

uMED 20 Vet

Veterinary Defibrillator/Monitor

Operator's Manual



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Preface

Manual Purpose

This manual contains the instructions necessary to operate the product safely and in accordance with its function and intended use. Observance of this manual is a prerequisite for proper product performance and correct operation and ensures animal and operator safety.

This manual is based on the maximum configuration and therefore some contents may not apply to your product. If you have any question, please contact us.

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

Intended Audience

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

Illustrations

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

Conventions

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

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1 Safety

1.1 Safety Information

DANGER

- Indicates an imminent hazard that, if not avoided, will result in death or serious injury.
-
-

WARNING

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

CAUTION

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

NOTE

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

1.1.1 Dangers

DANGER

- The equipment delivers up to 360 J of electrical energy. Unless properly used as described in these operating instructions, this electrical energy may cause serious injury or death. Do not operate this defibrillator unless thoroughly familiar with these operating instructions and the function of all controls, indicators, connectors, and accessories.
 - Defibrillation current may cause severe injury to operator or bystander, and it may even cause death. Keep distance from the animal or metal devices connected to the animal during defibrillation.
 - Do not disassemble the defibrillator. It contains no operator serviceable components and dangerous high voltages may be present. Contact authorized service personnel for repair.
 - To avoid explosion hazard, do not use the equipment in the presence of oxygen-rich atmospheres, flammable anesthetics, or other flammable agents (such as gasoline). Keep the equipment and the operating environment dry and clean.
-
-

1.1.2 Warnings

WARNING

- Before putting the system into operation, the operator must verify that the equipment, connecting cables and accessories are in correct working order and operating condition.
- To avoid risk of electric shock, this equipment must only be connected to a supply mains with protective earth. If the installation does not provide for a protective earth conductor, disconnect it from the power line and operate it on smart lithium-ion batteries.
- Ensure that the equipment is supplied with continuous electric power during work. Sudden power failure leads to the loss of animal data.

- Use and store the equipment in specified environmental condition. The equipment and accessories may not meet the performance specification due to aging, stored or used outside the specified temperature and humidity range.
- This equipment is used for single animal at a time.
- The equipment is not intended to be used within the Magnetic Resonance (MR) environment.
- Before each use, the operator must check the equipment condition to ensure that the equipment is ready for operation.
- Medical electrical equipment which does not incorporate defibrillator protection should be disconnected during defibrillation.
- Do not defibrillate an animal who lies on the wet ground.
- Do not touch the animal and live parts simultaneously.
- Do not touch the animal when connecting the peripheral equipment via the I/O signal ports to prevent animal leakage current from exceeding the requirements specified by the standard.
- Do not rely exclusively on the audible alarm system for monitoring. Adjustment of 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 different animal situations and always keeping the animal under close surveillance is the most reliable way for safe monitoring.
- Do not perform any functional check if the equipment is connected with an animal; otherwise the animal might be shocked.
- Remain attentive to the animal during applying therapy. Delay in delivering a shock may result in a rhythm that was analyzed as shockable converting spontaneously to non-shockable and could result in inappropriate delivery of a shock.
- For the treatment of animals with implantable pacemakers, place electrode pads or paddles away from internal pacemaker generator if possible to help prevent damage to the pacemaker.
- Do not place the equipment or accessories in any position that might cause it to fall on the animal.
- Do not start or operate the equipment unless the setup is verified to be correct.
- 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 to animals or personnel.
- Physiological data and alarm messages provided by the equipment should not be used as the sole basis for diagnosis or therapy decisions. They must be used in conjunction with clinical signs and symptoms. Misinterpretation of the measured values or other parameters can endanger the animal.
- Do not touch device connectors, thermal print head, battery connector or other live equipment if the operator is in contact with the animal; otherwise animal injury may result.
- To ensure animal safety, use only parts and accessories specified in this manual.
- When disposing of the packaging material, be sure to observe the applicable waste control regulations and keep it out of children's reach.

