Vetal 3

Portable Veterinary Monitor

Operator’s Manual

For this Operator's Manual, the issue date is 2023-07.

IMPORTANT!

The product is for veterinary use only.

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- the electrical installation of the relevant room complies with the applicable national and local requirements; and
- the product is used in accordance with the instructions for use.

NOTE:

This device must be operated by skilled/trained clinical professionals.

⚠ WARNING

It is important for the hospital or organization that employs this device to carry out a reasonable service/maintenance plan. Neglect of this may result in machine breakdown or personal injury.

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- Important data must be backed up on external memory media.
- Mindray Animal Medical shall not be liable for loss of data stored in the memory of this system caused by operator error or accidents.
- This manual contains warnings regarding foreseeable potential dangers, but you shall also be continuously alert to dangers other than those indicated. Mindray Animal Medical shall not be liable for damage or loss resulting from negligence or ignorance of the precautions and operating instructions described in this operator's manual.
- If a new manager takes over this system, be sure to hand over this operator's manual to the new manager.

About This Manual

This operator's manual describes the operating procedures for this diagnostic ultrasound system and the compatible probes. To ensure safe and correct operation, carefully read and understand the manual before operating the system.

NOTE:

- If you find that the contents of the multi-language manuals are NOT consistent with the system or the English manuals, refer ONLY to the corresponding English manuals.
- The accompanying manuals may vary depending on the specific system you purchased. Please refer to the packing list.

Meaning of Signal Words

In this manual, the signal words ⚠**DANGER**, ⚠**WARNING**, ⚠**CAUTION**, ***NOTE*** and ***TIP*** are used regarding safety and other important instructions. The signal words and their meanings are defined as follows. Please understand their meanings clearly before reading this manual.

Signal word	Meaning
⚠ **DANGER**	Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury.
⚠ **WARNING**	Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.

Signal word	Meaning
⚠ **CAUTION**	Indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury.
NOTE	Indicates a potentially hazardous situation that, if not avoided, may result in property damage.
TIP	Important information that helps you to use the system more effectively.

Software Interfaces in this Manual

Depending on the software version, preset settings and optional configuration, the actual interfaces may be different from those in this manual.

Conventions

In this manual, the following conventions are used to describe the buttons on the control panel, items in the menus, buttons in the dialog boxes and some basic operations:

- *Italic text* is used in this manual to quote the referenced manuals, chapters, sections and formulas.
- **Bold text** is used to indicate the screen texts and names of hard keys.
- Select: rotate the knob to move the focus to a menu item or button, and then press the knob.
- **Bold text** > **Bold text**: select a submenu item following the path.

Operator's Manuals

The content of the operator manual, such as screens, menus or descriptions, may be different from what you see in your system. The content varies depending on the software version, options and configuration of the system.

Contents

1 Important Information

1.1 Warnings

⚠ WARNING

- **This monitor is used for single animal at a time.**
- **Before putting the system into operation, the operator must verify that the monitor, connecting cables and accessories are in correct working order and operating condition**
- **To avoid risk of electric shock, the monitor must only be connected to mains power with protective earth. If a protective earth conductor is not provided, operate it on battery power, if possible.**
- **To avoid explosion hazard, do not use the monitor in the presence of oxygen-rich atmospheres, flammable anesthetics, or other flammable agents.**
- **Do not open the monitor housings. All servicing and future upgrades must be carried out by trained and authorized personnel.**
- **The monitor is not intended to be used within the Magnetic Resonance (MR) environment.**
- **Do not touch the animal and live parts simultaneously. Otherwise animal injury may result.**
- **Do not come into contact with the animal during defibrillation. Otherwise serious injury or death could result.**
- **Do not rely exclusively on the audible alarm system for animal monitoring. Turning the alarm volume to a low level or off may result in a hazard to the animal. Remember that alarm settings should be customized according to animal situations. Always keep the animal under close surveillance.**
- **The physiological data and alarm messages displayed on the monitor 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 animals or personnel.**
- **When disposing of the package material, be sure to observe the applicable waste control regulations and keep it out of children's reach.**
- **Ensure that the monitor is supplied with continuous electric power during work. Sudden power failure might lead to the loss of animal data.**
- **The monitor shall be installed by the authorized personnel.**
- **The software copyright of the monitor is solely owned by us. No organization or individual shall resort to juggling, copying, or exchanging it or to any other infringement on it in any form or by any means without due permission.**
- **Devices connected to the monitor must meet the requirements of the applicable IEC standards (e.g. IEC 62368-1 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 monitor's signal input/output port is responsible for providing evidence that the safety certification of the devices has been performed in accordance to the IEC 60601-1. If you have any question, please contact the Customer Service Department or sales representative.

- **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 animals and all devices concerned will not be impaired by the proposed combination.**
- **The monitor might be contaminated during storage and transport. Before use, please verify whether the packages are intact, especially the packages of single use accessories. In case of any damage, do not apply it to animals.**
- **Make sure that the operating environment of the monitor meets the specific requirements. Otherwise unexpected consequences, e.g. damage to the monitor, could result.**
- **Make sure that the alarm limits settings are appropriate for your animal before monitoring.**

1.2 Cautions

⚠ CAUTION

- **Use only parts and accessories specified in this manual.**
- **Magnetic and electrical fields are capable of interfering with the proper performance of the monitor. For this reason make sure that all external devices operated in the vicinity of the equipment comply with the relevant EMC requirements. Mobile phone, X-ray equipment or MRI devices are a possible source of interference as they may emit higher levels of electromagnetic radiation**
- **Before connecting the monitor to the power line, check that the voltage and frequency ratings of the power line are the same as those indicated on the monitor's label or in this manual.**
- **Always install or carry the monitor properly to avoid damage caused by drop, impact, strong vibration or other mechanical force.**
- **Dry the monitor immediately in case of rain or water spray.**
- **Never mix animal electrode types or brands. This may lead to problem due to impedance mismatch.**
- **Changing date and time will affect the storage of trends and events and may cause data missing.**

1.3 Notes

NOTE:

- Put the monitor in a location where you can easily view and operate the monitor.
- The monitor use a mains plug as isolation means to the mains power. Do not locate the monitor in a place difficult to operate the mains plug.
- The typical operator's position is in front of the monitor.
- This manual describes all features and options. Your monitor may not have all of them.

2 Product Overview

2.1 Intended Use

The Vetal 3 Portable Veterinary Monitor (hereafter called “the monitor”) is intended to be used for monitoring, displaying, reviewing, alarming and transferring of multiple physiological parameters including ECG, heart rate (HR), respiration (Resp), temperature (Temp), pulse oxygen saturation (SpO_2), pulse rate (PR), non-invasive blood pressure (NIBP) and carbon dioxide (CO_2).

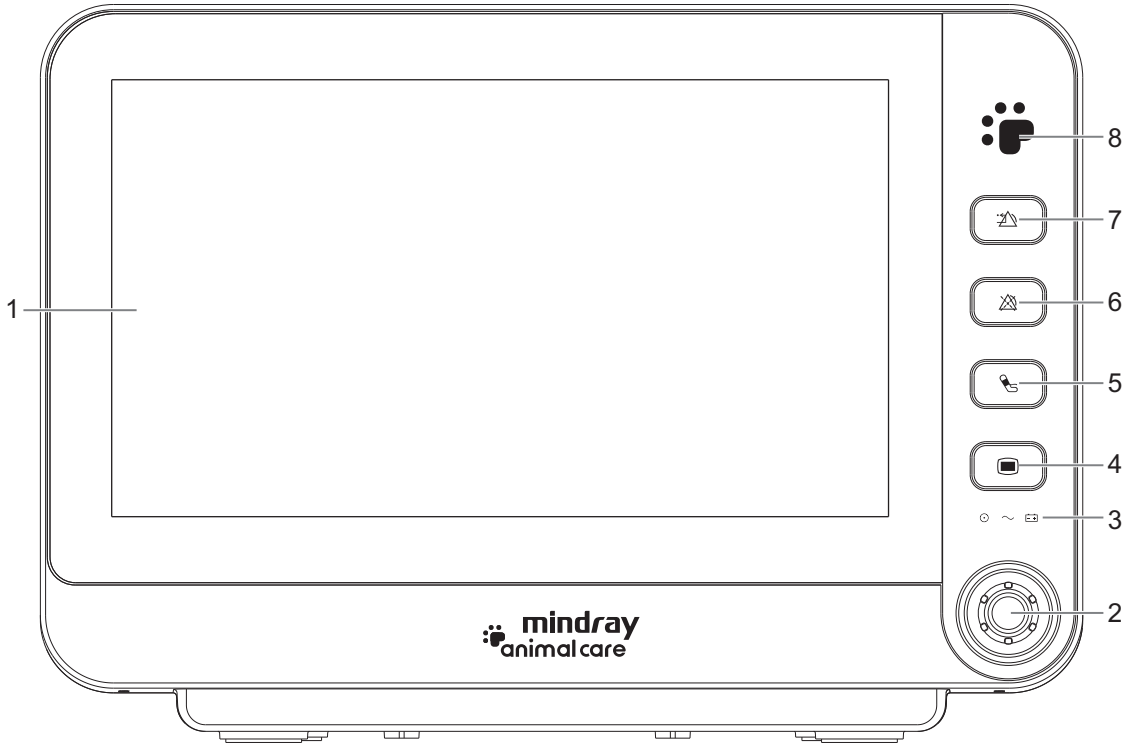
The monitor is to be used in animal medical institutions by clinical professionals or under their guidance.

2.2 Contraindication

Not identified yet.

2.3 Introduction of Each Unit

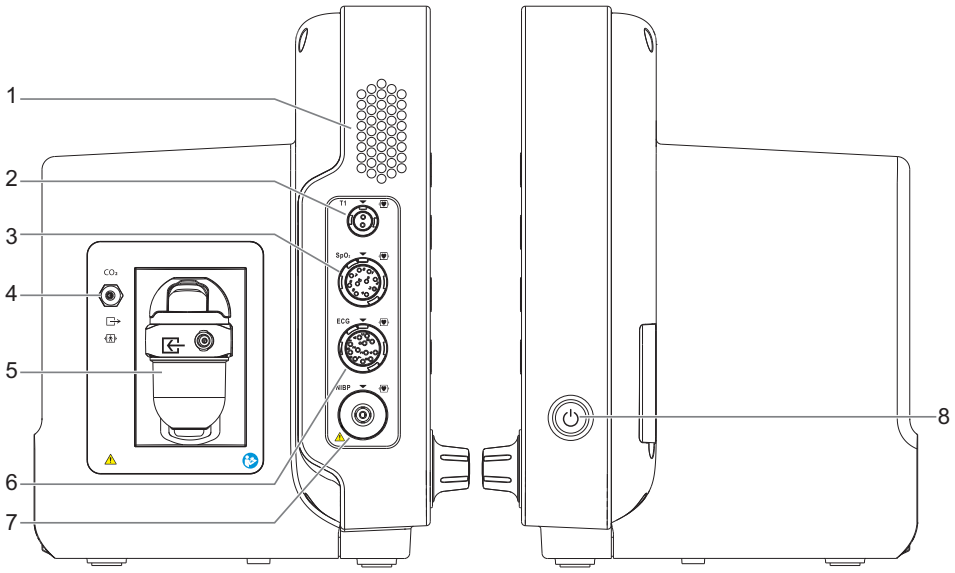
2.3.1 Front Panel



No.	Name	Description
1.	Display Screen	Displays various physiological parameters, waveforms and other information.
2.	Knob	Rotate the knob clockwise or counterclockwise. With each click, the highlight jumps to the neighboring item. When you reach your desired item, press the Knob to select it.
3.	Indicators	Battery indicator • On: when the battery is installed and the AC source is connected. • Off: when no battery is installed or the installed battery is malfunction, or no AC source is connected when the monitor is power off. • Flash: when the monitor operates on battery power.
		AC power indicator • On: when the power is connected. • Off: when the power is not connected.
		Power on/off indicator • On: when the monitor is on. • Off: when the monitor is off.

No.	Name	Description
4.	(Main menu) hard key	Enter or exit the main menu. If no menu is displayed on the screen, pressing it will enter the main menu. If there is a menu displayed on the screen, pressing it will close that menu.
5.	NIBP Start/Stop hard key	Press to start an NIBP measurement or stop the current NIBP measurement.
6.	(Alarm pause) hard key	Press to pause the physiological alarm system.
7.	(Alarm reset) hard key	Press to reset the alarm system.
8.	Alarm lamp	When a physiological alarm or technical alarm occurs, this lamp lights and flashes corresponding with the alarm priority: • High priority alarms: the lamp quickly flashes red. • Medium priority alarms: the lamp slowly flashes yellow. • Low priority alarms: the lamp lights in yellow without flashing.

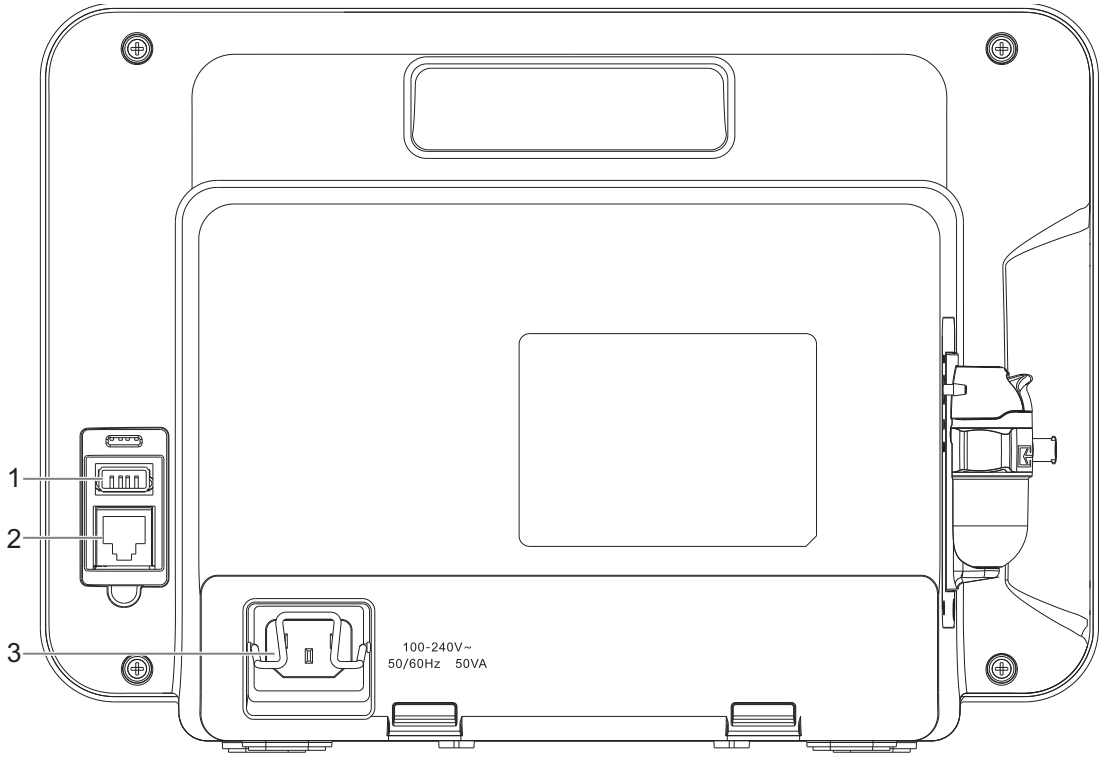
2.3.2 Side Panels



No.	Name	Description
1.	Speaker	/
2.	Temperature probe connector	/
3.	SpO_2 probe connector	/

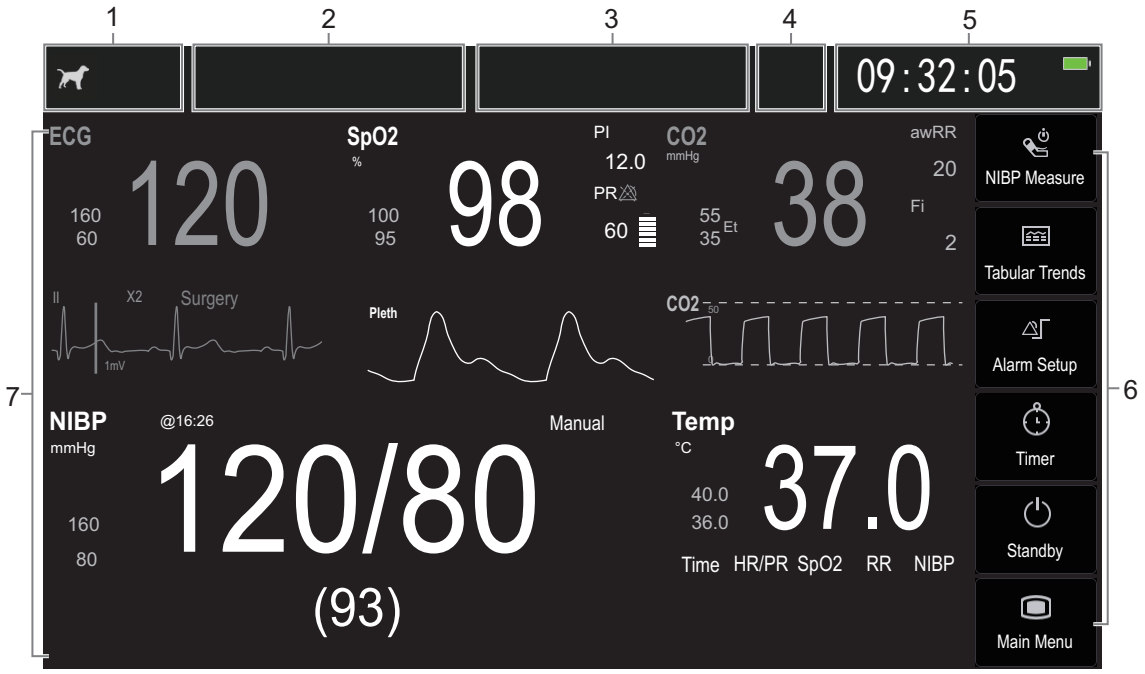
No.	Name	Description
4.	CO_2 gas outlet (optional)	Connect the gas outlet to the scavenging system using an exhaust tube.
5.	Watertrap (optional)	Connect the gas sample line to the watertrap.
6.	ECG cable connector	/
7.	NIBP cuff connector	/
8.	⏻ Power switch	• Press to turn on the monitor. • When the monitor is on, press and hold at least 5s to turn off the monitor.

2.3.3 Rear Panel



No.	Name	Description
1.	USB port	Connect USB devices.
2.	Network port	Reserved.
3.	AC Power input	Connect to AC power outlet.

