCI/DCIP/4050/4051



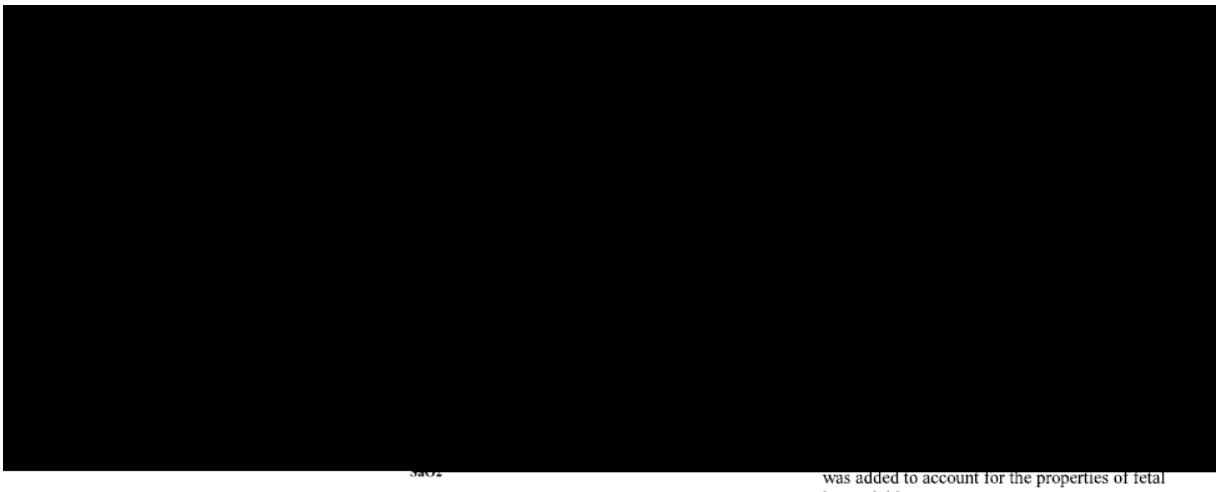
MEASURED A_{RMS} VALUES	
Range	**A_{RMS}**
90-100%	0.60%
80-90%	0.54%
70-80%	0.67%

Range	**A_{RMS}**
70-100%	2 %
Overall Claimed Accuracy Value	

4053

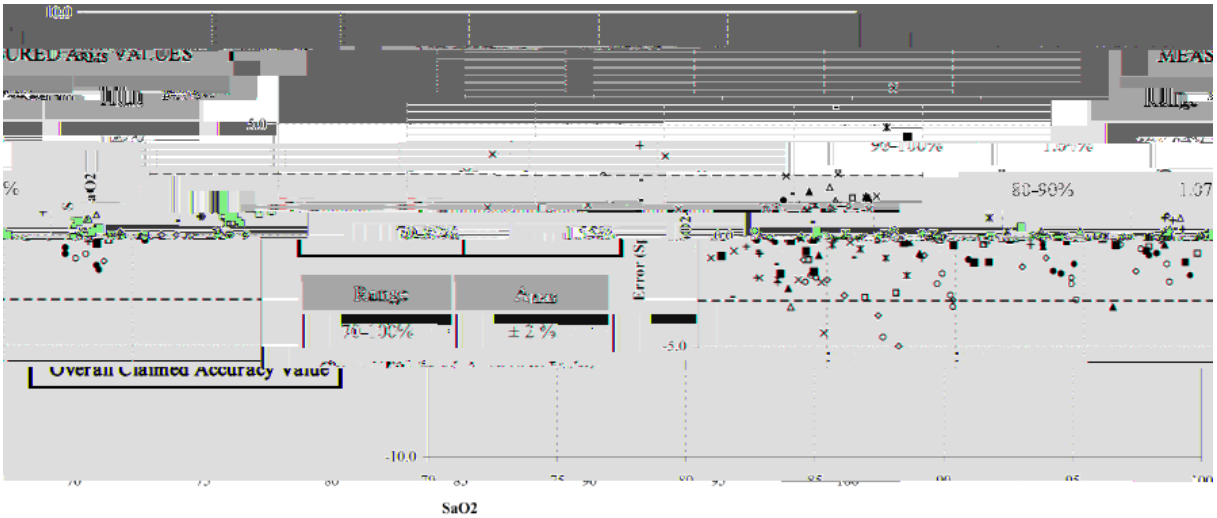


Inf/Neo/NeoPt/4002/4003/4004/4005



was added to account for the properties of fetal hemoglobin.