1.1.3 Cautions

CAUTION

- Use of Manual Therapy security password requires the clinician to know and remember the password. Failure to enter correct password will prevent the delivery of manual defibrillation.
- At the end of its service life, the equipment, as well as its accessories, must be disposed of in compliance with the guidelines regulating the disposal of such products to avoid contaminating the environment.
- Magnetic and electrical fields are capable of interfering with the proper performance of the equipment. For this reason make sure that all external devices operated in the vicinity of the equipment comply with the relevant EMC requirements. Mobile phones, X-ray equipment or MRI devices are a possible source of interference as they may emit higher levels of electromagnetic radiation.
- Before connecting the equipment to the power line, check that the voltage and frequency ratings of the power line are the same as those indicated on the equipment's label or in this manual.

- Do not loop the animal cable into a tight coil or wrap around the device, as this can damage the animal cable.
- Always install or carry the equipment properly to avoid damage caused by drop, impact, strong vibration or other mechanical force.
- Dry the equipment immediately in case of rain.
- Never charge and deliver shock frequently in non-clinical situations. Otherwise equipment damage could occur.

1.1.4 Notes

NOTE

- Put the equipment in a location where you can easily view and operate the equipment.
- The equipment uses a mains plug as isolation means to the mains power supply. Do not locate the equipment in a place difficult to operate the mains plug.
- During normal use, the operator shall stand in front of the equipment.
- Keep this manual in the vicinity of the equipment so that it can be obtained conveniently when needed.
- This manual describes all features and options. Your equipment may not have all of them.

1.2 Equipment Symbols

Symbol	Description	Symbol	Description
	Refer to instruction manual/booklet		General warning sign
	Dangerous voltage		Shock button
	Manufacturer		Date of manufacture
	Battery indicator		Alternating current
	Equipotentiality		Computer network
	DEFIBRILLATION-PROOF TYPE CF APPLIED PART		DEFIBRILLATION-PROOF TYPE BF APPLIED PART
IP42	Protected against solid foreign objects of 1,0 mm Ø and greater Protection against vertically falling water drops when ENCLOSURE tilted up to 15°	IP44	Protected against solid foreign objects of 1,0 mm Ø and greater Protected against splashing water
	Menu		Graphical record

Symbol	Description	Symbol	Description
	USB connector		Input/output
	Gas inlet		Gas outlet
	Humidity limitations		Atmospheric pressure limitations
	Temperature limitations		Non-ionizing electromagnetic radiation
	Stacking limit by number		Keep dry
	This way up		Fragile; handle with care
	Serial number		Unlocking
	General symbol for recovery/recyclable		CE mark
	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, please consult the distributor from whom you purchased the product.		

2 The Basics

2.1 Equipment Introduction

The uMED 20 Vet Veterinary Defibrillator/Monitor (hereinafter called the equipment) is a lightweight and portable defibrillator/monitor. It provides two operating modes: Monitor, and Manual Defib

- **Monitor Mode**

In the Monitor mode, the equipment is intended for monitoring, displaying, reviewing, storing and printing multiple physiological parameters and waveforms including ECG, pulse oximetry (SpO₂), respiration (Resp), pulse rate (PR), non-invasive blood pressure (NIBP) and carbon dioxide (CO₂).

- **Manual Defib Mode**

In the Manual Defib mode, the operator analyzes the animal's ECG, and selects appropriate energy setting. If smart analysis is used, the equipment automatically analyzes the animal's ECG rhythm and indicates whether or not a shockable rhythm is detected. Text messages and animal contact indicator on the screen also help the operator throughout the defibrillation process.

Defibrillation may be performed through electrode pads, external and internal paddles..

2.2 Intended Use

The equipment is intended to be used for external defibrillation, and internal defibrillation in the Manual Defib mode. It can also be used for ECG, SpO₂, Resp, PR, NIBP and CO₂ monitoring in the Monitor mode.

The equipment is intended to be used by qualified medical personnel trained in the operation of the equipment and qualified by training in basic life support, advanced cardiac life support or defibrillation.