2.4 Screen Display



No.	Name	Description
1.	Animal information area	Displays animal information, including animal category, animal name, age, weight, and so on. Selecting this area enters the animal information management menu.
2.	Technical alarm information area	Displays prompt messages and technical alarm messages. Selecting this area displays the list of active technical alarms.
3.	Physiological alarm information area	Displays physiological alarms. Selecting this area displays the list of active physiological alarms.
4.	Alarm status icon area	Displays the alarm symbol.
5.	System status information area	Displays battery status, system time, etc.
6.	Quick key area	Displays selected quick keys.
7.	Parameter display area	• Parameters with waveforms: displays parameter waveforms, parameter values, alarm limits, and alarm status. • No-waveform parameter: displays parameter values, alarm limits, and alarm status. Selecting a parameter numeric area enters corresponding parameter menu.

2.5 Available Quick Keys

The monitor provides quick keys for you to quickly access some functions. The quick keys displayed on the screen are configurable.

The following table shows available quick keys.

Symbol	Label	Function
	**NIBP Measure/Stop All**	Starts an NIBP measurement or stops the current NIBP measurement.
	**Alarm Setup**	Enters the Alarm Setup menu.
	**Tabular Trends**	Enters the animal data review screen.
	**Alarm Reset**	Resets the alarm system.
	**Screen Exchange**	Switches the screen display layout.
	**Timer**	Enables to show/hide the timer.
	**Alarm Pause**	Pauses the physiological alarms.
	**General Setup**	Enters the **General Setup** menu.
	**Standby**	Discharges the current animal and enters the standby mode.
	**Parameter Setup**	Enters the **Parameter Setup** menu.
	**Freeze**	Freezes waveforms.

Symbol	Label	Function
	**Main Menu**	Enters/Exits the main menu.

2.6 Symbols

Some symbols may not appear on your monitor.

Symbol	Description
	Refer to instruction manual/ booklet
	General warning sign
	Stand-by
	Alternating current
	USB port
	Network port
	Defibrillation-proof type CF applied part
	Defibrillation-proof type BF applied part
	Humidity limitation
	Atmospheric pressure limitation
	Temperature limit
IPX1	Protected against vertically falling water drops
CE	CE marking
UK CA	UKCA marking

Symbol	Description
	Input; entrance
	Output; exit
	Battery indicator
	Calibration
	Date of manufacture
	Manufacturer
	Serial number
	Locking
	Unlocking
	The following definition of the WEEE label applies to EU member states only: the use of this symbol indicates that waste electrical and electronic equipment must not be disposed of as unsorted municipal waste and must be collected separately. By ensuring that this product is disposed of correctly, you will help prevent bringing potential negative consequences to the environment and human health. For more detailed information with regard to returning and recycling this product, consult the distributor from whom you purchased the product.

3 Basic Operations

3.1 Using Keys

The monitor has the following types of keys:

- Soft key: A soft key is a graphic key on the screen, giving you fast access to certain menus or functions. The monitor has two types of soft keys:
  - Parameter keys: Each parameter numeric area can be seen as a soft key. You can enter a parameter setup menu by selecting its corresponding parameter numeric area.
  - Quick keys: Quick keys are configurable graphical keys.
- Hard keys: A hard key is a physical key on the monitor, such as the main menu hard key on the monitor's front.
- Pop-Up Keys: Pop-up keys are task-related keys that appear automatically on the monitor screen when required. For example, the confirm pop-up key appears only when you need to confirm a change.

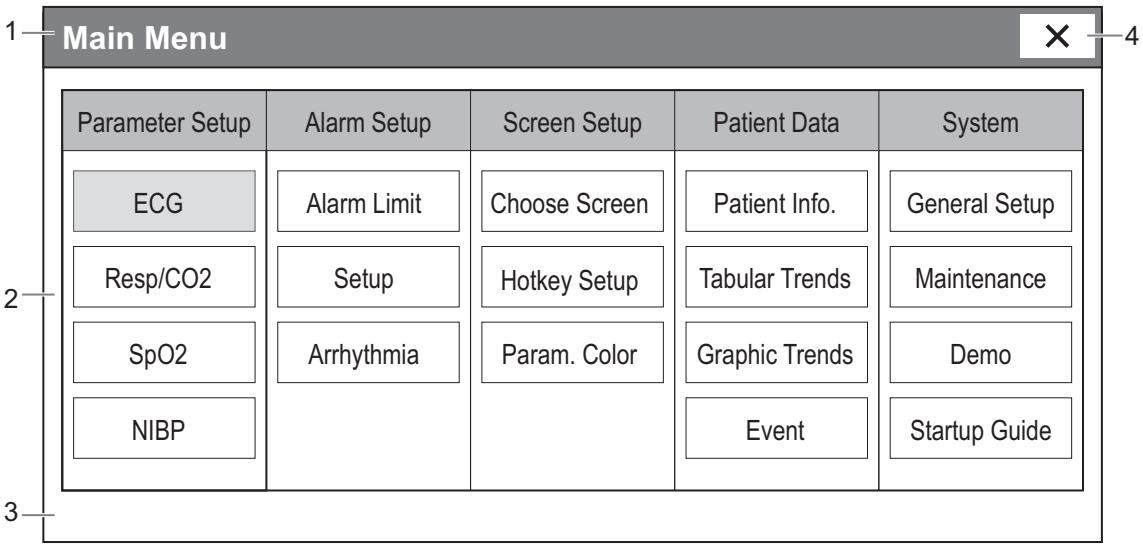
3.2 Using the On-screen Keyboard

The on-screen keyboard enables you to enter information:

- ← : to delete the previously entered character.
- A : to toggle between uppercase and lowercase letters.
- ↵ : to confirm what you have entered and close the on-screen keyboard.
- @!# : to access the symbol keyboard.
- ⮌ : to exit the symbol keyboard.

3.3 Using the Main Menu

To enter the main menu, select **Main Menu** quick key or press ▭ hard key on the front panel. Most of monitor operations and settings can be performed through the main menu.



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

No.	Name	Description
1.	Heading	gives a sum-up for the current menu.
2.	Main body	displays options, buttons, prompt messages, etc. The menu button with ">>" enlarges a secondary window to reveal more options or information.
3.	Help information area	displays help information for the highlighted menu item.
4.	✕ key	select to exit the current menu.

3.4 Using the On-Screen Timer

The monitor has a Timer function to notify you when a preset time period is expired.

Select **Timer** quick key on the screen to bring the **Timer** window.

3.4.1 Setting the Timer

Select **Setup** key on the **Timer** window to enter the **Timer Setup** menu.

Set the parameter value of the timer as required.

NOTE:

You cannot change timer settings when a timer is running.

3.4.2 Controlling the Timer

The timer provides the following controls:

- **Start**: starts timing.
- **Pause**: pauses timing.
- **Reset**: clears the timer and end this timing episode.

3.5 Alarms

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

⚠ WARNING

- **A potential hazard can exist if different alarm presets are used for the same or similar equipment in any single area, e.g. an intensive care unit or cardiac operating room.**
- **The monitors in your care area may each have different alarm settings to suit different animals. Always check that the alarm settings are appropriate for your animal before start monitoring. Always make sure that necessary alarm limits are active and set according to the animal's clinical condition.**
- **Pausing or switching off alarms may result in a hazard to the animal.**

NOTE:

In case of a temporary power failure, if the power is restored within 30 minutes, monitoring will resume with all active settings unchanged; if the monitor is without power for more than 30 minutes, the monitor behaves the same as it is normally turned off.

3.5.1 Alarm Categories

The monitor has two different types of alarms: physiological alarms and technical alarms.

- Physiological alarms are triggered by animal measurement exceeding the parameter limits, or by an abnormal animal conditions.
- Technical alarms are triggered by an electrical, mechanical, or other monitor failure, or by failure of a sensor or component. Technical alarm conditions may also be caused when an algorithm cannot classify or interpret the available data.

Apart from the physiological and technical alarms, the monitor can also prompt some messages telling the system status or animal status.

3.5.2 Alarm Priorities

By severity, the alarms are classified into the following priority levels:

- High priority alarms: indicate a life threatening situation or a severe device malfunction. High priority alarms require an immediate response.
- Medium priority alarms: indicate abnormal vital signs or a device malfunction. Medium priority alarms require a prompt response.

- Low priority alarms: indicate a discomfort condition, a device malfunction, or an improper operation. Low priority alarms require you to be aware of this condition.
- Messages: provides additional information on the animal or the monitor.

3.5.3 Alarm Indicators

When an alarm occurs, the monitor indicates it to you through visual or audible alarm indications. For more information, see the following table.

Alarm Indicator		High Priority Alarm	Medium Priority Alarm	Low Priority Alarm	Message	Comments
Alarm lamp		Red Flashing frequency: 1.4 - 2.8 Hz Duty ratio: 20 - 60%	Yellow Flashing frequency: 0.4 - 0.8 Hz Duty ratio: 20 - 60%	Yellow No flashing Duty ratio: 100%	None	None
Audible tone pattern	ISO	triple + double + triple + double beep	triple beep	single beep	None	None
	Mode 1	high-pitched single beep	double beep	low-pitched single beep	None	
	Mode 2	high-pitched triple beep	double beep	low-pitched single beep	None	
Alarm message		Black text inside a red box	Black text inside a yellow box	Black text inside a yellow box	White text	Alarm messages are displayed in the alarm information area at the top of the screen. You can select the alarm messages to show the alarm list.
Alarm priority indicator		!!!	!!	!	None	The indicator shows in front of corresponding alarm message.

Alarm Indicator	High Priority Alarm	Medium Priority Alarm	Low Priority Alarm	Message	Comments
Parameter value	If an alarm triggered by an alarm limit violation occurs, the numeric of the measurement in alarm will flash every second, and the corresponding alarm limit will also flash at the same frequency indicating the high or low alarm limit is violated.			None	None

NOTE:

- When multiple alarms of different priority levels occur simultaneously, the monitor selects the alarm of the highest priority to light the alarm lamp and issue the alarm tone.
- When multiple alarms of different priority levels occur simultaneously and should be displayed in the same area, alarm messages are displayed circularly.
- When multiple alarms of the same priority levels occur simultaneously, alarm messages are displayed circularly.

3.5.4 Alarm Status Symbols

Apart from the alarm indicators as described in the preceding section, the monitor uses the following symbols to indicate the alarm status:

-  (Alarm pause): indicates that the system is in the alarm pause status.
-  (Alarm off): indicates that the system is in the alarm off status.
-  (Audio off): indicates that audible alarm tones are turned off.
-  (Alarm reset): indicates that the alarm system is reset.

3.5.5 Checking Technical Alarm List

To check the technical alarm list, follow this procedure:

1. Select the technical alarm information area to enter the **Technical Alarms** menu.
2. From the alarm list select the desired alarm.

3.5.6 Checking Physiological Alarm List

To check the physiological alarm list, follow this procedure:

1. Select the physiological alarm information area to enter the **Physiological Alarms** menu.
2. From the alarm list select the desired alarm.

3.5.7 Pausing Alarms

Press  button on the front panel or select **Alarm Pause** quick key to disable alarm indicators to temporarily. When alarms are paused, the following rules are followed:

- No physiological alarm will be presented.
- For technical alarms, alarm sounds are paused, but alarm lamps and alarm messages remain presented.
- The parameter numerics of the physiological alarm and the high/low limits stop flashing.
- The remaining alarm pause time is displayed in the physiological alarm information area.
- The alarm pause symbol is displayed in the alarm status icon area.

When the alarm pause time expires, the alarm paused status is automatically deactivated. You can also cancel the alarm paused status by pressing button on the front panel or selecting **Alarm Pause** quick key.

3.5.8 Switching Off All Alarms

If **Alarm Pause Time** is set to **Permanent**, see the *User Maintenance* section in the *Setup* chapter), press button on the front panel or select **Alarm Pause** quick key to permanently switch off all alarms. The alarm off status has the following features:

- Physiological alarms are switched off. The alarm lamp does not flash and alarm sound is not issued.
- Alarm sound of technical alarms is switched off, but alarm lamp flashes and alarm messages are presented.
- The message **Alarm Off** with red background is displayed in the physiological alarm information area.
- The alarm off symbol is displayed in the alarm status icon area.

To exit the alarm off status, press button on the front panel or select **Alarm Pause** quick key again.

3.5.9 Resetting Alarms

NOTE:

If a new alarm is triggered after the alarm system is reset, the alarm reset icon will disappear and the alarm light and alarm tone will be reactivated.

Press button on the front panel or select **Alarm Reset** quick key to reset the alarm system. When the alarm system is reset, the alarm reset symbol displays in the alarm status icon area.

To Reset Physiological Alarms

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

- The alarm sound is silenced.
- A "√" appears before the alarm message.
- The parameter numeric and alarm limits still flash.

To Reset Technical Alarms

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

- Some technical alarms are cleared. The monitor gives no alarm indications.
- Some technical alarms are changed to the prompt messages.
- For some technical alarms, the alarm is silenced and a √ appears before the alarm message.

3.5.10 Actions When an Alarm Occurs

When an alarm occurs, observe the following steps and take proper actions:

1. Check the animal's condition.
2. Confirm the alarming parameter or alarm category.
3. Identify the source of the alarm.
4. Take proper action to eliminate the alarm condition.
5. Make sure the alarm condition is corrected.

For more information, see the *Alarm Messages* appendix.

3.6 Freezing Operations

During animal monitoring, the freeze feature allows you to freeze the currently displayed waveforms on the screen so that you can have a close examination of the animal's status.

NOTE:

The freeze status can be entered only when **Normal Screen** is selected from the **Screen Setup** menu.

3.6.1 Freezing Waveforms

To freeze waveforms, select **Freeze** quick key. All displayed waveforms stop refreshing and scrolling after you select **Freeze** quick key. The data in the parameter numeric area is normally refreshed.

3.6.2 Viewing Frozen Waveforms

To view the frozen waveforms, select **Scroll** button and then rotate the knob clockwise or counter-clockwise.

At the lower right corner of the bottommost waveform displays the freeze time. The initial frozen time is **0s**. With the waveforms scrolling, the freeze time changes at an interval of 1 second. For example, **-2s** means the 2 seconds before the frozen time. This change will be applied for all waveforms on the screen.

3.6.3 Unfreezing Waveforms

To unfreeze the frozen waveforms, you can either:

- Select ✕ button at the upper right corner of the **Freeze** menu.

- Perform any other action that causes the screen to be readjusted or opens a menu, such as pressing button.

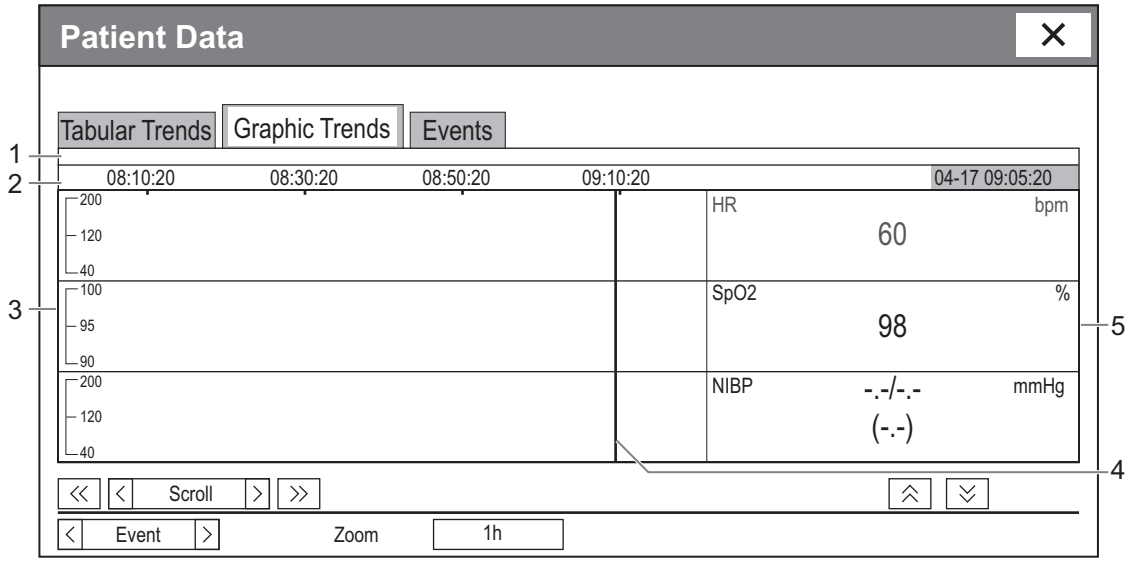
3.7 Review

Trends are animal data collected over time and displayed in graphic, tabular, or other forms to give you a picture of how your animal's condition is developing.

Select **Tabular Trends** quick key, or select **Main Menu** > **Graphic Trends**, **Tabular Trends** or **Events** to access their respective review windows.

3.7.1 Reviewing Graphic Trends

In the **Patient Data** menu, select **Graphic Trends** to access the following window.



1.	Event type indicator: different color blocks match different types of events.
2.	Current window time line: indicates the time length of the current window. In case of system time change, the question mark "?" is displayed beside the time.
3.	Waveform area: displays trend curves. The color of trend curves is consistent with the color of parameter labels.
4.	Cursor
5.	Numeric area: displays numeric values at the cursor indicated time. The background color of numeric values matches the alarm priority.

- You can set the time length of the review window by selecting **Zoom**.
- Select **<** or **>** beside **Scroll** to move the cursor one step to the left or right to navigate through the graphic trends; select **<<** or **>>** to move the cursor one page to the left or right to navigate through the graphic trends.

A time indicating your current position is displayed above the parameter area. Numeric measurement values corresponding to the cursor location change as the cursor is moved. The measurement value that triggered high level alarm has red background. The one that triggered medium/low level alarm has yellow background.

By selecting **<** or **>** beside **Event**, you can position the cursor to different event time.

3.7.2 Reviewing Tabular Trends

In the **Patient Data** 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.

- You can change the resolution of the trend data by selecting **Interval** and then selecting the appropriate setting:
  - **5 s** or **30 s**: select to view up to 4 hours of tabular trends at 5- or 30-second resolution.
  - **1 min**, **5 min**, **10 min**, **15 min**, **30 min**, **1 h**, **2 h** or **3 h**: select to view up to 120 hours of tabular trends at your selected resolution.
  - **NIBP**: select to view the tabular trends when NIBP measurements were acquired.
- Select **<** or **>** beside **Scroll** to drag the scrollbar left or right to navigate through the trend database, or select **<<** or **>>** to scroll left or right to navigate through the trend database.
- By selecting **<** or **>** beside **Event**, you can position the cursor to different event time.

3.7.3 Reviewing Events

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

In the **Patient Data** menu, select **Events** tab to review events.

The events that can be reviewed include parameter alarm events and arrhythmia alarm events. When an event occurs, all the measurement numerics at the event trigger time and related waveforms 16 seconds before and after the event trigger time are stored.

In this window:

- You can view the desired events by selecting **Event**.
- You can view the desired events according to the level by selecting **Level**.

After selecting the desired event, you can select **Details** to access the details 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.