Adtx/Pdtx/4000/4001

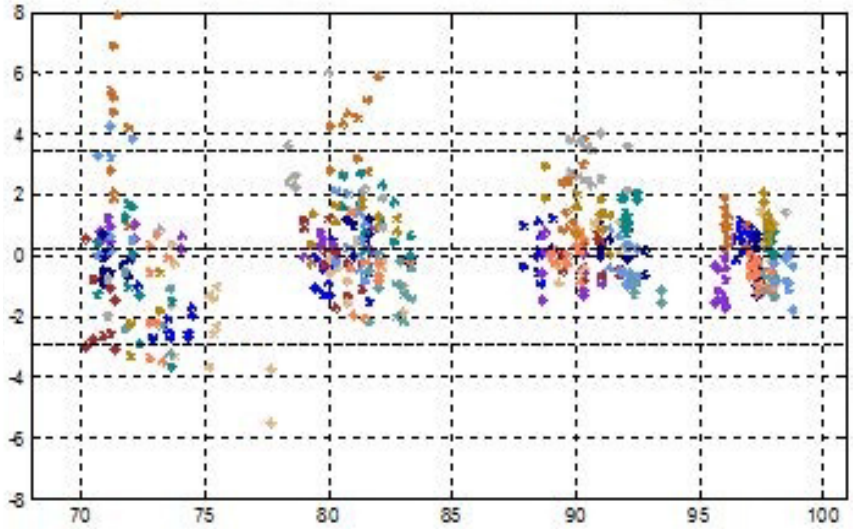


A.2 Accuracy of Nellcor SpO_2 Sensors

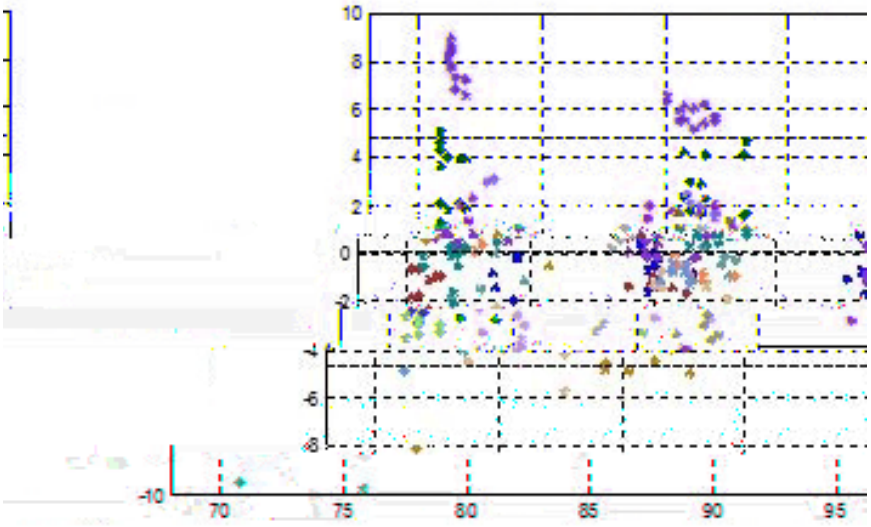
- SpO_2 Accuracy for Nellcor™ Sensors vs. Co-Oximeters

SpO_2 Range	100% to 70%	100% to 90%	90% to 80%	80% to 70%
DS-100A	1.64%	1.16%	1.67%	2.25%
OXI-P/I, OXI-A/N	2.41%	1.38%	2.50%	3.60%
MAX-AI, MAX-PI, MAX-II	1.62%	1.49%	1.57%	2.50%
MAX-NI	1.85%	1.71%	1.51%	1.59%