2.2.1 Manual Defibrillation

Asynchronous defibrillation is the initial treatment for ventricular fibrillation and ventricular tachycardia in animals that are pulseless and unresponsive.

2.2.2 ECG

The ECG monitoring function is used to monitor and/or record the animal's ECG waveform and heart rate.

2.2.3 Resp

The respiration monitoring function is used to continuously monitor the animal's respiration rate and respiration waveform.

2.2.4 PR

The PR function is intended to measure the animal's arterial pulsation in arterial blood.

2.2.5 SpO₂

The SpO₂ function is intended to measure the animal's oxygen saturation in arterial blood.

2.2.6 NIBP

The NIBP function is intended for non-invasive measurement of the animal's arterial blood pressure.

2.2.7 CO₂

The CO₂ function is intended for monitoring the animal's exhaled carbon dioxide and to provide a respiration rate.

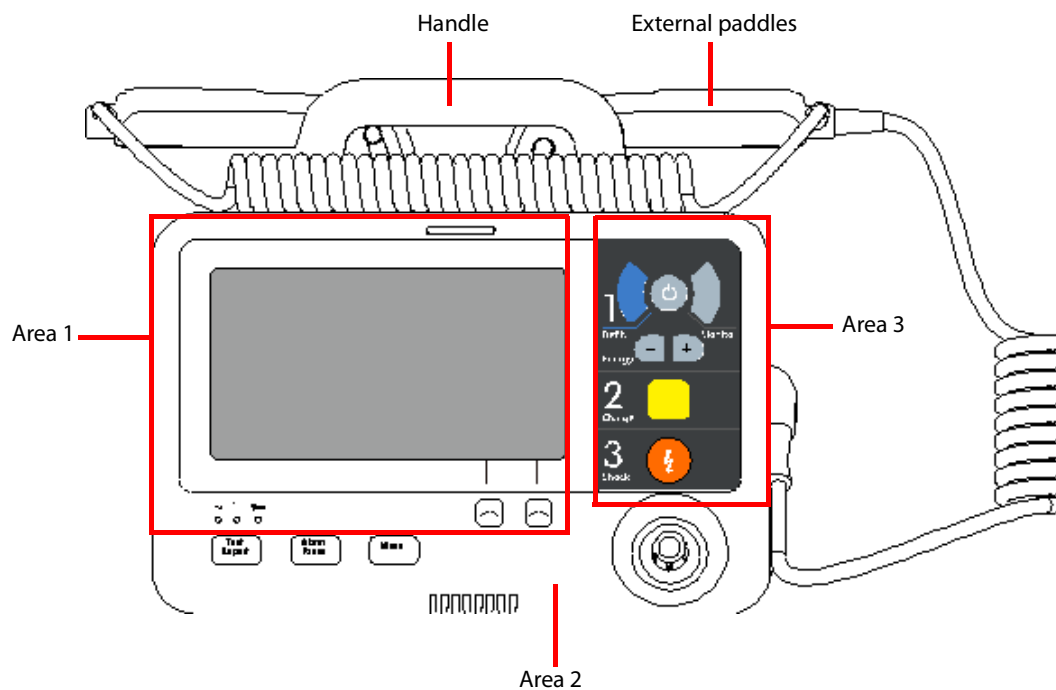
2.3 Applied Parts

The applied parts of the equipment are:

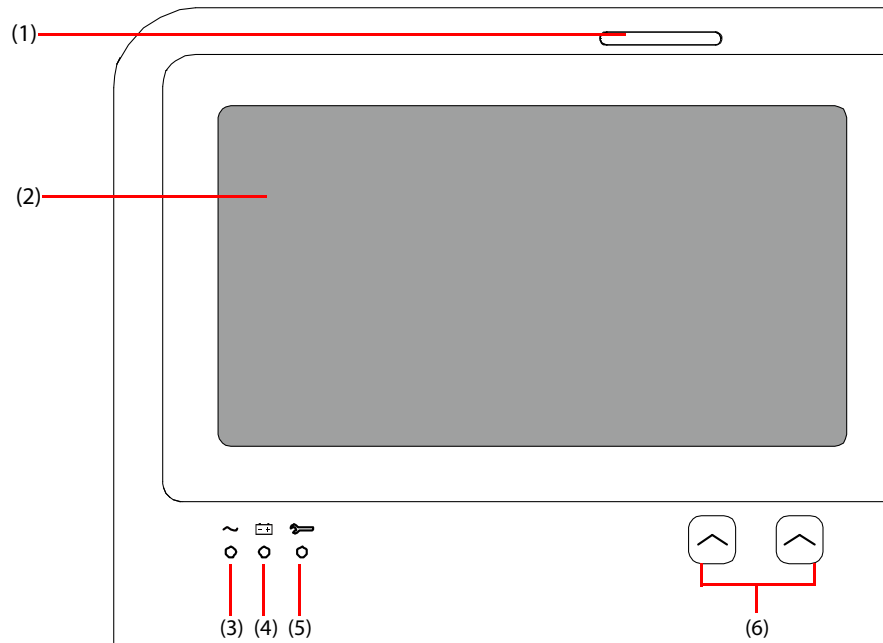
- ECG electrodes and leadwires
- SpO₂ sensor
- NIBP cuff
- CO₂ sampling line/Nasal sampling cannula, airway adapter
- External defibrillation paddles
- Internal defibrillation paddles
- Multifunction electrode pads

2.4 Main Unit

2.4.1 Front View

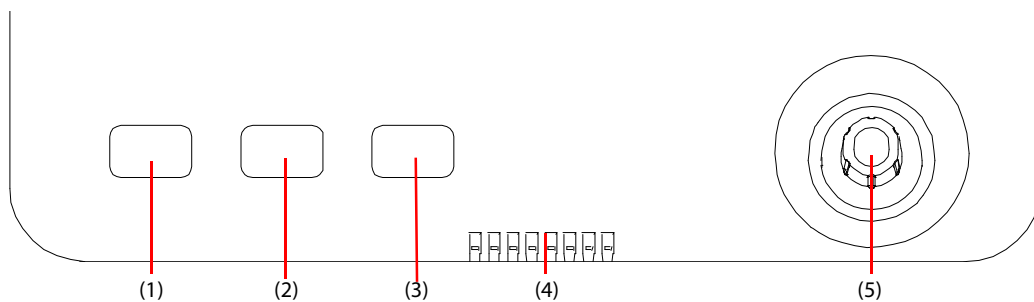


Area 1



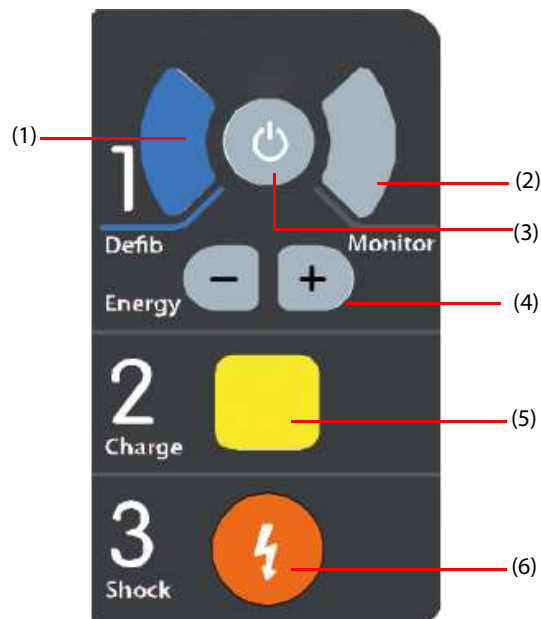
- (1) Alarm lamp
The Alarm lamp flashes in different color and frequency to match the alarm level.
- (2) Display screen
- (3) AC power indicator
 - ◆ Illuminated: the AC mains is connected.
 - ◆ Off: the AC mains is not connected.
- (4) Battery indicator
 - ◆ Yellow: the battery is being charged.
 - ◆ Green: the battery is fully charged or the equipment operates on battery power.
 - ◆ Off: no battery is installed or battery fails.
- (5) Status indicator
 - Green:
 - ◆ AC mains is connected, and the equipment operates properly.
 - ◆ only the battery is connected, the equipment is turned on and operates properly.
 - Flashing green:
 - ◆ only the battery is connected, the equipment is turned off and operates properly.
 - Flashing red
 - ◆ only AC mains is connected, [**No Battery**] is configured as [**Status Indicator On**] on the equipment.
 - ◆ only the battery is connected, and the battery has a low power (battery symbol).
 - ◆ auto test fails, or a failure is detected on the equipment.
 - Off: the AC mains and battery are not connected.
- (6) Soft keys
They are corresponding with the soft key labels located immediately above. The labels of the soft keys changes according to the current operating mode.