In this window:

- You can select < or > to navigate through the waveforms.
- You can select < or > beside the **Event** button to switch between events.
- You can set the desired **Gain** for ECG waveform.
- You can set the desired **Sweep**.
- By selecting **Events List** button, you can view the events list.

4 Preparation before Use

4.1 Installation

4.1.1 Unpacking and Checking

Before unpacking, examine the packing case carefully for signs of damage. If any damage is detected, contact the carrier or the Customer Service Department or sales representative.

If the packing case is intact, open the package and remove the monitor and accessories carefully. Check all materials against the packing list and check for any mechanical damage. Contact the Customer Service Department or sales representative in case of any problem.

NOTE:

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

4.1.2 Environmental Requirements

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

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

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

4.2 Connecting the Power Cord

4.2.1 Connecting the AC Mains

⚠ WARNING

- **Always use the accompanying power cord delivered 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.**

Perform the following procedure:

1. Plug the power cord in the socket of the monitor and pull the retaining clamp downward to lock the power cord.
2. Plug the other end power plug into an appropriate outlet.

4.2.2 Powered by Batteries

This monitor is designed to operate on rechargeable Lithium-ion battery power during intra-hospital animal transfer or whenever the power supply is interrupted. The battery is charged automatically when the monitor is connected to AC power, no matter the monitor is powered on or not. Whenever the AC power is interrupted during animal monitoring, the monitor will automatically run power from the internal batteries.

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

-  : indicates that the battery works correctly. The solid portion represents the current charge level of the battery in proportion to its maximum charge level.
-  : indicates that the battery has low charge level and needs to be charged.
-  : indicates that the battery is almost depleted and needs to be charged immediately. Otherwise, the monitor shuts down automatically.
-  : indicates that no battery is installed.

The capacity of the internal battery is limited. If the battery charge is too low, a technical alarm will be triggered and the message **Low Battery** or **Battery Depleted** displayed. At this moment, apply AC power to the monitor. Otherwise, the monitor will power off automatically before the battery is completely depleted.

Battery Guidelines

⚠ WARNING

- **If you need to change the battery or buy a new one, contact the Customer Service Department or sales representative.**
- **Keep the battery out of the reach of children.**
- **Use only the battery specified by the manufacturer.**
- **If the battery shows signs of damage or signs of leakage, replace it immediately. Do not use a faulty battery in the monitor.**
- **The battery is inside the machine. Only the manufacturer technical professionals or engineers authorized by the manufacturer following training can perform battery installation and uninstallation.**

Life expectancy of a battery depends on how frequent and how long it is used. For a properly maintained and stored lithium ion battery, its life expectancy is about 3 years. For more aggressive use models, life expectancy can be less. We recommend replacing lithium ion batteries every 3 years.

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

- Condition a battery once when it is used or stored for 2 months, or when its operating time becomes noticeably shorter.
- Remove the battery from the monitor if it is not being used regularly. (Leaving the battery in a monitor that is not in regular use will shorten the life of the battery).
- The shelf life of a Lithium Ion battery is about 6 months when the battery is stored with the battery power being 50% of the total power. In 6 months the battery power must be depleted before the Lithium Ion battery is fully charged. Then run the monitor on this fully charged battery. When its battery power becomes 50% of the total power, take out the battery from the monitor and store it.

Conditioning the Battery

A battery should be conditioned before it is used for the first time. A battery conditioning cycle is one uninterrupted charge of the battery, followed by an uninterrupted battery discharge and charge. Batteries should be conditioned regularly to maintain their useful life.

NOTE:

The actual battery capacity will decrease over time with use of batteries. When a monitor operates on batteries that have been used before, the full capacity battery symbol does not indicate the capacity and operating time of this battery can still fulfill battery specifications in the operator's manual. When conditioning a battery, please replace the battery if its operating time is significantly lower than the specified time.

Perform the following procedure:

1. Disconnect the monitor from the animal and stop all monitoring or measuring.
2. Apply AC power to the monitor and allow the battery to charge uninterrupted for 10 hours.
3. Remove AC power and allow the monitor to run from the battery until it shuts off.
4. Apply AC power again to the monitor and allow the battery to charge uninterrupted for 10 hours.

   This battery is now conditioned and the monitor can be returned to service.

Battery Recycling

When a battery has visual signs of damage, or no longer holds a charge, it should be replaced. Remove the old battery from the monitor and recycle it properly. To dispose of the batteries, follow local laws for proper disposal.

⚠ WARNING

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

4.3 Turning on the Monitor

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

1. Before you start to make measurements, check the monitor for any mechanical damage and make sure that all external cables and accessories are properly connected.
2. Plug the power cord into the AC power source. If you run the monitor on battery power, ensure that the battery is sufficiently charged.
3. Press the power button switch.

4.4 Check the system after it is powered on

⚠ WARNING

Check that visual and auditory alarm signals are presented correctly when the monitor is powered on. Do not use the monitor for any monitoring procedure on an animal if you suspect it is not working properly, or if it is mechanically damaged. Contact the Customer Service Department or sales representative.

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

Check the following items for the power-on test:

- The monitor powers on properly.
- The alarm system works properly.
- The monitor displays properly.

4.5 Standby Mode

⚠ WARNING

Pay attention to the potential risk of placing the monitor to standby. In the standby mode, the monitor stops all parameter measurements and disable all the alarm indications.

Select **Standby** quick key, and then select **Yes** to enter the standby mode and discharge the current animal.

The current animal monitoring is interrupted in standby mode, but the monitor is not shut down.

Rotate or press the knob to exit the standby mode.

4.6 Turning Off the Monitor

Perform the following procedure:

1. Ensure that the monitoring of the animal has been completed.
2. Disconnect the cables and sensors from the animal.

3. Make sure to save or clear the animal monitoring data as required.
4. Press and hold the power button at least 5 seconds to turn off the monitor.

⚠ CAUTION

Press and hold the power switch for 10 seconds to forcibly shut down the monitor if it could not be shut down normally. This may cause loss of animal data.

NOTE:

- Turning off the monitor does not disconnect the monitor from the AC mains. To completely disconnect the power supply, unplug the power cord.
- In case of a temporary power failure, if the power is restored within 30 minutes, monitoring will resume with all active settings unchanged; if the monitor is without power for more than 30 minutes, the monitor behaves the same as it is normally turned off.

5 Setup

⚠ WARNING

The setup must be performed by clinical professionals.

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

The system configuration items can be classified as:

- Parameter configuration items: These items relates to parameters, e.g., waveform gain, alarm switch, alarm limits.
- Conventional configuration items: These items define how the monitor works, e.g., screen layout and alarm settings.
- User maintenance items: These items relates to user maintenance settings, e.g., unit setup, time format and data format.

TIP:

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

Perform the following procedure:

1. Select **Main Menu** quick key or press button to enter the **Main Menu** screen.
2. Rotate the knob to move the focus, and then press the knob to enter the selected menu or set the parameters.
3. Exit system setup.

   Select the corresponding mode to exit the setup menu according to the actual screen display.

   – Select button of the menu.
   – Select **Ok** or **Cancel**.

5.1 Parameter Setup

5.1.1 ECG Setup Menu

Item	Description
Lead Set	Set the lead type according to the lead type you are going to use.
ECG	Set the lead of the displayed ECG waveform.
Gain	Set the ECG waveform gain.
Sweep	Set the wave sweep speed.
Esophageal	Set to **Yes** when the esophageal ECG probe is in use.
Filter	The ECG filter setting defines how ECG waves are smoothed. • **Monitor**: Use under normal measurement conditions. • **Diagnostic**: Use when diagnostic quality is required. The unfiltered ECG wave is displayed so that changes such as R-wave notching or discrete elevation or depression of the ST segment are visible. • **Surgery**: Use when the signal is distorted by high frequency or low frequency interference. High frequency interference usually results in large amplitude spikes making the ECG signal look irregular. Low frequency interference usually leads to wandering or rough baseline. In the operating room, the surgery filter reduces artifacts and interference from electrosurgical units. Under normal measurement conditions, selecting **Surgery** may suppress the QRS complexes too much and then interfere with ECG analysis.
Notch Filter	The notch filter removes the line frequency interference. Only when **Filter** is set to **Diagnostic**, the **Notch Filter** is adjustable.
Smart Lead Off	Set to enable/disable the **Smart Lead Off** Function. The monitor provides the smart lead off function. When the lead of the first ECG wave is detached but another lead is available, the monitor automatically switches to the available lead to recalculate heart rate, and to analyze and detect arrhythmias. When you reconnect the detached leads, the monitor automatically switches back to the original lead. ***NOTE:*** The Smart Lead Off function is only available when using 5-lead ECG monitoring.

5.1.2 Resp Setup Menu

When the monitor is configured with the CO_2 module, set **Module Select** to **Resp** to enter the Resp parameter setup menu.

Item	Description
Resp Lead	Set the respiration lead.
Gain	Set the Resp waveform size.
Sweep	Set the Resp waveform speed.

5.1.3 CO_2 Setup Menu

When the monitor is configured with the CO_2 module, set **Module Select** to **CO2** to enter the CO_2 parameter setup menu.

Item	Description
Operating Mode	set the CO_2 module to one of the following modes according to the module status: • **Measure**: when use the CO_2 module for monitoring. • **Standby**: when do not use the CO_2 module to prolong the service life of the CO_2 module. The default operating mode is Measure. If you are not using the CO_2 module, set Operating Mode to Standby mode.
Sweep	Set the waveform sweep speed. The faster the wave sweeps, the wider the wave is.
Scale	Set the size of the CO_2 waveform.
Wave Type	Select **Wave Type** and toggle between **Draw** and **Fill**: • **Draw**: The CO_2 wave is displayed as a curved line. • **Fill**: The CO_2 wave is displayed as a filled area.
Auto Standby	Sets the period of automatically entering the standby mode. The monitor enters standby mode automatically after the configured period of time if no breath is detected since the last detected breath.
BTPS Compen	Set the humidity compensation. The CO_2 modules is configured to compensate CO_2 readings for Body Temperature and Pressure, Saturated Gas (BTPS) to account for humidity in the animal's breath. BTPS: $P_{CO2}(mmHg) = CO_2(vol) \cdot (P_{amb} - 47)/100$ Where, P_{CO2} = partial pressure, vol%= CO_2 concentration, P_{amb} = ambient pressure, and unit is mmHg.
O2 Compen	Select an appropriate setting according to the amount of O_2 in the ventilation gas mixture.

Item	Description
AA Compen	Set the concentration of anesthetic gas present in the ventilation gas mixture to compensate for the effect of AG on the readings.

5.1.4 SpO_2 Setup Menu

Item	Description
Sensitivity	Set the data collection interval for averaging. **High**, **Med** and **Low**, which are respectively correspond to 7s, 9s and 11s. ***NOTE:*** The SpO_2 value displayed on the monitor screen is the average of data collected within a specific time. The shorter the averaging time is, the quicker the monitor responds to changes in the animal's oxygen saturation level. Contrarily, the longer the averaging time is, the slower the monitor responds to changes in the animal's oxygen saturation level, but the measurement accuracy will be improved. For critically ill animals, selecting shorter averaging time will help understanding the animal's state.
Sweep	Set the sweep speed of Pleth waveform. The faster the waveform sweeps, the wider the waveform is.

5.1.5 NIBP Setup Menu

Item	Description
Interval	For auto NIBP measurement, set the interval between two NIBP measurements. The monitor will then automatically repeat NIBP measurements at the set time interval. Set **Manual** to switch to manual mode.
Initial Pressure	Set initial cuff inflation pressure.
Display PR	Set whether to display the PR value in the NIBP parameter area.
NIBP End Tone	Set to enable/disable the NIBP end tone function. When it is enabled, the monitor can issue a reminder tone at the completion of NIBP measurement.
Start NIBP button	Select to start NIBP measurement after the settings are completed.

5.2 Alarm Setup

⚠ WARNING

- **A potential hazard can exist if different alarm presets and default configuration settings are used for the same or similar equipment in the same care area, for example an intensive care unit or cardiac operating room.**
- **The monitors in your care area may each have different alarm settings to suit different animals. Always check that the alarm settings are appropriate for your animal before start monitoring. Always make sure that necessary alarm limits are active and set according to the animal's clinical condition.**
- **When the alarm sound is switched off, the monitor gives no alarm tones even if a new alarm occurs. Be careful about whether to switch off the alarm sound or not. When the alarms are off or while alarm audio is paused either temporarily or indefinitely, observe the animal frequently.**
- **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 animal. Always make sure that the audio alarm volume level is adequate in your care environment. Always keep the animal under close surveillance.**
- **Setting alarm limits to extreme values may cause the alarm system to become ineffective.**

5.2.1 Alarm Limits Setup

You can review and set alarm limits, alarm switches and alarm level for all parameters.

5.2.2 Alarm Tone Setup

Item	Description
Alm Volume	Set the alarm volume. ***NOTE:*** • When Alarm Volume is set to 0, the alarm sound is turned off and the audio off symbol appears on the screen. • You cannot set the volume of high priority alarms if Alarm Volume is set to 0.
High Alarm Volume	Set the volume of the high priority alarm.
Reminder Volume	Set the volume of the reminder tone.
HR/PR Alarm Source	Set the alarm source. • **HR**: set the HR to be the alarm source for HR/PR. • **PR**: set the PR to be the alarm source for HR/PR. • **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 becomes disconnected, the monitor will automatically switch to **PR** as the alarm source.

Item	Description
Apnea Delay	Set the delay time of the apnea alarm. The monitor will alarm if the animal has stopped breathing for longer than the set apnea time.

5.2.3 Arrhythmia Alarm Settings

⚠ WARNING

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

Sets arrhythmia alarm properties such as arrhythmia alarm switch and alarm level.

5.3 Screen Setup

5.3.1 Choose Screen

Set the screen Layout.

Item	Description
Normal Screen	Parameter numerics, waveforms, and their sequence display in the normal layout.
Big Numerics	Parameter numerics display in big font size.

5.3.2 Quick Keys

Set your desired quick keys to display on the screen.

The set quick keys are displayed on the left of the **Hotkey Setup** tab, corresponding to the display sequence of the quick keys on the screen. All the quick keys provided by the monitor are displayed on the right of the **Hotkey Setup** tab.

Perform the following procedure:

1. Use the knob to select a block on the left of the **Hotkey Setup** tab where you want to show a certain quick key.
2. Select the quick key from the right of the **Hotkey Setup** tab.
3. Exit the setup menu.

   The quick key area of the screen displays the set quick keys.

5.3.3 Parameter Color

Select the color box of your desired parameter on the left of the **Param. Color** setup menu and then select a color from the right.

5.4 System Settings

5.4.1 General Setup

Item	Description
QRS Volume	Set the appropriate QRS volume. 0 means off, and 10 the maximum volume.
Brightness	Select the appropriate setting for the screen brightness. 10 is the brightest, and 1 is the least bright
Key Volume	Set the key volume when you press the navigation knob or the hard keys on the panel.
eStart	Set if animal category selection screen is available while startup. ***NOTE:*** The eStart screen is not displayed if the monitor is restarted within 30 min after an abnormal power failure.
Date/Time	Set the system date, time and display formats.
Load Configuration	Select to enter the Load Configuration screen and load the appropriate configuration. The monitor allows you to load a desired configuration to ensure that all the settings are appropriate for your animal.
Unload USB Drive	Select to remove the USB drive from the monitor safely.

5.4.2 User Maintenance

Select **Maintenance** button on the main menu and then input the maintenance password.

Setup

Item	Description
Weight Unit	Set the weight unit.
Temp Unit	Set the temperature unit.
Press. Unit	Set the pressure unit
CO2 Unit	Set the CO_2 unit.

Item	Description
Language	Set the system display language. The setting will take effect after the monitor is restarted.
Save user config	Select to save the changed configuration as a user configuration.
Defaults	Set the configuration automatically loaded by the monitor. This configuration can be either factory configuration or saved user configuration.
Modify Password	Set the monitor's password for accessing the User Maintenance screen.

Module

Item	Description
ECG Standard	Set the ECG standard according to the used leadwire.
Notch Filter	Set notch frequency according to the electric power frequency of your country.
SpO2 Tone	Set the SpO_2 tone mode. ***NOTE:*** The same SpO_2 tone mode shall be used for the same monitors in a single area.
Calibrate ECG	Enable the ECG module calibration function. The ECG signal may be inaccurate due to hardware or software problems. As a result, the ECG wave amplitude becomes greater or smaller. In that case, you need to calibrate the ECG module. **1.** Enter the ECG parameter setup menu and set **Filter** to **Diagnostic**. **2.** Select **Main Menu** > **Maintenance** > enter the required password > **Module** > **Calibrate ECG**. A square wave appears on the screen and the message "**ECG Calibrating**" is displayed. **3.** Compare the amplitude of the square wave with the wave scale. The difference should be within 5%. **4.** After the calibration is completed, select **Stop Calibrating ECG**. If the difference exceeds 5%, contact the Customer Service Department or sales representative.
NIBP Leakage Test.	For details, contact the Customer Service Department or sales representative.
NIBP Accuracy Test	For details, contact the Customer Service Department or sales representative.

Item	Description
Maintain CO2 >>	For details, contact the Customer Service Department or sales representative. ***NOTE:*** The CO_2 module performs zero calibration automatically when needed.

Arrhythmia Threshold Settings

Set threshold settings for some arrhythmia alarms. In case an arrhythmia violates its threshold, an alarm will be triggered. When HR is less than 30 bpm, it is recommended to set the asystole delay time to 10 seconds.

Arrh. event	Range	Step	Unit
PVCs/min	1 to 100	1	/min
Tachy High	60 to 300	5	bpm
Brady Low	15 to 120	5	bpm
Extreme Tachy	60 to 300	5	bpm
Extreme Brady	15 to 120	5	bpm
Asys. Delay	3 to 10	1	s
Multif. PVC's Window	3 to 31	1	/min
Vtac Rate	100 to 200	5	bpm
Vtac PVC	3 to 99	1	/min
Pause Time	1.5, 2.0, 2.5	/	s
Vbrd Rate	15 to 60	5	bpm
Vbrd PVCs	3 to 99	1	/min

Alarm

Item	Description
Minimum Alarm Volume	Set the minimum alarm volume. The minimum alarm volume refers to the minimum value you can set for the alarm volume, which is not affected by user or factory default configurations. The setting of minimum alarm volume remains unchanged when the monitor shuts down and restarts.
Alarm Pause Time	Set the alarm pause time.

Item	Description
Alarm Off Reminder	Selects the prompt tone rule when the alarm volume is set to zero, or the alarm is reset or switched off. • **On**: the monitor issues prompt tones at a designated interval. • **Re-alarm**: if the alarm condition persists, the alarms marked with √ will be regenerated after the designated prompt tone interval. • **Off**: the monitor does not issue prompt tones at a designated interval. The alarms marked with √ will be silenced.
Reminder Interval	Set the interval between prompt tones.
Alarm Sound	Defines the alarm tone pattern to distinguish the heart beat tone, pulse tone, and keystroke tone by frequency.
Alarm Delay	Set the alarm delay time for over-limit alarms of continuously measured parameters. If the alarm triggered condition disappears within the delay time, the monitor will not give the alarm.
Defaults	Restore the system default values of the parameters on the current Alarm setup menu.