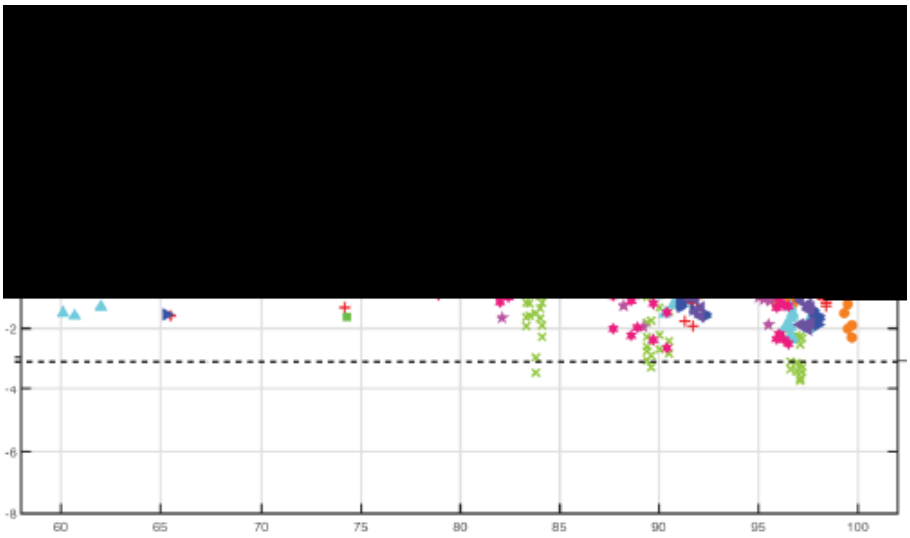
Modified Bland-Altman for SpO_2-DS-100A Sensor: (SpO_2 - SaO_2) vs. SaO_2



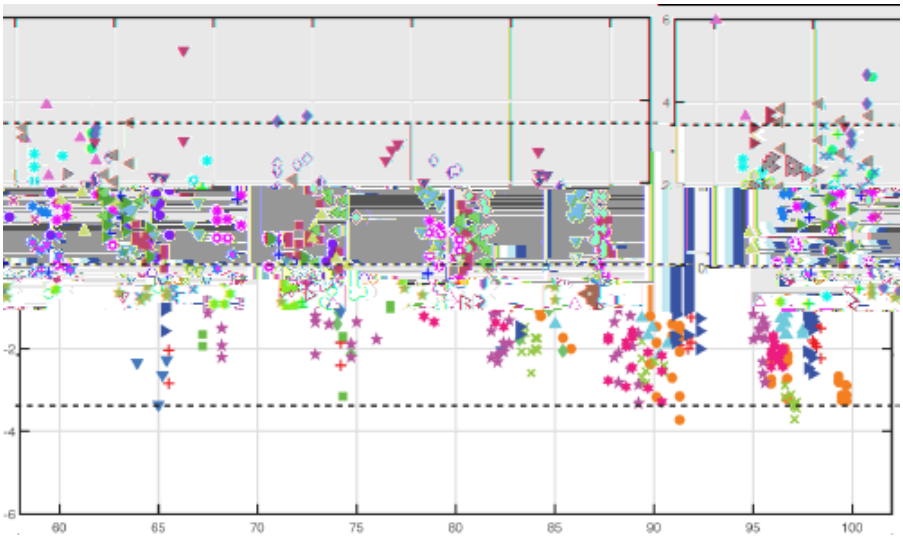
Modified Bland-Altman for SpO_2-OXI-P/I, OXI-A/N Sensors: (SpO_2 - SaO_2) vs. SaO_2



Modified Bland-Altman for SpO_2- MAX-AI, MAX-AI, MAX-PI, MAX-II Sensors: SaO_2 vs. (SpO_2 - SaO_2)



Modified Bland-Altman for SpO_2- MAX-NI Sensor: SaO_2 vs. (SpO_2 - SaO_2)