Checking Monitor and Module Information

View the information about the monitor configuration and system software version.

5.4.3 Demo

Select **Demo** in the main menu, enter the password and select **Ok** to enter the demo mode.

Enter the main menu again and select **Exit Demo** to exit the demo mode.

5.4.4 Startup Guide

Select **Startup Guide** and follow the screen prompts to view the quick operation instructions.

6 Animal Management

6.1 Admitting an Animal

6.1.1 Auto Admitting an Animal

⚠ WARNING

As the animal category will contain the default settings, please check whether the setting information is suitable for the currently admitted animal.

After being switched off, the monitor automatically discharges the previous animal and admits a new animal at startup.

6.1.2 Manually Admitting an Animal

Always discharge the previous animal before starting monitoring a new animal. Failure to do so can lead to data being attributed to the wrong animal.

Perform the following procedure:

1. Select **Standby** quick key, and then select **Yes** to enter the standby screen.
2. Rotate or press the knob to enter the Admit New Animal screen.
3. Select animal type and input the weight.
4. Select **Enter** to admit a new animal.

6.2 Managing Animal Information

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

1. Do one of the following to enter the **Patient Info.** screen:
   - Rotate the knob to select the animal information area on the screen and press the knob.
   - Select **Patient Info.** quick key.
   - Select **Main Menu** > **Patient Info.**

2. Modify animal information as needed.
3. Select **Ok** to confirm the modification.

6.3 Discharging an Animal

⚠ WARNING

Always discharge the previous animal before starting monitoring a new animal. Failure to do so can lead to data being attributed to the wrong animal.

NOTE:

- Discharging an animal clears the current animal data from the monitor.
- The monitor automatically discharges an animal after the monitor has been switched off normally.

Before monitoring a new animal, discharge the previous animal. After the animal is discharged, all animal data, including animal information, trend data, and physiological alarm information is deleted from the monitor. The technical alarms are reset, and monitor settings return to their defaults.

Select **Standby** quick key, and then select **Yes** to enter the standby screen to discharge the current animal.

7 Monitoring ECG

7.1 Introduction

The electrocardiogram (ECG) measures the electrical activity of the heart and displays it on the monitor as a waveform and a numeric.

7.2 Safety Information

⚠ WARNING

- **Do not use alligator clip during defibrillating and electro-surgery, otherwise, animal ambustion may occur.**
- **Use only ECG electrodes, cables and esophageal ECG probe specified by the manufacturer.**
- **Make sure the conductive parts of electrodes and associated connectors for applied parts, including the neutral electrode, should not contact any other conductive parts including earth.**
- **Periodically inspect the electrode application site to ensure skin quality. If the skin quality changes, replace the electrodes or change the application site.**
- **Use defibrillation-proof ECG cables during defibrillation.**
- **Do not touch the animal, or table, or instruments during defibrillation.**
- **Interference from ungrounded instrument near the animal and electrosurgery interference can induce noise and artifact into the waveforms.**
- **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).**
- **When using electrosurgical units (ESU), animal leads should be placed in a position that is equal distance from the Electrosurgery electrotome and the grounding plate to avoid burns to the animal. Never entangle the ESU cable and the ECG cable together.**
- **When using electrosurgical units (ESU), never place ECG electrodes near to the grounding plate of the ESU, as this can cause a lot of interference on the ECG signal.**
- **This monitor is not suitable for direct cardiac application.**
- **Only use parts and accessories specified in this manual. Follow the instructions for use and adhere to all warnings and cautions.**

NOTE:

Never mix animal electrode types or brands. This may lead to problem due to impedance mismatch.

7.3 ECG Monitoring (Limb Leads)

Perform the following procedure:

1. Select an appropriate leadwire.

Confirm that the selected leadwire is consistent with the lead information in ECG parameter setup menu and User Maintenance menu.

2. Prepare the animal's skin.

Proper skin preparation is necessary for good signal quality at the electrode, as the skin is a poor conductor of electricity. To properly prepare the skin, choose flat areas and then follow this procedure:

a. Shave hair from skin at chosen sites.

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

c. Thoroughly cleanse the site with a mild soap and water solution.

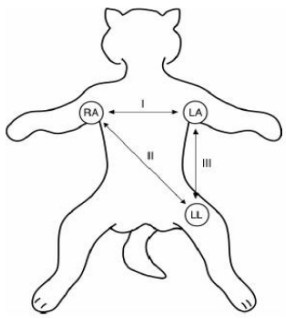
We do not recommend using ether or pure alcohol, because this dries the skin and increases the resistance.

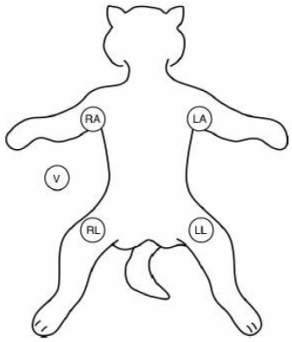
d. Dry the skin completely before applying the electrodes.

3. Attach the clips or snaps to the electrodes before placing them.

4. Place the electrodes on the animal.

Apply electrodes according to the selected lead type. The electrode placement illustrations in this chapter adopt the AHA standard.

3-Leadwire Electrode Placement	 • RA lead: on the right forelimb. • LA lead: on the left forelimb. • LL lead: on the left hindlimb.

5-Leadwire Electrode Placement	 • RA lead: on the right forelimb. • LA lead: on the left forelimb. • RL lead: on the right hindlimb. • LL lead: on the left hindlimb. • V (precordial) lead: exploring lead.
Lead Placement for Surgical Animals	The surgical site should be taken into consideration when placing electrodes on a surgical animal. e.g. for openchest 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.

5. Connect the ECG cable to the ECG connector of the monitor.
6. Adjust parameters in the ECG parameter setup menu to obtain the optimized waveform display.

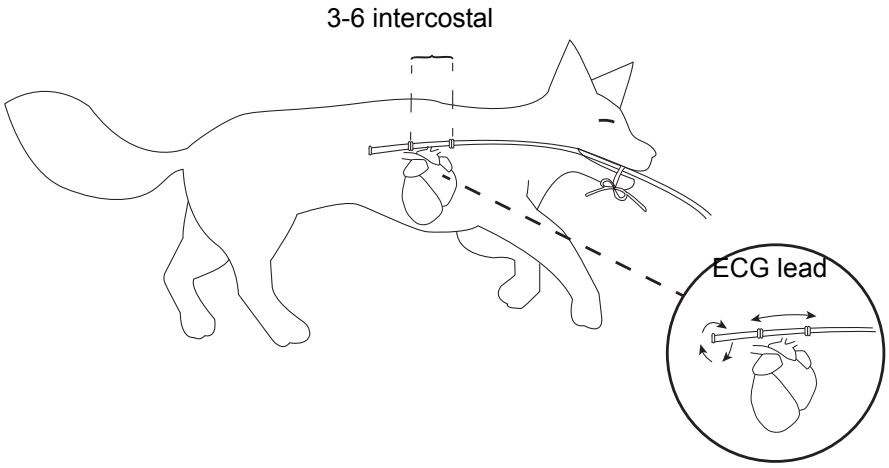
7.4 ECG Monitoring (Transesophageal)

Perform the following procedure:

1. In the **ECG** tab of the **Parameter Setup** menu, set **Esophageal** to **Yes**.
2. Apply sufficient water to the probe.
3. Insert the probe into esophagus through mouth.

   The probe should be placed neither too deep nor too shallow, otherwise, the ECG measurement may be incorrect.

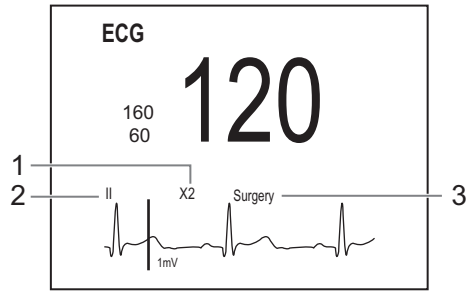
   To obtain a better ECG signal, locate the heart area (3-6 intercostal) between the two electrometal leads. Before placing the probe, the depth of the probe should be estimated outside the animal to avoid the depth exceeding the chest cavity.



4. Fix the probe to the mandible of the animal with gauze.
5. Connect the ECG cable to the ECG connector of the monitor.
6. Adjust parameters in the ECG parameter setup menu to obtain the optimized waveform display.

7.5 Result Display

Your display may be configured to look slightly different.



1.	ECG waveform gain
2.	ECG lead label of the displayed waveform
3.	ECG filter mode

7.6 Monitoring Arrhythmia

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

⚠ WARNING

- **Heart rate reading may be affected by cardiac arrhythmias. Do not rely entirely on heart rate alarms when monitoring animals with arrhythmia. Always keep these animals under close surveillance.**
- **The arrhythmia analysis program may incorrectly identify the presence or absence of an arrhythmia. Therefore, a physician must analyze the arrhythmia information with other clinical findings.**

⚠ CAUTION

- **Since the arrhythmia detection algorithm sensitivity and specificity are less than 100%, sometimes there may be some false arrhythmias detected and also some true arrhythmia events may not be detected. This is especially true when the signal is noisy.**
- **The ECG size and minimum QRS detection threshold settings affect arrhythmia detection and heart rate calculation sensitivity.**
- **If QRS amplitude is low, the monitor might not be able to calculate heart rate and false asystole calls may occur.**

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.	Lethal arrhythmia
Vtac	The consecutive PVCs ≥ Vtac PVCs limit, and the HR ≥ the Vtac rate limit.	Lethal arrhythmia
Vent. Brady	The consecutive PVCs ≥ the Vbrd threshold and the ventricular HR < the Vbrd Rate threshold.	Lethal arrhythmia
Extreme Tachy	The heart rate is greater than the extreme tachycardia limit.	Lethal arrhythmia
Extreme Brady	The heart rate is less than the extreme bradycardia limit.	Lethal arrhythmia
PVCs/min	PVCs/min exceeds high limit	Nonlethal arrhythmia
R on T	R on T detected in normal heartbeats.	Nonlethal arrhythmia
Run PVCs	More than two consecutive PVCs, lower than Vent. Brady PVCs threshold, and HR lower than Vent Rate threshold.	Nonlethal arrhythmia
Couplet	Paired PVCs detected in normal heartbeats.	Nonlethal arrhythmia
Multif. PVC	Multiform PVCs detected in Multif. PVC's Window (which is adjustable).	Nonlethal arrhythmia
PVC	One PVC detected in normal heartbeats.	Nonlethal arrhythmia

Arrhythmia message	Description	Category
Bigeminy	A dominant rhythm of N, V, N, V, N, V.	Nonlethal arrhythmia
Trigeminy	A dominant rhythm of N, N, V,N, N, V, N, N, V.	Nonlethal arrhythmia
Tachy	The average heart rate is greater than the tachycardia limit.	Nonlethal arrhythmia
Brady	The average heart rate is lower than the bradycardia limit.	Nonlethal arrhythmia
Missed Beat	At least 3 consecutive Ns, andThe current RR interval is greater than 1.5 x previous RR interval, andThe next RR interval is lower than 1.5 x average RR interval, andHR greater than 100 and the current RR interval is greater than 1.75 x average RR interval, or HR is greater than or equal to 100 and the current RR interval is greater than 1000 ms.	Nonlethal arrhythmia
Nonsus. Vtac	Consecutive PVCs (V) is lower than Vtac PVCs limit but greater than 2, and HR is greater or equal to the Vtac Rate limit.	Nonlethal arrhythmia
Vent. Rhythm	The consecutive PVCs is greater or equal to Vbrd PVCs limit, and HR is greater or equal to Vbrd Rate limit but lower than Vtac Rate limit.	Nonlethal arrhythmia
Pause	No QRS is detected within the set time threshold of pause.	Nonlethal arrhythmia
Irr. Rhythm	Consistently irregular rhythm (N, irregular RR interval change is greater than 12.5%)	Nonlethal arrhythmia

7.7 Alarm Operations

For details about physiological and technical alarms, see the *Alarm Messages* appendix.

7.8 Troubleshooting

This section lists the problems that might occur. If you encounter problems when using the monitor or accessories, check the table below before requesting for services. If the problem persists after you have taken corrective actions, contact the Customer Service Department or sales representative.

Problem	Corrective Actions
Noisy ECG traces	Follow the steps below: **1.** Check that electrodes are not detached or dry. Replace with fresh and moist electrodes if necessary. **2.** Check that leadwires are not defective. Replace leadwires if necessary. **3.** Check that animal cable or leadwires are routed too close to other electrical devices. Move the animal cable or leadwires away from electrical devices.
Excessive electrosurgical Interference	Use ESU-proof ECG cables. For more information, see the *Accessories* appendix.
Muscle Noise	Inadequate skin preparation, tremors, tense subject, and/or poor electrode placement. Follow the steps below: **1.** Perform skin preparation again and re-place the electrodes. For more information, see “7.3 ECG Monitoring (Limb Leads)”. **2.** Apply fresh, moist electrodes. Avoid muscular areas.
Intermittent Signal	Follow the steps below: **1.** Check that cables are properly connected. **2.** Check that electrodes are not detached or dry. Perform skin preparation again, see “7.3 ECG Monitoring (Limb Leads)”, and apply fresh and moist electrodes. **3.** Check that the animal cable or leadwires are not damaged. Change them if necessary.
Excessive alarms: heart rate, lead fault	Follow the steps below: **1.** Check that electrodes are not dry. Perform skin preparation again and replace the electrodes. For more information, see “7.3 ECG Monitoring (Limb Leads)”. **2.** Check for excessive animal movement or muscle tremor. Reposition the electrodes. Replace with fresh and moist electrodes if necessary.
Low Amplitude ECG Signal	Follow the steps below: **1.** Check that the ECG gain is not set too low. Adjust the gain as required. For more information, see the *Setup* chapter. **2.** Perform skin preparation again and re-place the electrodes. For more information, see “7.3 ECG Monitoring (Limb Leads)”. **3.** Check electrode application sites. Avoid bone or muscular area. **4.** Check that electrodes are not dry or used for a prolonged time. Replace with fresh and moist electrodes if necessary.

Problem	Corrective Actions
No ECG Waveform	Follow the steps below: **1.** Check that the ECG gain is not set too low. Adjust the gain as required. For more information, see the *Setup* chapter. **2.** Check that the leadwires and animal cables are properly connected. **3.** Change cable and lead wires. **4.** Check that the animal cable or leadwires are not damaged. Change them if necessary.
Base Line Wander	Follow the steps below: **1.** Check for excessive animal movement or muscle tremor. Secure leadwires and cable. **2.** Check that electrodes are not detached or dry and replace with fresh and moist electrodes if necessary. For more information, see "7.3 ECG Monitoring (Limb Leads)". **3.** Check for ECG filter setting. Set ECG Filter mode to Monitor to reduce baseline wander on the display.

8 Monitoring Respiration

8.1 Introduction

Impedance respiration is measured across the thorax. When the animal 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.

8.2 Safety Information

⚠ WARNING

- **When monitoring the animal's respiration, do not use ESU-proof ECG cables.**
- **The respiration measurement does not recognize the cause of apneas. It only indicates an alarm if no breath is detected when a pre-adjusted time has elapsed since the last detected breath. Therefore, it cannot be used for diagnostic purpose.**
- **If operating under conditions according to the EMC Standard IEC 60601-1-2 (Radiated Immunity 3V/m), field strengths above 1V/m may cause erroneous measurements at various frequencies. Therefore it is recommended to avoid the use of electrically radiating equipment in close proximity to the respiration measurement unit.**

NOTE:

Respiration monitoring is not suitable for the animals who are very active, as this will cause false alarms.

8.3 Starting Measurements

Perform the following procedure:

1. Preparing the animal skin.

Proper skin preparation is necessary for good signal quality at the electrode, as the skin is a poor conductor of electricity. To properly prepare the skin, choose flat areas and then follow this procedure:

a. Shave hair from skin at chosen sites.

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

c. 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.

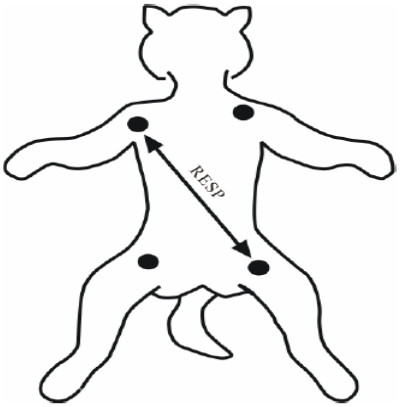
d. Dry the skin completely before applying the electrodes.

2. If the monitor is configured with a CO_2 module, select **Resp** module from the Resp/CO2 parameter setup menu.

3. Select an appropriate Resp lead from the Resp parameter setup menu.

4. Place the electrodes on the animal.

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



NOTE:

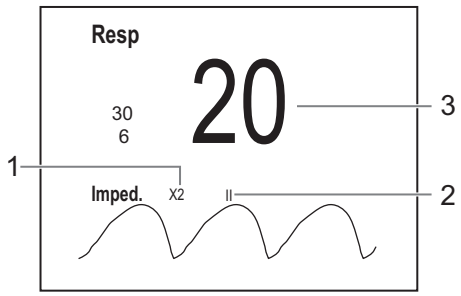
- To optimize the respiration waveform, place the RA and LA electrodes horizontally when monitoring respiration with ECG Lead I; place the RA and LL electrodes diagonally when monitoring respiration with ECG Lead II.
- Optimizing Lead Placement for Resp: If you want to measure Resp and you are already measuring ECG, you may need to optimize the placement of the two electrodes between which Resp will be measured. Repositioning ECG electrodes from standard positions results in changes in the ECG waveform and may influence ST and arrhythmia interpretation.
- Cardiac Overlay: Cardiac activity that affects the Resp waveform is called cardiac overlay. It happens when the Resp electrodes pick up impedance changes caused by the rhythmic blood flow. Correct electrodes placement can help to reduce cardiac overlay: avoid the liver area and the ventricles of the heart in the line between the respiratory electrodes.
- Abdominal Breathing: Some animals with restricted movement breathe mainly abdominally. In these cases, you may need to place the left leg electrode on the left abdomen at the point of maximum abdominal expansion to optimize the respiratory wave.
- Lateral Chest Expansion: Some animals expand their chests laterally, causing a negative intrathoracic pressure. In these cases, it is better to place the two respiration electrodes in

the right midaxillary and the left lateral chest areas at the animal's maximum point of the breathing movement to optimize the respiratory waveform.

5. Connect the ECG cable to the ECG connector of the monitor.
6. Adjust parameters in the Resp parameter setup menu to obtain the optimized waveform display.

8.4 Result Display

Your display may be configured to look slightly different.



1.	Gain
2.	Resp lead label
3.	Respiration rate

8.5 Alarm Operations

For details about physiological and technical alarms, see the *Alarm Messages* appendix.

9 Monitoring Pulse Oxygen Saturation

9.1 Introduction

Pulse Oxygen Saturation (SpO_2)

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 emitter side of the probe is partly absorbed when it passes through the monitored tissue.
The amount of transmitted light is detected in the detector side of the probe. When the pulsative part of the light signal is examined, the amount of light absorbed by the haemoglobin is measured and the pulse oxygen saturation can be calculated. This monitor is calibrated to display functional oxygen saturation.

Pulse Rate (PR)

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. The displayed pulse numeric is color-coded to match its source.

In most cases the HR and pulse numerics are identical. In order to avoid simultaneous alarms on HR and Pulse, the monitor uses either HR or Pulse as its active alarm source. To change the alarm source, see the *Alarm Setup* section in the *Setup* chapter.

9.2 Safety Information

⚠ 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.**
- **Before use, verify the compatibility between the monitor, probe, and cable. Otherwise, animal injury may occur.**
- **When a trend toward animal deoxygenation is indicated, blood samples should be analyzed by a laboratory co-oximeter to completely understand the animal's condition.**
- **Do not use SpO2 sensors during magnetic resonance imaging (MRI). Induced current could nmpotentially cause burns. The sensor may affect the MRI image, and the MRI unit may affect the accuracy of the oximetry measurements.**

- **Prolonged continuous monitoring may increase the risk of undesirable changes in skin characteristics, such as irritation, reddening, blistering or burns. Inspect the sensor site every two hours and move the sensor if the skin quality changes. Change the application site every four hours.**

⚠ CAUTION

- **Do not apply sensor too tightly as this results in venous pulsation which may severely obstruct circulation and lead to inaccurate measurements.**
- **At elevated ambient temperatures be careful with measurement sites that are not well perfused, because this can cause burns after prolonged application.**
- **Avoid placing the sensor on extremities with an arterial catheter, an NBP cuff or an intravascular venous infusion line.**

NOTE:

- A functional tester or SpO2 simulator can be used to determine the pulse rate accuracy.
- A functional tester or SpO2 simulator cannot be used to assess the SpO2 accuracy.

9.3 Measurement Limitations

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

- Ambient light
- Physical movement (animal 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.

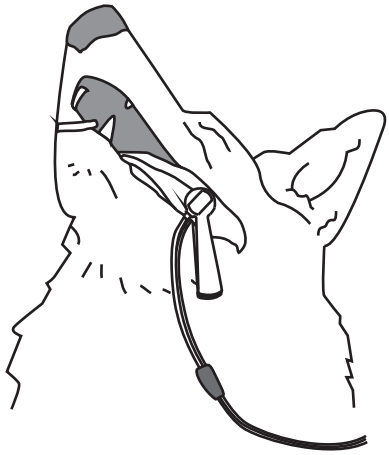
9.4 Starting Measurements

Perform the following procedure:

1. Select an appropriate sensor according to the module type, animal category and weight.
2. Clean the contact surface of the reusable sensor.
3. Clean the application site.
4. Apply the sensor to the animal according to the instruction for use of the sensor.

The SpO_2 sensor selection and application site depend on the animal category.

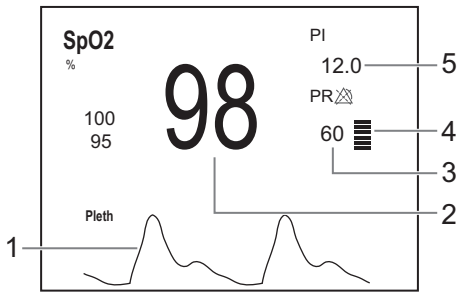
The preferred sensor site for canine, feline and equine is on the tongue. The other sites such as lip, toe, prepuce, vulva or ear can also be measured. The optical components of the sensor should be positioned to the center of the tongue, you can place the sensor as shown below.



5. Connect the SpO_2 sensor tubing to the SpO_2 connector.
6. Adjust parameters in the SpO_2 parameter setup menu to obtain the optimized waveform display.

9.5 Result Display

Your display may be configured to look slightly different.



1.	Pleth waveform (Pleth): visual indication of animal'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.	Pulse rate (derived from pleth wave): detected pulsations per minute.
4.	Perfusion indicator: the pulsatile portion of the measured signal caused by arterial pulsation.

5.	Perfusion index (PI): gives the numerical value for the pulsatile portion of the measured signal caused by arterial pulsation. PI is an indicator of the pulsatile strength. You can also use it to assess the quality of SpO_2 measurement. • Above 1 is optimal, • Between 0.3 and 1 is acceptable. • Below 0.3 indicates low perfusion. When PI is below 0.3, the low perfusion status indicator (a question mark) is displayed to the right of the SpO_2 value, indicating that the SpO_2 value may be inaccurate. Reposition the SpO_2 sensor or find a better site. If low perfusion persists, choose another method to measure oxygen saturation if possible.

9.6 Alarm Operations

For details about physiological and technical alarms, see the *Alarm Messages* appendix.

10 Monitoring NIBP

10.1 Introduction

The monitor uses the oscillometric method for measuring the non-invasive blood pressure (NIBP). NIBP measurement is based on the principle that pulsatile blood flow through an artery creates oscillations of the arterial wall. The oscillometric device uses a blood pressure cuff to sense these oscillations that appear as tiny pulsations in cuff pressure. The Oscillometric devices measure the amplitude of pressure changes in the occluding cuff as the cuff deflates from above systolic pressure. The amplitude suddenly increases as the pulse breaks through the occlusion in the artery. As the cuff pressure decreases further, the pulsations increase in amplitude, reach a maximum (which approximates to the mean pressure), and then diminish. The oscillometric method measures the mean pressure and determines the systolic and diastolic pressures.

10.2 Safety Information

⚠ WARNING

- **Be sure to select the correct weight value setting for your animal before measurement. Do not apply the higher weight value settings for low value animals. Otherwise it may present a safety hazard.**
- **Do not measure NIBP on animals with sickle-cell disease or on the limb where skin damage has occurred or is expected.**
- **Use clinical judgement to determine whether to perform frequent unattended blood pressure measurements on animals with severe blood clotting disorders because of the risk of hematoma in the limb fitted with the cuff.**
- **Do not use the NIBP cuff on a limb with an intravenous infusion or arterial catheter in place. This could cause tissue damage around the catheter when the infusion is slowed or blocked during cuff inflation.**
- **NIBP reading can be affected by the measurement site, the position of the animal, exercise, or the animal's physiologic condition. If you doubt the NIBP measurements, determine the animal's vital signs by alternative means and then verify that the monitor is working correctly.**
- **Continuous CUFF pressure due to connection tubing kinking may cause blood flow interference and resulting harmful injury to the animal.**
- **NIBP diagnostic significance must be decided by the doctor who performs the measurement**

⚠ CAUTION

- **Using IABP may cause NIBP, including PR, measurements inaccurate or failed.**
- **Only use parts and accessories specified in this manual. Follow the instructions for use and adhere to all warnings and cautions.**
- **Accuracy of NIBP measurement depends on using a cuff of proper size. It is essential to measure limb circumference and choose a cuff with proper size.**
- **Do not touch or apply external pressure against the cuff and air tubing during NIBP measurement. This may cause inaccurate blood pressure values.**

10.3 Measurement Limitations

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

The measurement may be inaccurate or impossible:

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

10.4 Measurement Methods

There are four methods of measuring NIBP:

- Manual: measurement on demand.
- Auto: repeated measurements at set interval.

10.5 Starting Measurements

Perform the following procedure:

1. Verify that the weight value is correct.
2. Connect the air tubing to the NIBP connector.
3. Place the NIBP Cuff:
   a. Select a correct sized cuff.
   b. Confirm that the cuff is completely deflated, and select a cuff position based on the animal type and weight.

c. Connect the cuff to the air tubing and make sure that the air tubing is not compressed or twisted. Air must pass unrestricted through the tubing.

NOTE:

For detailed information about the NIBP cuff, see the instructions delivered with it.

4. Adjust the measurement parameter and measurement method in the NIBP setup menu as required.

5. Do one of the following to start measurement:

- Select **NIBP Measure** quick key and you can start the desired measurement from the popup menu.
- Press the hard key on the front panel.
- Select **Start NIBP** in the NIBP setup menu.

6. Do one of the following to stop measurement:

- Select **Stop All** quick key.
- Press the hard key on t he front panel.
- Select **Stop All** in the NIBP setup menu.

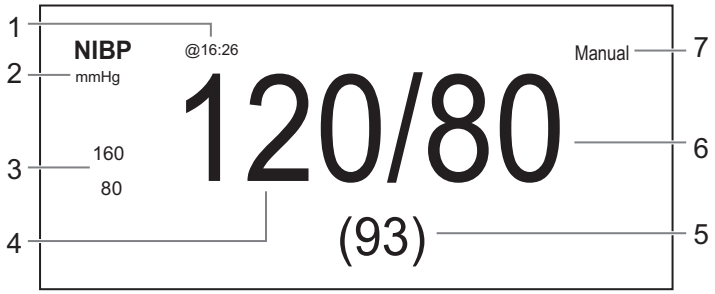
10.6 Result Display

NOTE:

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

Your display may be configured to look slightly different.

The NIBP display shows numerics only.



1.	The last NIBP measurement time
2.	NIBP unit
3.	Systolic pressure alarm limits
4.	Systolic pressure
5.	Mean pressure (displayed after measurement completed) or cuff pressure (displayed during the measurement)

6.	Diastolic pressure
7.	Measurement mode

10.7 Correcting the NIBP Measurements

The middle of the cuff should be at the level of right atrium. If the limb is not at the heart level, you need to correct the measurement:

- Add 0.75 mmHg (0.10 kPa) to the displayed value for each centimeter higher.
- Deduct 0.75 mmHg (0.10 kPa) to the displayed value for each centimeter lower.

10.8 Alarm Operations

For details about physiological and technical alarms, see the *Alarm Messages* appendix.

11 Monitoring Temperature

11.1 Introduction

Thermally sensitive resistors (thermistors) are used. They are based on the principle that electrical resistance of the thermistor changes as temperature changes. Thermistors measure the resistance change and use it to calculate the temperature.

11.2 Starting Measurements

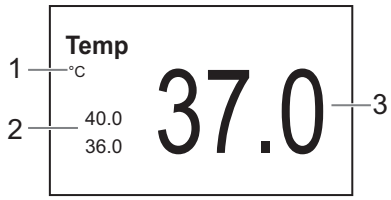
Perform the following procedure:

1. Select an appropriate probe for your animal according to animal category and measured site.
2. Attach the probe to the animal correctly.
3. Plug the probe or temperature cable to the temperature connector.
4. Check that the alarm settings are appropriate for this animal.

11.3 Result Display

Your display may be configured to look slightly different.

The following figure shows the Temp numeric area for temperature monitoring.



1.	Temperature unit
2.	Alarm limits
3.	Temperature value

11.4 Alarm Operations

For details about physiological and technical alarms, see the *Alarm Messages* appendix.

11.5 Temperature Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the monitor or accessories, check the table below before requesting for services. If the problem persists, contact the Customer Service Department or sales representative.

Problem	Solution
Measurement fails/'--' is displayed in the Temp numeric area	Try using a known good probe in case the sensor is damaged.

12 Monitoring Carbon Dioxide

12.1 Introduction

CO_2 monitoring is a continuous, non-invasive technique for determining the concentration of CO_2 in the animal' 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 is passed through respiratory gas samples, some of IR light will be absorbed by the CO_2 molecules. The amount of IR light transmitted after it has been passed through the respiratory gas sample is measured with a photodetector. From the amount of IR light measured, the concentration of CO_2 is calculated.

CO_2 measurements are used to monitor the animal's respiratory status.

12.2 Safety Information

⚠ WARNING

- **Route all tubing away from the animal's throat to avoid strangulation.**
- **Make sure to use the appropriate compensations. Inappropriate compensations may cause inaccurate measurement values and result in misdiagnosis.**

⚠ CAUTION

- **Remove the airway sample line from the animal's airway while nebulized medications are being delivered.**
- **Leakage in the breathing or sampling system may cause the displayed $EtCO_2$ values to be significantly low. Always make sure that all components are securely connected.**
- **$EtCO_2$ values measured from the CO_2 module may differ from those of from the blood gas analysis.**
- **Inspect the airway adapter for a tight connection and proper operation before attaching it to the animal.**
- **Squeezing or bending the sample line during the CO_2 measurement may cause inaccurate CO2 reading or no reading.**
- **Choose proper watertrap and module according to the animal category and animal weight. Otherwise, animal injury could result.**
- **Connect the gas outlet to the scavenging system when measuring CO_2 using the CO_2 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. Extended use could destroy the filter in watertrap and fail to stop the bacterium, water and secretions entering the module, result in damaging the gas module and having infection risk. Replacing the watertrap once a month is recommended.**

NOTE:

- To extend the lifetime of the watertrap and module, disconnect the watertrap from the module and set the operating mode to **Standby** mode when CO2 monitoring is not required.
- The sample rates are different when different types of watertraps are used.
- For the emptying interval of the watertrap, see the Instructions for Use of the watertrap.

12.3 Measurement Limitations

The following factors may influence the measurement accuracy:

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

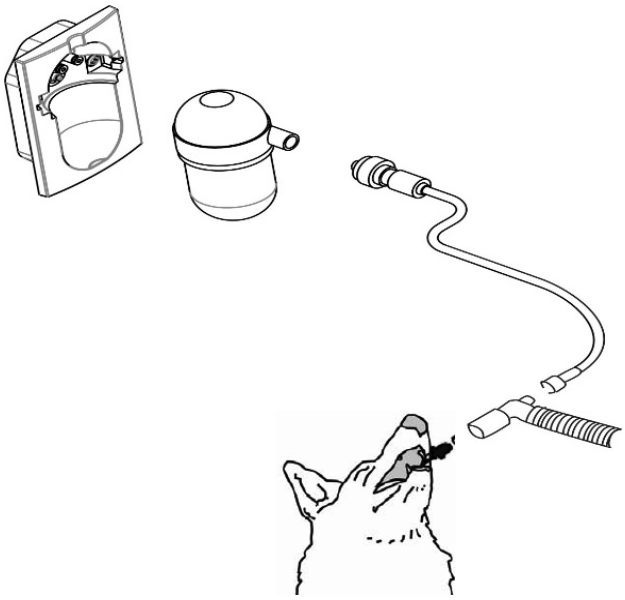
Measurement accuracy may be affected by the breath rate and inspiration/expiration (I/E) ratio as follow:

- EtCO2 value is within specification for breath rate ≤ 60 rpm and I/E ratio ≤ 1: 1.
- EtCO2 value is within specification for breath rate ≤ 30 rpm and I/E ratio ≤ 2: 1.

12.4 Starting Measurements

Perform the following procedure:

1. Select the appropriate watertrap and sampling line according to the animal category.



a. Connect the watertrap to the watertrap receptacle, and then connect the sampling line to the watertrap.

b. Connect the other end of the sampling line to the animal.

c. Connect the gas outlet to the scavenging system using an exhaust tube.

2. Select **CO2** module from the **Resp/CO2** parameter setup menu.

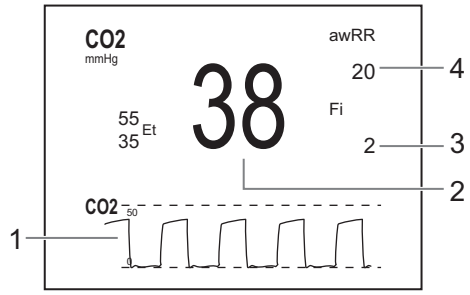
After the CO_2 module is connected, it enters **Measure** mode by default and the monitor displays CO_2 Starting. CO_2 can be measured after the start-up is complete.

3. Adjust parameters in the CO2 parameter setup menu to obtain the optimized waveform display.

12.5 Result Display

Your display may be configured to look slightly different.

The CO_2 parameter and waveform areas provide $FiCO_2$ measurement, $EtCO_2$ measurement, awRR measurement, and a CO_2 waveform.



1.	CO_2 waveform

2.	End tidal CO_2 value ($EtCO_2$)
3.	Fraction of inspired CO_2 ($FiCO_2$)
4.	Airway respiration rate (awRR)

12.6 Alarm Operations

For details about physiological and technical alarms, see the *Alarm Messages* appendix.

12.7 Zeroing the Module

The purpose of zeroing is to eliminate the influence of baseline wander on the measurement result and ensure the correctness of the measurement result.

The CO_2 module performs zero calibration automatically when needed.

NOTE:

The CO_2 module temporally stops measuring during zeroing.

12.8 Calibrating the Module

⚠ CAUTION

Connect the gas outlet to the scavenging system when calibrating the CO_2 module.

A calibration should be performed once a year or when the readings go far beyond the range. To calibrate the CO_2 module, contact the Customer Service Department or sales representative.

13 Care and Maintenance

13.1 Care

Use only the substances approved by us and methods listed in this chapter to clean or disinfect your monitor. Warranty does not cover damage caused by unapproved substances or methods.

We make no claims regarding the efficacy of the listed chemicals or methods as a means for controlling infection. For the method to control infection, consult your hospital's Infection Control Officer or Epidemiologist.

In this chapter we only describe cleaning and disinfection of the main unit. For the cleaning and disinfection of other reusable accessories, see instructions for use of corresponding accessories.

Keep you monitor and accessories free of dust and dirt. To avoid damage to the monitor, follow these rules:

- Always dilute according the manufacturer's instructions or use lowest possible concentration.
- Do not immerse part of the monitor into liquid.
- Do not pour liquid onto the monitor 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 disconnect all power cables from the outlets before cleaning the monitor.

⚠ CAUTION

If you spill liquid on the monitor or accessories, contact the Customer Service Department or sales representative.

NOTE:

- To clean or disinfect reusable accessories, see the instructions delivered with the accessories.
- Avoid the external connectors and thermovent during cleaning or disinfection procedures.

13.1.1 Cleaning

⚠ CAUTION

Any contact of cleaners or disinfectants with connectors or metal parts may cause corrosion.

Clean your monitor on a regular basis. Before cleaning the monitor, consult your hospital's regulations for cleaning the monitor.

To clean the monitor, follow this procedure:

1. Dampen a soft lint-free cloth with water or ethanol (70%), and wring excess liquid from the cloth.
2. Wipe the display screen of the monitor.
3. Wipe the external surface of the monitor and modules with the damp cloth, avoiding the connectors and metal parts.
4. Dry the surface with a clean cloth. Allow the monitor air dry in a ventilated and cool place.