F Symbols and Abbreviations

F.1 Symbols

µA	microampere
µV	microvolt
µs	Microsecond
A	ampere
Ah	ampere hour
bpm	beat per minute
bps	bit per second
ºC	centigrade
cc	cubic centimeter
cm	centimeter
cmH2O	centimeters of water
dB	decibel
DS	dyne second
ºF	fahrenheit
g	gram
GHz	gigahertz
GTT	gutta
h	hour
Hz	hertz
in	inch
kg	kilogram
kPa	kilopascal
L	litre
lb	pound
m	meter
mAh	milliampere hour
Mb	mega byte
mg	milligram
min	minute
ml	milliliter
mm	millimeter
mmHg	millimeters of mercury
ms	millisecond
mV	millivolt
mW	milliwatt
MΩ	megaohm
nm	nanometer
rpm	respirations per minute
s	second

V	volt
VA	volt ampere
Ω	ohm
W	watt

–	minus, negative
%	percent
/	per; divide; or; none; not applicable
+	plus
=	equal to
<	less than
>	greater than
≤	less than or equal to
≥	greater than or equal to
±	plus or minus
×	multiply

F.2 Abbreviations

AAMI	Association for Advancement of Medical Instrumentation
AC	alternating current
Adu	adult
AHA	American Heart Association
Air Flow	air flow
ANSI	American National Standard Institute
Ao	aortic pressure
Art	arterial
aVF	left foot augmented lead
aVL	left arm augmented lead
aVR	right arm augmented lead

CMOS	complementary metal oxide semiconductor
CMS	central monitoring system
CO_2	carbon dioxide
COHb	carboxyhemoglobin
Compl	compliance
CP	cardiopulmonary
CPI	cardiac power index
CPO	Cardiac Power Output
Cstat	static compliance
CVP	central venous pressure
DC	direct current
Des	desflurane
Dia	diastolic
DPI	dot per inch
dPmx	left ventricular contractility
DVI	digital video interface
ECG	electrocardiograph
EDV	end-diastolic volume
EEC	European Economic Community
EEG	electroencephalogram
EMC	electromagnetic compatibility
EMG	electromyography
EMI	electromagnetic interference
ESU	electrosurgical unit
Et	end-tidal
$EtCO_2$	end-tidal carbon dioxide
EtN_2O	end-tidal nitrous oxide
EtO	ethylene oxide
EtO_2	end-tidal oxygen
ELWI	extravascular lung water index
EVLW	extravascular lung water
Exp. Flow	expiratory flow
Exp%	inspiration termination level
FAP	femoral arterial pressure
FCC	Federal Communication Commission
FDA	Food and Drug Administration
FEV1.0%	first second forced expiratory volume ratio
Fi	fraction of inspired
FPGA	field programmable gate array
GEDI	global end diastolic volume index
GEF	global ejection fraction
Hb	hemoglobin
Hb-CO	carbon mono-oxide hemoglobin
HbO_2	oxyhemoglobin
HIS	hospital information system
HR	heart rate

I:E	inspiratory-expiratory ratio
IBP	invasive brood pressure

pArt-M	mean artery pressure
pArt-S	systolic artery pressure
PD	photodetector
Ped	pediatric
Pleth	plethysmogram
PPV	Pulse Pressure Variation
PR	pulse rate
PVC	premature ventricular contraction
PVR	pulmonary vascular resistance
PVRI	pulmonary vascular resistance index
PVPI	pulmonary vascular permeability index
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
Rise Time%	rise time
RL	right leg
RR	respiration rate
SFM	self-maintenance
SI	stroke index
SpO_2	arterial oxygen saturation from pulse oximetry
SQI	signal quality index
SR	suppression ratio
STR	systolic time ratio
SV	stroke volume
SVI	Stroke Volume Index
SVR	systemic vascular resistance
SVRI	systemic vascular resistance index
SVV	stroke volume variation
Sync	synchronization
Sys	systolic pressure
Taxil	axillary temperature
TB	Blood Temperature
TD	temperature difference
Temp	temperature
TFC	thoracic fluid content
TFI	thoracic fluid index
TFT	thin-film technology
Thigh	time for the upper pressure level
Toral	oral temperature

Tplat	plateau time
Trect	rectal temperature
Trise	rise time
Tslope	time for the pressure to rise to target pressure
Tube ID	tube ID
UAP	umbilical arterial pressure
UPS	uninterruptible power supply
USB	universal serial bus
UVP	umbilical venous pressure
VAC	volts alternating current
WLAN	wireless local area network
WOB	work of breathing
WOBimp	imposed work of breathing