13.1.2 Disinfection

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

13.1.3 Cleaning and Disinfecting the Accessories

For the cleaning, disinfection, and sterilization methods of accessories such as reusable sensors, cables, and lead wires, consult instructions for use delivered with the accessories. If the accessories do not have instructions for use attached, see this section.

⚠ CAUTION

- **Fluids entering the NIBP air hose can damage the monitor. When cleaning 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 after cleaning or disinfecting the NIBP air hose. Replace the NIBP air hose if you detect a leak. Dispose of damaged NIBP air hose according to local laws for disposal of hospital waste.**
- **Never immerse or soak the accessories in any liquid.**
- **Never clean or disinfect the connectors and metal parts.**
- **Use only the 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.**

Cleaning

You should clean the accessories on a regular basis. Before cleaning the accessories, consult your hospital's regulations for cleaning the accessories.

Perform the following procedure:

1. Clean the accessories with a soft cloth moistened with water or ethanol (70%).
2. Wipe off all the cleaner residue with a dry cloth.
3. Allow the accessories to air dry.

Disinfecting

The recommended disinfectant is 70% ethanol.

Perform the following procedure:

1. Clean the accessories before disinfection.
2. Wipe the accessories with a cotton ball or soft cloth moistened with proper amount of disinfectant.
3. Use a soft cloth moistened with water to wipe off the disinfectant on the accessories.
4. Allow the accessories to air dry.

13.1.4 Sterilization

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

13.2 Maintenance

⚠ WARNING

- **Failure on the part of the responsible individual hospital or institution using this monitor to implement a recommended maintenance schedule may cause undue monitor failure and possible health hazards.**
- **No modification of this monitor is allowed.**
- **This monitor contains no user serviceable parts.**
- **The safety checks or maintenance involving any disassembly of the monitor should be performed by professional service personnel. Otherwise, undue monitor failure and possible health hazards could result.**
- **Do not open batteries, heat batteries to above 60°C, incinerate batteries, or short the battery terminals. Batteries may ignite, explode, leak or heat up, causing personal injury.**
- **The service personnel must be properly qualified and thoroughly familiar with the operation of the monitor.**

⚠ CAUTION

- **The monitor and accessories shall not be served or maintained while in use with an animal.**
- **If you discover a problem with any of the monitor, contact the Customer Service Department or sales representative.**
- **Use and store the monitor within the specified temperature, humidity, and altitude ranges.**
- **At the end of its service life, the monitor, 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 monitor, please contact the Customer Service Department or sales representative.

NOTE:

If needed, contact the Customer Service Department or sales representative for circuit diagrams, component part lists, descriptions, calibration instructions, or other information concerning the repair of the monitor.

Regular maintenance is essential to ensure that the monitor functions properly.

13.2.1 Regular Inspection

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

Follow these guidelines when inspecting the monitor:

- Make sure that the environment and power supply meet the requirements.
- Inspect the monitor and its accessories for mechanical damage.
- Inspect all power cords for damage, and make sure that their insulation is in good condition.
- Make sure that only specified accessories are applied.
- Inspect if the alarm system functions correctly.
- Make sure that the batteries meet the performance requirements.
- Make sure that the 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 the Customer Service Department or sales representative.

13.2.2 Maintenance and Testing Schedule

The following maintenance and tests, except for visual inspection, power on test and battery check, shall be carried out by the service personnel only. Contact the Customer Service Department or sales representative if any maintenance is required. Make sure to clean and disinfect the monitor before any test and maintenance.

Check/Maintenance Item		Recommended Frequency
Performance Tests	Visual inspection	Visually inspect the monitor before its first used every day. If you find any signs of damage, remove your monitor from use and contact the Customer Service Department or sales representative. Verify that the monitor meets the following requirements: • Environment and power supply specifications are met. • The monitor housing and display screen are free from cracks or other damages • The power cord is not damaged and the insulation is in good condition. • Connectors, plugs, and cables are not damaged and kinked. • Power cord and animal cables are securely connected with the monitor and modules.
	Measurement module performance test and calibration	• If you suspect that the measurement values are incorrect. • Follow any repairs or replacement of relevant module. • Once a year for CO_2 and NIBP tests. • Once every two years for other parameter module performance tests.
Electrical Safety Tests	Select test items based on the requirements of IEC 60601-1	• After the power module is repaired or replaced • The monitor drops. • At least once every two years.

Check/Maintenance Item		Recommended Frequency
Battery check	Functionality test	• When first installed. • Whenever a battery is replaced.
	Performance test	Every 2 months or if the battery runtime reduced significantly. Follow the steps below: **1.** Disconnect the monitor from the animal and stop all monitoring or measuring. **2.** Apply AC/DC power to the monitor and allow the battery to charge uninterrupted for 10 hours. **3.** Remove AC/DC power and allow the monitor to run from the battery until it shuts off. The operating time of battery reflects its performance directly. Please contact the Customer Service Department or sales representative if its operating time is significantly lower than the specified time. ***NOTE:*** • Life expectancy of a battery depends on how frequent and how long it is used. For a properly maintained and stored lithium ion battery, its life expectancy is about 3 years. For more aggressive use models, life expectancy can be less. We recommend replacing lithium ion batteries every 3 years. • The battery might be damaged or malfunctioned if its operating time is too short after being fully charged. The operating time depends on the configuration and operation. For example, measuring NIBP more frequently will also shorten the operating time. • When a battery has visual signs of damage, or no longer holds a charge, it should be replaced. Remove the old battery from the monitor and recycle it properly.

A Product Specifications

A.1 Monitor Safety Specifications

The monitor is classified, according to IEC 60601-1:

Item	Description
Type of protection against electrical shock	Class I
Degree of protection against electrical shock	• Type CF defibrillation proof for ECG/TEMP/SpO_2/NIBP • Type BF defibrillation proof for CO_2
Degree of protection against harmful ingress of water	IPX1
Degree of safety of application in the presence of flammable anesthetic mixture with air or with oxygen or nitrous oxide	The monitor is not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide
Mode of operation	Continuous

A.2 Environmental Specifications

⚠ CAUTION

The monitor may not meet the performance specifications if stored or used outside the specified temperature and humidity ranges. If the performance of the monitor is degraded due to aging or environmental conditions, contact the Customer Service Department or sales representative.

NOTE:

The environmental specification of unspecified parameter modules are the same as those of the main unit.

Main Unit

Conditions	Ambient temperature (°C)	Relative humidity (no condensation)	Atmospheric pressure
Operating	0 to 40	15% to 95%	427.5 mmHg to 805.5 mmHg (57.0 kPa to 107.4 kPa)
Storage and transportation	-20 to 60	10% to 95%	120 mmHg to 805.5 mmHg (16.0 kPa to 107.4 kPa)

CO_2 Module

Conditions	Ambient temperature (°C)	Relative humidity (no condensation)	Atmospheric pressure
Operating	5 to 40	15% to 95%	430 mmHg to 790 mmHg (57.3 to 105.3 kPa）
Storage and transportation	-20 to 60	10% to 95%	430 mmHg to 790 mmHg (57.3 to 105.3 kPa）

A.3 Power Supply Specifications

External Power Supply Specifications

Item	Description
Input voltage	100-240V AC (±10%)
Input power	50VA
Frequency	50/60Hz (±3Hz)

Battery Specifications

Item	Description
Battery Type	Chargeable Lithium-Ion, 7.2V, 2600mAh

Item	Description
Run time	≥ 2 h when powered by a new fully-charged battery (25°C±5 °C, display brightness set to default value, Resp, SpO_2, ECG and Temp connected, auto NIBP measurements at an interval of 15 minutes)
Charge time	• Less than 4 hours to 100% when the monitor is off • Less than 6 hours to 100% when the monitor is on
Shutdown delay	at least 5 min (after a low battery alarm first occurs)

A.4 Physical Specifications

Item	Description
Size (W×H×D)	Approx. 300 mm×215 mm×155 mm
Weight	• Approx. 2.3 kg (with battery and CO_2 module) • Approx. 2.1 kg (with battery but without CO_2 module)

A.5 Hardware Specifications

Item	Description
Display	• 10.1 inches color display • Resolution at least 1024×600 pixels
Indicators	• Alarm lamp: 1 (two color coded: yellow and red) • Power on LED: 1 (green) • AC power LED: 1 (green) • Battery LED: 1 (green)
Speaker	• Give alarm tones (45 to 85 dB), key tones, QRS tones. • Support PITCH TONE and multi-level tone modulation. • Alarm tones comply with IEC 60601-1-8.
Interface	• Power: 1 ×AC power input • Wired network: 1 RJ45 port • USB: 1 ×USB 2.0 port

A.6 Data Storage

Item	Description
Trends	• Trends: 4 hours, at 5 seconds resolution • Mid-length trends: 120 hours, at 1 min resolution • Long-trends: 1200 hours, at 1 hour resolution
Parameter alarms	1800 alarms and related parameter waveforms
Arrh. events	128 arrhythmia events and related waveforms and parameters
NIBP measurements	1600 sets

A.7 Measurement Specifications

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

A.7.1 ECG Specifications

Item	Description
Lead set	• 3-lead: I, II, III • 5-lead: I, II, III, aVR, aVL, aVF, V
ECG standard	AHA, IEC
Display sensitivity	• 1.25 mm/mV (X0.125), 2.5 mm/mV (X0.25), 5 mm/mV (X0.5), 10 mm/mV (X1), 20 mm/mV (X2), 40 mm/mV (X4), Auto, Accuracy: ±5% • Electrode offset potential tolerance: ±500 mV
Sweep speed	6.25 mm/s, 12.5 mm/s, 25 mm/s, 50 mm/s; Accuracy: ±5%
Bandwidth (-3dB)	• Diagnostic mode: $0.05Hz - 150Hz\begin{pmatrix}0.4dB\\-3.0dB\end{pmatrix}$ • Monitor mode: $0.5Hz - 40Hz\begin{pmatrix}0.4dB\\-3.0dB\end{pmatrix}$ • Surgical mode: $1Hz - 20Hz\begin{pmatrix}0.4dB\\-3.0dB\end{pmatrix}$
Noise	≤ 30 μV (p-v RTI)

Item	Description
Common mode rejection ratio (with Notch on)	• Diagnostic mode: ≥ 90 dB • Monitor mode: ≥ 105 dB • Surgical mode: ≥ 105 dB
Notch	50/60 Hz Monitor and surgical modes: Notch turns on automatically. Diagnostic mode: Notch is turned on/off manually
Differential input impedance	≥5 MΩ
Input signal range	±8 mV (peak-to-peak value)
Accuracy of signal reproduction	Use A and D 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
Recovery time	<5 s (after defibrillation)
Calibration signal	1mV (peak-to-peak value) ±5%
ESU protection	• Cut mode: 300 W • Coagulate mode: 100 W • Recovery time: ≤10 s In compliance with the requirements of IEC 60601-2-27
ESU noise suppression	Use standard ECG leadwires, relative to ECG baseline, noise ≤ 2 mV (peak-to-peak)

Item		Description
HR	Measurement range	15 to 350 bpm
	Resolution	1 bpm
	Accuracy	±1 bpm or ±1%, whichever is greater.
	Sensitivity	200 μV±100μV (lead II)
	HR averaging method	In compliance with the requirements of IEC 60601-2-27, the following method is used: If the last 3 consecutive RR intervals are greater than 1200 ms, the 4 most recent RR intervals are averaged to compute the HR. Otherwise, heart rate is computed by subtracting the maximum and minimum ones from the most recent 12 RR intervals and then averaging them. The HR value displayed on the monitor screen is updated every second.
	Arrhythmia Analysis Classifications	Asystole, VFib/VTac, Vtac, Vent. Brady, Extreme Tachy, Extreme Brady, PVCs/min, R on T, Run PVCs, Couplet, Multif. PVC, PVC, Bigeminy, Trigeminy, Tachy, Brady, Missed Beats, Nonsus. Vtac, Vent. Rhythm, Pause, Irr. Rhythm
	Response to irregular rhythm	In compliance with the requirements of IEC 60601-2-27, the heart rate after 20 seconds of stabilization is displayed as follows: • Ventricular bigeminy (3a): 80±1 bpm • Slow alternating ventricular bigeminy (3b): 60±1 bpm • Rapid alternating ventricular bigeminy (3c): 120±1 bpm • Bidirectional systoles (3d): 90±2 bpm
	Response time to heart rate change	In compliance with the requirements of IEC 60601-2-27. • From 80 to 120 bpm: less than 11 s • From 80 to 40 bpm: less than 11 s
	Time to alarm for tachycardia	In compliance with the requirements of IEC 60601-2-27. • Waveform 4ah - range: < 11 s • Waveform 4a - range: < 11 s • Waveform 4ad - range: < 11 s • Waveform 4bh - range: < 11 s • Waveform 4b - range: < 11 s • Waveform 4bd - range: < 11 s
	Tall T-wave rejection capability	When the test is performed based on IEC 60601-2-27, the heart rate calculation is not affected for QRS of 1 mV amplitude and 100 ms duration, T-wave duration of 180 ms and amplitude lower than 1.2 mV, and QT interval of 350 ms.
Alarn limit	HR High	(low limit + 2) to 300 bpm, 1 bpm/step
	HR Low	15 to (high limit - 2) bpm, 1 bpm/step

A.7.2 Resp Specifications

Item		Description
Lead		Options are lead I and II
Respiration excitation waveform		<300 μA RMS, 64 kHz (±10%)
Sweep speed		3 mm/s, 6.25 mm/s, 12.5 mm/s, 25 mm/s, or 50 mm/s Accuracy: ±5%
Respiration Rate	Measurement range	0 rpm to 150 rpm
	Resolution	1 rpm
	Accuracy	• 7 rpm to 150 rpm: ±2 rpm or ±2%, whichever is greater • 0 rpm to 6 rpm: not specified
Alarm limit	RR High (rpm)	(low limit + 2) to 150, 1 rpm/step
	RR Low (rpm)	0 to (high limit – 2), 1 rpm/step

A.7.3 SpO_2 Specifications

Item		Description
Measurement range		0% to 100%
Resolution		1%
Response time		<30s (SpO_2 value sudden change within 70% to 100%)
Accuracy		• 70% to 100%: ±3% • 0% to 69%: Not specified.
Refreshing rate		≤2 s
PI	Measurement range	0.05% to 20%
	Resolution	0.01
Alarm limit	SpO_2 High (%)	(low limit+2) to 100, 1 /step
	SpO_2 Low (%)	Desat to (high limit-2), 1 /step
	Desat (%)	0 to (high limit-2), 1/step

A.7.4 PR Specifications

PR from SpO_2 Module

Item	Description
Measurement range	20 bpm to 254 bpm

Item	Description
Response time	<30s (PR value sudden change within 25bpm to 240bpm)
Resolution	1 bpm
Accuracy	±3 bpm
Refreshing rate	≤2s

PR from NIBP Module

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

A.7.5 NIBP Specifications

Item	Description
Mode of operation	Manual, Auto
Auto mode repetition intervals	1min, 2min, 2.5min, 3min, 5min, 10min, 15min, 20min, 30min, 1h
Max measurement time	120s
Static pressure measurement range	0 mmHg to 300 mmHg
Static pressure measurement accuracy	±3 mmHg

Item	Description		
Measurement ranges	Weight Range (>50 lb or >23kg)	Systolic	25 to 290 mmHg
			3.3 to 38.7 kPa
		Mean	15 to 260 mmHg
			2.0 to 34.7 kPa
		Diastolic	10 to 250 mmHg
			1.3 to 33.3 kPa
	Weight Range (21 lb to 50 lb or 10 kg to 23 kg)	Systolic	25 to 240 mmHg
			3.3 to 32.0 kPa
		Mean	15 to 215 mmHg
			2.0 to 28.7 kPa
		Diastolic	10 to 200 mmHg
			1.3 to 26.7 kPa
	Weight Range (<21 lb or <1 0kg)	Systolic	25 to 240 mmHg
			3.3 to 32.0 kPa
		Mean	15 to 215 mmHg
			2.0 to 28.7 kPa
		Diastolic	10 to 200 mmHg
			1.3 to 26.7 kPa
Accuracy	• Max mean error: ±5 mmHg • Max standard deviation: 8 mmHg		
Resolution	1 mmHg (0.1 kPa)		
Initial cuff inflation pressure range (mmHg)	• Weight Range (>50 lb or >23 kg): 80 to 280 • Weight Range (21 lb to 50 lb or10 kg to 23 kg): 80 to 210 • Weight Range (<21 lb or <10 kg): 80 to 210		
Default initial cuff inflation pressure (mmHg)	• Weight Range (>50 lb or >23 kg): 160 • Weight Range (21 lb to 50 lb or 10 kg to 23 kg): 140 • Weight Range (<21 lb or <10 kg): 140		
Software overpressure protection (mmHg)	297±3		

Item	Description		
Alarm limit (mmHg)	NIBP-S High	• Weight Range (>50 lb or >23 kg): (low limit+5) to 290 • Weight Range (21 lb to 50 lb or10 kg to 23 kg): (low limit+5) to 240 • Weight Range (<21 lb or <10 kg): (low limit+5) to 240	Step (mmHg): • NIBP ≤ 50: 1 • NIBP>50: 5
	NIBP-S Low	25 to (high limit-5)	Step (mmHg): • NIBP ≤ 50: 1 • NIBP>50: 5
	NIBP-M High	• Weight Range (>50 lb or >23 kg): (low limit+5) to 260 • Weight Range (21 lb to 50 lb or10 kg to 23 kg): (low limit+5) to 215 • Weight Range (<21 lb or <10 kg): (low limit+5) to 215	Step (mmHg): • NIBP ≤ 50: 1 • NIBP>50: 5
	NIBP-M Low	15 to (high limit-5)	Step (mmHg): • NIBP ≤ 50: 1 • NIBP>50: 5
	NIBP-D High	• Weight Range (>50 lb or >23 kg): (low limit+5) to 250 • Weight Range (21 lb to 50 lb or10 kg to 23 kg): (low limit+5) to 200 • Weight Range (<21 lb or <10 kg): (low limit+5) to 200	Step (mmHg): • NIBP ≤ 50: 1 • NIBP>50: 5
	NIBP-D Low	10 to (high limit-5)	Step (mmHg): • NIBP ≤ 50: 1 • NIBP>50: 5

A.7.6 Temp Specifications

Item	Description	
Measurement range	0°C to 50°C (32°F to 122°F)	
Resolution	0.1°C	
Accuracy	±0.1°C (±0.2 °F)	
Refreshing rate	≤2s	
Minimum time for accurate measurement	• Body surface: <100s • Body cavity: <80s	
Alarm limit	High limit (°C)	(low limit+1) to 50, 0.1/step
	Low limit (°C)	0.1 to (high limit-1), 0.1/step

A.7.7 CO_2 Specifications

Item	Description
Measurement mode	Sidestream
Measurement range	0 to 20%
Resolution	1mmHg
Accuracy	• CO2 concentration<1%: ±0.1% • 1%≤CO2 concentration<5%: ±0.2% • 5%≤CO2 concentration<7%: ±0.3% • 7%≤CO2 concentration<12%: ±0.4% • 12%≤CO2 concentration≤13%: ±0.5% • 13%<CO2 concentration≤20%: ±(0.43%+8%rel) • 20%<CO2 concentration: unspecified
Accuracy drift	Meet the requirement for measurement accuracy within 6 hours
Sample flowrate tolerance	±15% or ±15 ml/min, whichever is greater
Start-up time	< 90s
Rise time	• Measured with a 2nd generation small watertrap and a 2.5 m small airway sampling line: <330 ms@90mL/min • Measured with a 2nd generation large watertrap and a 2.5 m large airway sampling line: <300 ms@120mL/min

Item	Description	
Response time	• Measured with a 2nd generation small watertrap and a 2.5 m small airway sampling line: <4.5 s @ 90 mL/min • Measured with a 2nd generation large watertrap and a 2.5 m large airway sampling line: <5.5 s @120 mL/min	
Apnea time	10s, 15s, 20s, 25s, 30s, 35s, 40s	
awRR	Measurement range	0 rpm to 150 rpm
	Measurement precision	• less than 60 rpm: ±1rpm • 60rpm to 150rpm: ±2rpm
	Resolution	1 rpm
Alarm limit	$EtCO_2$ High limit	(low limit+2) mmHg to 99 mmHg, 1 mmHg/step
	$EtCO_2$ Low limit	1 mmHg to (high limit-2) mmHg, 1 mmHg/step
	$FiCO_2$ High limit	1 mmHg to 99 mmHg, 1 mmHg/step
	awRR High limit	(low limit+2) rpm to 150 rpm, 1 rpm/step
	awRR Low limit	0 rpm to (high limit-2) rpm, 1 rpm/step

Effect of interference gases on CO_2 measurements

Gas	Concentration (%)	Quantitative effect*
N_2O	≤60	±1 mmHg
HAL	≤4	
SEV	≤5	
ISO	≤5	
ENF	≤5	
DES	≤15	±2 mmHg
O_2	≤100	±1 mmHg

*means an extra error should be added in case of gas interference when CO_2 measurements are performed between 0-40 mmHg.

B Accessories

The accessories listed in this chapter comply with the requirements of IEC 60601-1-2 when in use with the monitor. For details about the accessories, see the instructions for use provided with the accessory.

⚠ WARNING

- **Use accessories specified in this chapter. Using other accessories may cause damage to the monitor or not meet the claimed specifications.**
- **The accessories listed in this chapter must be used in conjunction with Mindray Animal Medical's monitors. It is the user's responsibility to read the instructions for use of the monitor (including accessories) or contact the Customer Service Department or sales representative for consultation before use to confirm that the accessories match the monitor. Otherwise, the animal may be injured.**
- **Single use accessories are not designed to be reused. Reuse may cause a risk of contamination and affect the measurement accuracy**

⚠ CAUTION

- **The accessories may not meet the performance specifications if stored or used outside the specified temperature and humidity ranges. If accessory performance is degraded due to aging or environmental conditions, contact the Customer Service Department or sales representative.**
- **Check the accessories and their packages for any sign of damage. Do not use them if any damage is detected.**
- **Use the accessories before the expiry date if their expiry date is indicated.**
- **The disposable accessories shall be disposed of according to hospital's regulations.**

NOTE:

- For accessories with a safe service life, see the accessory package for the service life.
- For sterilization accessories, see the accessory package.

B.1 SpO_2 Accessories

Model	Description
552A Vet	7 Pin SpO2 Sensor(Vet, 2-Clips)
562A	7 Pin SpO2 Extension Cable, Vet
551B	Veterinary SpO2 Sensor(Reusable,2-Clips)
551B	Veterinary SpO2 Sensor(Reusable,2-Clips)
/	MINDRAY SpO2 Accessory Kit(7 pin)
/	SpO2 Accessory Kit

B.2 ECG Accessories

Model	Description
EA050S3I	12Pin 3-Lead ECG Cable,IEC,Snap(Vet)
EA050S3A	12Pin 3-Lead ECG Cable,AHA,Snap(Vet)
EA050C3I	12Pin 5-Lead ECG Cable,IEC,Clip(Vet)
EA050C3A	12Pin 3-Lead ECG Cable,AHA,Clip(Vet)
EV6201	12Pin 3/5-Lead ECG Host Cable, Vet
EL6304A	3-Lead Leadset,IEC,Clip,Long, Vet
EL6302B	3-Lead Leadset,IEC,Snap, Vet
EL6301B	3-Lead Leadset,AHA,Snap, Vet
EL6303A	3-Lead Leadset,AHA,Clip,Long, Vet
EL6502B	5-Lead Leadset,IEC,Snap, Vet
EL6504A	5-Lead Leadset,IEC,Clip,Long, Vet
EL6501B	5-Lead Leadset,AHA,Snap, Vet
EL6502A	5-Lead Leadset,IEC,Clip, Vet
EL6301A	3-Lead Leadset,AHA,Clip, Vet
EL6503A	5-Lead Leadset,AHA,Clip,Long, Vet
EL6501A	5-Lead Leadset,AHA,Clip, Vet
EL6302A	3-Lead Leadset,IEC,Clip, Vet
/	ECG Accessory Kit:5-lead, Snap,IEC ,Vet
/	ECG Accessory Kit:3-lead,Clip,IEC ,Vet
/	ECG Accessory Kit:3-lead, Snap,IEC ,Vet
/	ECG Accessory Kit:5-lead,Clip,IEC ,Vet

Model	Description
/	ECG Accessory Kit:3-lead, Snap, AHA,Vet
/	ECG Accessory Kit:5-lead, Snap, AHA,Vet
/	ECG Accessory Kit:3-lead,Clip,AHA,Vet
/	ECG Accessory Kit:5-lead,Clip, AHA,Vet
ODM-W0013B	E-Probe(Small, for BW<13kg animal)
ODM-W0013A	E-Probe(Large, for BW>13kg animal)
EB6903	ALLIGATOR CLIP,VET

B.3 Temp Accessories

Model	Description
W0013B	2Pin Temp Probe,Eso/Recta,(Vet)
MR402B	Reusable Temp Probe,Eso/Recta,Small,Vet
MR401B	Reusable Temp Probe,Eso/Rectal,Large,Vet

B.4 NIBP Accessories

Model	Description
CMA01 Vet	NIBP Cuff 1# (CMA01 Vet, 3.1-5.7, 20pcs)
CMA02 Vet	NIBP Cuff 2# (CMA02 Vet, 4.3-8.0, 20pcs)
CMA03 Vet	NIBP Cuff 3# (CMA03 Vet, 5.8-10.9, 20pcs)
CMA04 Vet	NIBP Cuff 4# (CMA04 Vet, 7.1-13.1,20pcs)
CMA05 Vet	NIBP Cuff 5# (CMA05 Vet,8-15, 20pcs)
CMA01 Vet	NIBP Cuff 1# (CMA01 Vet,3.1-5.7, 20pcs)
CMA02 Vet	NIBP Cuff 2# (CMA02 Vet,4.3-8.0, 20pcs)
CMA03 Vet	NIBP Cuff 3# (CMA03 Vet,5.8-10.9, 20pcs)
CMA04 Vet	NIBP Cuff 4# (CMA04 Vet,7.1-13.1,20pcs)
CMA05 Vet	NIBP Cuff 5# (CMA05 Vet,8-15, 20pcs)
CMA91 Vet	Tube for NIBP Cuff, Vet
CMA92 Vet	Tube for NIBP Cuff, Vet, Self locking
/	NIBP Accessory Kit(CMA01 Vet~CMA05Vet)
/	NIBP Accessory Kit(CMA01 Vet~CMA05Vet)

B.5 CO_2 Accessories

Model	Description
/	Sidestream CO2 Kit, Small, Vet
/	Sidestream CO2 Kit, Large, Vet
/	Single CO2 Accessory Kit, Small, Vet
/	Single CO2 Accessory Kit, Large, Vet
/	DRYLINE II Water Trap, Large(10pcs), Vet
/	DRYLINE II Water Trap, Small(10pcs), Vet
/	Sampling Line, Large(25pcs), Vet
/	Sampling Line, Small(25pcs), Vet
/	Adapter, Airway, STRT, Small(10pcs), Vet
/	Adapter, Airway, STRT, Large(10pcs), Vet
/	Adapter, Airway, ELBOW, Large(10pcs),Vet

C EMC Guidance and Manufacturer's Declaration

The device meets the requirements of IEC 60601-1-2: 2014.

⚠ WARNING

- **Use of accessories, transducers and cables other than those specified or provided by the manufacturer of this equipment could result in increased electromagnetic emissions or decreased electromagnetic immunity of this equipment and result in improper operation.**
- **The non-ME EQUIPMENT (e.g. ITE) that is a part of an ME SYSTEM may be disrupted by the electromagnetic interference of nearby equipment. It may be necessary to take mitigation measures, such as re-orienting or relocating the non-ME EQUIPMENT or shielding the location.**
- **Use of this equipment adjacent to or stacked with other equipment should be avoided because it could result in improper operation. If such use is necessary, this equipment and the other equipment should be observed to verify that they are operating normally.**
- **This device is intended for use in professional healthcare facility environment and home healthcare environment. If it is used in special environment, such as magnetic resonance imaging environment, the equipment/system may be disrupted by the operation of nearby equipment.**
- **Portable RF communications equipment (including peripherals such as antenna cables and external antennas) should be used no closer than 30 cm (12 inches) to any part of the this device, including cables specified by the manufacturer. Otherwise, degradation of the performance of this equipment could result.**

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**
Conducted and radiated RF EMISSIONS CISPR 11	Group 1	The device uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.

Guidance and Declaration - Electromagnetic Emissions		
The device is intended for use in the electromagnetic environment specified below. The customer or the user of the device should assure that it is used in such an environment.		
Emission tests	**Compliance**	**Electromagnetic environment - guidance**
Conducted and radiated RF EMISSIONS CISPR 11	Class A	The device is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes
Harmonic distortion EMISSIONS IEC 61000-3-2	Class A	
Voltage Fluctuations/Flicker EMISSIONS IEC 61000-3-3	Complies	

If the system is operated within the electromagnetic environment listed in Table Guidance and Declaration -Electromagnetic Immunity, the system will remain safe and provide the following essential performance:

- Operating mode
- Accuracy
- Function
- Accessories identification
- Data stored
- Alarm
- Detect for connection

NOTE:

- If the essential performance is lost or degraded, it may be necessary to take mitigation measures, such as re-orienting or relocating the ME EQUIPMENT or ME SYSTEM or shielding the location or stopping using the monitor and contact the Customer Service Department or sales representative.
- The device needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided below.
- Other devices may interfere with this device even though they meet the requirements of CISPR.
- When the inputted signal is below the minimum amplitude provided in technical specifications, erroneous measurements could result.
- The EMISSIONS characteristics of this device make it suitable for use in industrial areas and hospitals (CISPR 11 class A). If it is used in a residential environment (for which CISPR 11 class B is normally required) this device might not offer adequate protection to radio-frequency communication services. The user might need to take mitigation measures, such as relocating or re-orienting the device.

Guidance and Declaration - Electromagnetic Immunity			
The device is intended for use in the electromagnetic environment specified below. The customer or the user of the device should assure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	±8 kV contact ±15 kV air	±8 kV contact ±15 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 and voltage interruptions IEC 61000-4-11	0% U_T for 0.5 cycle: at 0°, 45°, 90°, 135°, 180°, 225°, 270° and 315° 0% U_T for 1 cycle and 70% U_T for 25/30 cycles: at 0° 0% U_T for 250/300 cycle	0% U_T for 0.5 cycle: at 0°, 45°, 90°, 135°, 180°, 225°, 270° and 315° 0% U_T for 1 cycle and 70% U_T for 25/30 cycles: at 0° 0% U_T for 250/300 cycle	Mains power quality should be that of a typical commercial or hospital environment. If the user of our product requires continued operation during power mains interruptions, it is recommended that our product be powered from an uninterruptible power supply or a battery.
RATED power frequency magnetic fields IEC 61000-4-8	30 A/m 50 Hz/60 Hz	30 A/m 50 Hz/60 Hz	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Note: U_T is the 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	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Conducted disturbances induced by RF fields IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz 80% AM at 1 kHz	3Vrms	Portable and mobile RF communications equipment should be used no closer to any part of the system, including cables, than the recommended separation distance calculated from the equation appropriate for the frequency of the transmitter. Recommended separation distances: $d = 1.2 \times \sqrt{P}$
	6 Vrms in ISM bands between 0.15 MHz and 80 MHz 80% AM at 1 kHz	6 Vrms	
Radiated RF EM fields IEC 61000-4-3	3 V/m 80 MHz to 2,7 GHz 80% AM at 1 kHz	3V/m	Recommended separation distances: 80 MHz to 800 MHz: $d = 1.2 \times \sqrt{P}$ 800MHz - 2.7GHz: $d = 2.3 \times \sqrt{P}$ Where, P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m)[b]. Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey[a] should be less than the compliance level in each frequency range[b]. Interference may occur in the vicinity of equipment marked with the following symbol: 
Proximity fields from RF wireless communications equipment IEC 61000-4-3	27 V/m 385 MHz	27 V/m	
	28 V/m 810 MHz, 870 MHz, 930 MHz, 1720 MHz, 1845 MHz, 1970 MHz, 2450 MHz (pulse modulation)	28 V/m	
	28V/m 450 MHz (FM modulation)	28 V/m	
	9V /m 710 MHz, 745 MHz, 780 MHz, 5240 MHz, 5500 MHz, 5785 MHz	9 V/m	
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.			

Guidance and Declaration - Electromagnetic Immunity			
The device is intended for use in the specified electromagnetic environment. The customer or the user of the device should assure that it is used in such an environment as described below.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**

a: Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the ME EQUIPMENT or ME SYSTEM is used exceeds the applicable RF compliance level above, the ME EQUIPMENT or ME SYSTEM should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the ME EQUIPMENT or ME SYSTEM.

b: Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3V/m.

⚠ 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 to 80 MHz $d = 1.2\sqrt{P}$	**80 MHz to 800 MHz** $d = 1.2\sqrt{P}$	**800 MHz to 2.7 GHz** $d = 2.3\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.20	1.20	2.30
10	3.80	3.80	7.30
100	12.00	12.00	23.00

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 to 80 MHz $d = 1.2\sqrt{P}$	**80 MHz to 800 MHz** $d = 1.2\sqrt{P}$	**800 MHz to 2.7 GHz** $d = 2.3\sqrt{P}$

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.

D Default Settings

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. The last column of the following tables is for your notes and review.

D.1 Parameters Configuration

Item	Name	Default Setting
ECG	**Lead Set**	**Auto**
	ECG	II
	Gain	X2
	Sweep	25 mm/s
	Esophageal	**No**
	Filter	**Surgery**
	Notch Filter	**On**
	Smart Lead Off	**On**
Resp	**Module Select**	**CO2**
	Resp Lead	II
	Gain	X2
	Sweep	6.25 mm/s

Item	Name	Default Setting
CO2	**Module Select**	**CO2**
	Operating Mode	**Measure**
	Sweep	6.25mm/s
	Scale	• mmHg: 50 • kPa: 7.0
	Wave Type	**Draw**
	Auto Standby	60 min
	BTPS Compen	**Off**
	O2 Compen	90
	AA Compen	0
SpO2	**Sensitivity**	**Med**
	Sweep	25 mm/s
NIBP	**Interval**	5 min
	Initial Pressure	• Weight > 23 kg: 160 • Weight ≤ 23 kg: 140 • When the weight is not set: 140
	Display PR	Off
	NIBP End Tone	Off

D.2 Alarm Default Settings

Alarm Limit

Item	Name	Default Setting
HR/PR	**On/Off**	**On**
	High	Canine/other: 160; Feline: 180
	Low	Canine/other: 60; Feline:100
	Level	**Med**
RR	On/Off	**On**
	High	30
	Low	6
	Level	**Med**

Item	Name	Default Setting
Apnea	**On/Off**	**On**
	High	/
	Low	/
	Level	**High**
SpO2	**On/Off**	**On**
	High	100
	Low	95
	Level	**Med**
Desat	**On/Off**	**On**
	High	/
	Low	85
	Level	**High**
NIBP-S	**On/Off**	**On**
	High	Canine/other: 160; Feline: 160
	Low	Canine/other: 80; Feline: 80
	Level	**Med**
NIBP-D	**On/Off**	**On**
	High	Canine/other: 90; Feline: 90
	Low	Canine/other: 55; Feline: 60
	Level	**Med**
NIBP-M	**On/Off**	**On**
	High	Canine/other: 100; Feline: 100
	Low	Canine/other: 60; Feline: 65
	Level	**Med**
Temp	**On/Off**	**On**
	High	40.0
	Low	Canine/other: 36.0; Feline: 37.0
	Level	**Med**
EtCO2	**On/Off**	**On**
	High	Canine/other: 55; Feline: 50
	Low	Canine/other: 35; Feline: 30
	Level	**Med**

Item	Name	Default Setting
FiCO2	**On/Off**	**On**
	High	5
	Low	/
	Level	**Med**

Setup

Item	Default Setting
Alm Volume	2
High Alarm Volume	**Alm Volume+3**
Prompt **Reminder Volume**	2
HR/PR Alarm Source	**Auto**
Apnea Delay	15s

Arrhythmia Alarm Default Settings

Item	Alarm Switch	Priority
Asystole	**On**	**High**, unadjustable
VFib/VTac	**On**	**High**, unadjustable
Vtac	**On**	**High**, unadjustable
Vent. Brady	**On**	**High**, unadjustable
Extreme Tachy	**On**	**High**, unadjustable
Extreme Brady	**On**	**High**, unadjustable
PVCs/min	**Off**	**Med**
R on T	**Off**	**Med**
Run PVCs	**Off**	**Low**
Couplet	**Off**	**Prompt**
Multif. PVC	**Off**	**Med**
PVC	**Off**	**Prompt**
Bigeminy	**Off**	**Med**
Trigeminy	**Off**	**Med**
Tachy	**Off**	**Med**
Brady	**Off**	**Med**
Missed Beat	**Off**	**Prompt**
Nonsus. Vtac	**Off**	**Med**

Item	Alarm Switch	Priority
Vent. Rhythm	**Off**	**Med**
Pause	**Off**	**Low**
Irr. Rhythm	**Off**	**Prompt**

D.3 Screen Setup

Item	Default Setting
Choose Screen	**Big Numerics**
Hotkey Setup	• Hotkey 1: **NIBP Measure** • Hotkey 2: **Tabular Trends** • Hotkey 3: **Alarm Setup** • Hotkey 4: **Timer** • Hotkey 5: **Standby** • Hotkey 6: **Main Menu**
Param. Color	• ECG: Green • SpO2: Cyan • NIBP: White • Resp: Yellow • Temp: White • CO2: Yellow

D.4 System

General Setup

Item	Default Setting
QRS Volume	2
Brightness	5
Key Volume	2
eStart	**On**
Date Format	yyyy-mm-dd
Time Format	24 h

Maintenance

Item	Name	Default Setting
Setup	**Weight Unit**	kg
	Temp Unit	°C
	Press. Unit	mmHg
	CO2 Unit	mmHg
	Language	English
	Defaults	**Latest Config**
Module	**ECG Standard**	AHA
	Notch Filter	50 Hz
	SpO2 Tone	**Mode 1**
Arrh. Threshold	**PVCs/min**	10
	Tachy High	Canine/other: 160; Feline: 180
	Brady Low	Canine/other: 60; Feline: 100
	Extreme Tachy	Canine/other: 180; Feline: 200
	Extreme Brady	Canine/other: 50; Feline: 90
	Asys. Delay	5
	Multif. PVC's Window	15
	Vtac Rate	160
	Vtac PVC	3
	Pause Time	2.0
	Vbrd Rate	40
	Vbrd PVCs	5
Alarm	**Minimum Alarm Volume**	2
	Alarm Pause Time	2 min
	Alarm Off Reminder	**On**
	Reminder Interval	1 min
	Alarm Sound	ISO
	Alarm Delay	6 s

E 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 the "Cause and Solution" column, corresponding solutions are given instructing you to troubleshoot problems. If the problem persists, contact the Customer Service Department or sales representative.

E.1 Physiological Alarm Messages

NOTE:

- The "Default level" field indicates the alarm level: H means high, M means medium and L means low. "*" means the alarm level is user-adjustable.
- XX represents a measurement or parameter label.

E.1.1 General Alarm Messages

Alarm messages	Default level	Cause and solution
XX **Too High**	M*	XX value has risen above the high alarm limit or fallen below the low alarm limit. Check the animal's condition and check if the animal category and alarm limit settings are correct.
XX **Too Low**	M*	

E.1.2 ECG Alarm Messages

Alarm messages	Default level	Cause and solution
ECG Weak Signal	H	The ECG signal is so weak that the monitor can't perform ECG analysis. Check the animal's condition and the ECG connections.

Alarm messages	Default level	Cause and solution
Asystole	H	Arrhythmia has occurred to the animal. Check the animal's condition and the ECG connections.
VFib/VTac	H	
Vtac	H	
Vent. Brady	H	
Extreme Tachy	H	
Extreme Brady	H	
R on T	M*	
Run PVCs	L*	
PVC	M*	
Multif. PVC	M*	
Bigeminy	M*	
Trigeminy	M*	
Tachy	M*	
Brady	M*	
Vent. Rhythm	M*	
Nonsus. Vtac	M*	
Pause	L*	

E.1.3 Resp

Alarm messages	Default level	Cause and solution
Resp Apnea	H	The respiration signal was so weak that the monitor cannot perform respiration analysis. Check the animal's condition and the Resp connections.
Resp Artifact	H	The animal's heartbeat has interfered with his respiration. Check the animal's condition and the Resp connections.

E.1.4 SpO2

Alarm messages	Default level	Cause and solution
SpO2 Desat	H	The SpO_2 value has fallen below the desaturation alarm limit. Check the animal's condition and check if the alarm limit settings are correct.
No Pulse	H	The pulse signal was so weak that the monitor cannot perform pulse analysis. Check the animal's condition, SpO_2 sensor and measurement site.

E.1.5 CO2

Alarm messages	Default level	Cause and solution
CO2 Apnea	H	The animal stops breathing, or the respiration signal was so weak that the monitor cannot perform respiration analysis. Check the animal's condition and the RM connections.

E.2 Technical Alarm Messages

NOTE:

- The "Alarm clearing mode" 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.
- The "Default level" field indicates the alarm level: H means high, M means medium and L means low. "*" means the alarm level is user-adjustable.
- XX represents a measurement or parameter label.

E.2.1 General Technical Alarm Messages

Alarm messages	Default level	Alarm clearing mode	Cause and solution
XX SelfTest Err	H	C	An error occurred to the XX module, or there is a problem with the communications between the module and the monitor. Re-plug the module and restart the monitor, or plug the module into another monitor.
XX Init Err	H	A	
XX Init Err N (N is within 1 to 8)	H	A	
XX Comm Err	H	A	
XX Comm Stop	H	C	
XX Limit Err	L	C	XX parameter limit is accidentally changed. Contact the Customer Service Department or sales representative.
XX Overrange	L	C	The measured XX value is not within the specified range for XX measurement. Contact the Customer Service Department or sales representative.

E.2.2 ECG

Alarm messages	Default level	Alarm clearing mode	Cause and solution
ECG Lead Off	L	B	The electrode has become detached from the animal or the lead wire has become disconnected from the adapter cable. Check the connections of the electrodes and leadwires.
ECG YY Lead Off	L	B	
ECG Noisy	L	A	The ECG signal is noisy. Check for any possible sources of signal noise around the cable and electrode, and check the animal for great motion.

E.2.3 Resp

Alarm messages	Default level	Alarm clearing mode	Cause and solution
Resp Disturbed	L	A	The respiration circuit is disturbed. Restart the monitor.

E.2.4 Temp

Alarm messages	Default level	Alarm clearing mode	Cause and solution
Sensor Off	L	A	The Temp sensor has become detached from the animal or the module. Check the sensor connections.

E.2.5 SpO2

Alarm messages	Default level	Alarm clearing mode	Cause and solution
SpO2 Sensor Off	L	B	The SpO_2 sensor has become detached from the animal or the module, or there is a fault with the SpO_2 sensor, or an unspecified SpO_2 sensor has been used. Check the sensor application site and the sensor type, and make sure if the sensor is damaged. Reconnect the sensor or use a new sensor.
SpO2 No Sensor	L	B	
SpO2 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.
SpO2 Weak Pulse	L	C	The SpO_2 signal is too low or too weak. Check the animal's condition and change the sensor application site. If the error persists, replace the sensor.

E.2.6 NIBP

Alarm messages	Default level	Alarm clearing mode	Cause and solution
NIBP Loose Cuff	L	A	The NIBP cuff is not properly connected, or there is a leak in the airway.
NIBP Air Leak	L	A	
NIBP Pneumatic Leak	L	A	Check the NIBP cuff and pump for leakages.
NIBP Air Pressure Err	L	A	An error occurred to the air pressure. Verify that the monitor application site meets the environmental requirements and check if there is any source that affects the air pressure.
NIBP Weak Signal	L	A	The animal's pulse is weak or the cuff is loose. Check the animal's condition and change the cuff application site. If the error persists, replace the cuff.
NIBP Overrange	L	A	The measured NIBP value exceeds the module measurement range.

Alarm messages	Default level	Alarm clearing mode	Cause and solution
NIBP Excessive Motion	L	A	Check the animal's condition and reduce the animal motion.
NIBP Cuff Overpress.	L	A	The NIBP airway may be occluded. Check the airway and measure again.
NIBP Equip Err	H	A	An error occurred during NIBP measurement and therefore the monitor cannot perform analysis correctly. Check the animal's condition and NIBP connections, or replace the cuff.
NIBP Timeout	L	A	
NIBP Illegally Reset	L	A	An illegal reset occurred during NIBP measurement. Check if the airway is occluded.

E.2.7 CO2

Alarm messages	Default level	Alarm clearing mode	Cause and solution
CO2 Sensor High Temp	L	C	Check, stop using or replace the sensor.
CO2 FilterLine Occluded	L	C	The airway or watertrap was occluded. Check the airway and remove the occlusion.
CO2 No Watertrap	L	B	Check the watertrap connections.
CO2 Zero Failed	L	A	Check the CO2 connections. After the sensor's temperature becomes stabilized, perform a zero calibration again.
CO2: Change Watertrap	L	C	Replace the watertrap.

E.2.8 Power Supply

Alarm messages	Default level	Alarm clearing mode	Cause and solution
Battery Too Low	H	C	Connect the monitor to an AC power source and allow the batteries to charge.

E.2.9 System

Alarm messages	Default level	Alarm clearing mode	Cause and solution
PWR interrupted. Check meas. state	L	A	Power supply failed accidently. Check the measurements when the monitor restarts.

F Electrical Safety Inspection

The following electrical safety tests are recommended as part of a comprehensive preventive maintenance program. They are a proven means of detecting abnormalities that, if undetected, could prove dangerous to either the animal or the operator. Additional tests may be required according to local regulations.

All tests can be performed using commercially available safety analyzer test equipment. These procedures assume the use of a 601PROXL International Safety Analyzer or equivalent safety analyzer. Other popular testers complying with IEC 60601-1 used in Europe, such as Fluke, Metron, or Gerb, may require modifications to the procedure. Please follow the instructions of the analyzer manufacturer.

The electrical safety inspection should be periodically performed every two years.The safety analyzer also proves to be an excellent troubleshooting tool to detect abnormalities of line voltage and grounding, as well as total current loads.

F.1 Power Cord Plug

Test Item		Acceptance Criteria
The power plug	The power plug pins	No broken or bent pin. No discolored pins.
	The plug body	No physical damage to the plug body.
	The strain relief	No physical damage to the strain relief. No plug warmth for device in use.
	The power plug	No loose connections.
The power cord		No physical damage to the cord. No deterioration to the cord.
		For devices with detachable power cords, inspect the connection at the device.
		For devices with non-detachable power cords, inspect the strain relief at the device.

F.2 Device Enclosure and Accessories

F.2.1 Visual Inspection

Test Item	Acceptance Criteria
The enclosure and accessories	No physical damage to the enclosure and accessories.
	No physical damage to meters, switches, connectors, etc.
	No residue of fluid spillage (e.g., water, coffee, chemicals, etc.).
	No loose or missing parts (e.g., knobs, dials, terminals, etc.).

F.2.2 Contextual Inspection

Test Item	Acceptance Criteria
The enclosure and accessories	No unusual noises (e.g., a rattle inside the case).
	No unusual smells (e.g., burning or smoky smells, particularly from ventilation holes).
	No taped notes that may suggest device deficiencies or operator concerns.

F.3 Device Labeling

Check the labels provided by the manufacturer or the healthcare facilities are present and legible.

- Main unit label
- Integrated warning labels

F.4 Protective Earth Resistance

1. Plug the probes of the analyzer into the device's protective earth terminal and protective earth terminal of the AC power cord.
2. Test the earth resistance with a current of 25 A.
3. Verify the resistance is less than limits.

LIMITS

For all countries, R = 0.2 Ω Maximum

F.5 Earth Leakage Test

Run an Earth Leakage test on the device being tested before performing any other leakage tests.

The following outlet conditions apply when performing the Earth Leakage test:

- normal polarity (Normal Condition)
- reverse polarity (Normal Condition)
- normal polarity with open neutral (Single Fault Condition)
- reverse polarity with open neutral (Single Fault Condition)

LIMITS

- For UL 60601-1,
  - 300 µA in Normal Condition
  - 1000 µA in Single Fault Condition
- For IEC 60601-1,
  - 500 µA in Normal Condition
  - 1000 µA in Single Fault Condition

F.6 Animal Leakage Current

Animal leakage currents are measured between a selected applied part and mains earth. All measurements have a true RMS only.

The following outlet conditions apply when performing the Animal Leakage Current test.

- normal polarity (Normal Condition)
- reverse polarity (Normal Condition)
- normal polarity with open neutral (Single Fault Condition)
- reverse polarity with open neutral (Single Fault Condition)
- normal polarity with open earth (Single Fault Condition)
- reverse polarity with open earth (Single Fault Condition)

LIMITS

- For CF  applied parts
  - 10 µA in Normal Condition
  - 50 µA in Single Fault Condition
- For BF  applied parts
  - 100 µA in Normal Condition
  - 500 µA in Single Fault Condition

F.7 Mains on Applied Part Leakage

The Mains on Applied Part test applies a test voltage, which is 110% of the mains voltage, through a limiting resistance, to selected applied part terminals. Current measurements are then taken between

the selected applied part and earth. Measurements are taken with the test voltage (110% of mains) to applied parts in the normal and reverse polarity conditions

The following outlet conditions apply when performing the Mains on Applied Part test.

- Normal Polarity
- Reversed Polarity

LIMITS

- For CF applied parts: 50 µA
- For BF applied parts: 5000 µA

F.8 Animal Auxiliary Current

Animal Auxiliary currents are measured between any selected Applied Part connector and the remaining Applied Part connector s. All measurements may have a true RMS only response.

The following outlet conditions apply when performing the Animal Auxiliary Current test.

- normal polarity (Normal Condition)
- reverse polarity (Normal Condition)
- normal polarity with open neutral (Single Fault Condition)
- reverse polarity with open neutral (Single Fault Condition)
- normal polarity with open earth (Single Fault Condition)
- reverse polarity with open earth (Single Fault Condition)

LIMITS

- For CF applied parts,
  - 10 µA in Normal Condition
  - 50 µA in Single Fault Condition
- For BF applied parts,
  - 100 µA in Normal Condition
  - 500 µA in Single Fault Condition

NOTE:

- Make sure the safety analyzer is authorized comply with requirement of IEC 60601-1.
- Follow the instructions of the analyzer manufacturer.

G Units, Symbols and Abbreviations

G.1 Units

Abbreviation	In Full
µA	microampere
µV	microvolt
µs	microsecond
A	ampere
Ah	ampere hour
bpm	beat per minute
bps	bit per second
°C	centigrade
cc	cubic centimeter
cm	centimeter
dB	decibel
DS	dyne second
°F	Fahrenheit
g	gram
GHz	gigahertz
GTT	gutta
h	hour
Hz	hertz
in	inch
k	kilo
kg	kilogram
kPa	kilopascal
L	litre

Abbreviation	In Full
lb	pound
m	meter
mAh	milliampere hour
Mb	mega byte
mcg	microgram
mEq	milli-equivalents
mg	milligram
min	minute
mL/ml	milliliter
mm	millimeter
mmHg	millimeters of mercury
cmH_2O	centimeters of water
ms	millisecond
mV	millivolt
mW	milliwatt
MΩ	megaohm
nm	nanometer
rpm	breaths per minute
s	second
V	volt
VA	volt ampere
Ω	ohm
W	watt

G.2 Symbols

Symbol	Explanation
-	minus
–	negative
%	percent
/	per; divide; or
~	to
+	plus
=	equal to

Symbol	Explanation
<	less than
>	greater than
≤	less than or equal to
≥	greater than or equal to
±	plus or minus
×	multiply
©	copyright

G.3 Abbreviations

Abbreviation	In Full
$AaDO_2$	alveolar-arterial oxygen gradient
AC	alternating current
AG	anaesthesia gas
AHA	American Heart Association
Ao	aortic pressure
Art	arterial
ATMP	barometric pressure
aVF	left foot augmented lead
aVL	left arm augmented lead
aVR	right arm augmented lead
awRR	airway respiratory rate
BAP	brachial arterial pressure
BL	baseline
BSA	body surface area
BT	blood temperature
BTPS	body temperature and pressure, saturated
CaO_2	arterial oxygen content
CE	Conformité Européenne
C.I.	cardiac index
CISPR	International Special Committee on Radio Interference
CMOS	complementary metal oxide semiconductor
CMS	central monitoring system

Abbreviation	In Full
CO_2	carbon dioxide
COHb	carboxyhemoglobin
Compl	compliance
COPD	chronic obstructive pulmonary disease
CVP	central venous pressure
DC	direct current
Des	desflurane
Dia	diastolic
dpi	dot per inch
DVI	digital video interface
DO_2	oxygen delivery
DO_2I	oxygen delivery index
ECG	electrocardiograph
EDV	end-diastolic volume
EEC	European Economic Community
EMC	electromagnetic compatibility
EMG	electromyograph
EMI	electromagnetic interference
ESU	electrosurgical unit
Et	end-tidal
EtAA	end-tidal anesthetic agent
EtDes	end-tidal anesthetic agent
EtEnf	
EtHal	
EtIso	
EtSev	
$EtCO_2$	end-tidal carbon dioxide
EtN_2O	end-tidal nitrous oxide
EtO	ethylene oxide
EtO_2	end-tidal oxygen
FAP	femoral arterial pressure
FCC	Federal Communication Commission
FDA	Food and Drug Administration
$FeCO_2$	Mixed Expired CO2 Concentration
Fi	fraction of inspired

Abbreviation	In Full
FiAA	inspired anesthetic agent
FiDes	inspired anesthetic agent
FiEnf	
FiHal	
FiIso	
FiSev	
FiCO2	fraction of inspired carbon oxygen
FiN_2O	fraction of inspired nitrous oxide
FiO_2	fraction of inspired oxygen
Hal	halothane
Hb	hemoglobin
Hct	haematocrit
HR	heart rate
IABP	intra-aortic balloon pump
IBP	invasive blood pressure
ICP	intracranial pressure
ICU	intensive care unit
ID	identification
I:E	inspiratory time: expiratory time ratio
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
IP	internet protocol
Iso	isoflurane
LA	left arm
LAP	left atrial pressure
LCD	liquid crystal display
LCW	left cardiac work
LCWI	left cardiac work index
LED	light emitting diode
LL	left leg
LVSW	left ventricular stroke work
LVSWI	left ventricular stroke work index
MAC	minimum alveolar concentration
MetHb	methemoglobin
MRI	magnetic resonance imaging

Abbreviation	In Full
MV	minute volume
N/A	not applied
N2	nitrogen
N2O	nitrous oxide
NIBP	noninvasive blood pressure
NIF	negative inspiratory force
O_2	oxygen
O_2%	oxygen concentration
PA	pulmonary artery
PAWP	pulmonary artery wedge pressure
PEEP	positive end expiratory pressure
PEF	peak expiratory flow
PEP	pre-ejection period
PIF	peak inspiratory flow
PIP	peak inspiratory pressure
Pleth	plethysmogram
PPV	pulse pressure variation
PR	pulse rate
PVC	premature ventricular contraction
PVR	pulmonary vascular resistance
PVRI	pulmonary vascular resistance index
RA	right arm
RAP	right atrial pressure
Rec	record, recording
Resp	respiration
RL	right leg
RQ	respiratory quotient
RR	respiration rate
Sev	sevoflurane
SpO_2	arterial oxygen saturation from pulse oximetry
SQI	signal quality index
SV	stroke volume
SVI	stroke volume index
SVR	systemic vascular resistance
SVRI	systemic vascular resistance index

Abbreviation	In Full
Sync	synchronization
Sys	systolic pressure
TB	Blood Temperature
TD	temperature difference
Temp	temperature
TFC	thoracic fluid content
TI	injectate temperature
TP	total power
TV	tidal volume
UAP	umbilical arterial pressure
UPS	uninterruptible power supply
USB	universal serial bus
UVP	umbilical venous pressure
VAC	volts alternating current