Area 2



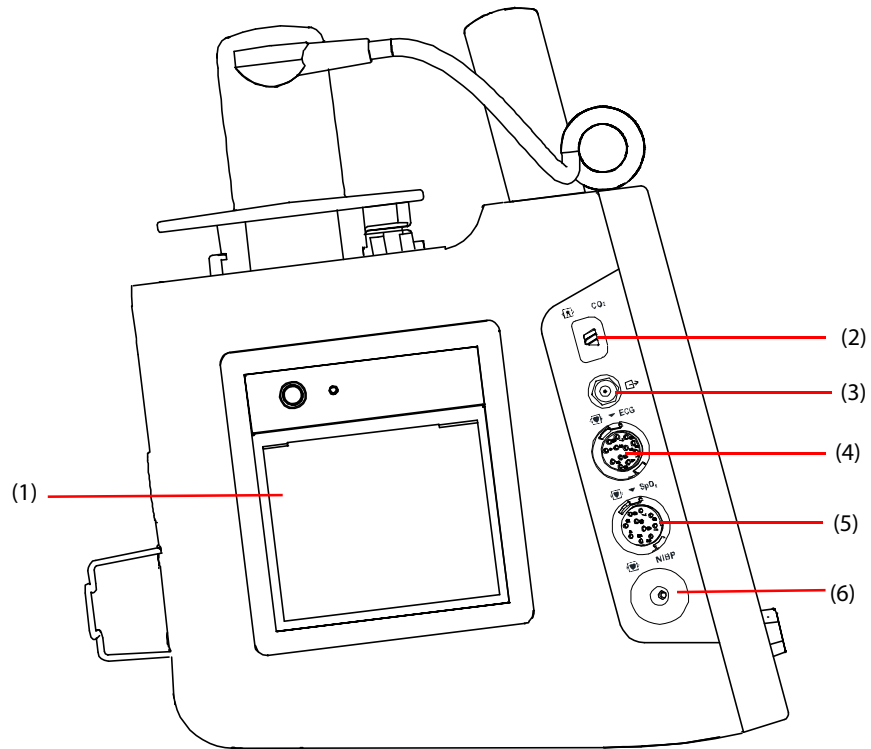
- (1) Test Report () button
Press this button to enter the **[Test Summary]** menu.
- (2) Alarm Pause () button
Press this button to pause, reactivate or switch off the alarms.
- (3) Main Menu () button
 - ◆ If no menu is displayed on the screen, pressing it will enter the main menu.
 - ◆ If there is a menu displayed, pressing it will close that menu.
- (4) Speaker
It gives alarm sounds and voice prompts.
- (5) Navigation knob
 - ◆ Rotate it clockwise or counterclockwise to move the cursor.
 - ◆ Press it to confirm the selection.

Area 3



- (1) Defib Mode button
 - ◆ When the equipment is turned on, press it to enter the Manual Defib mode.
 - ◆ When the equipment is turned off, press it to turn on the equipment and enter the Manual Defib mode automatically.
- (2) Monitor Mode button
 - ◆ When the equipment is turned on, press it to enter the Monitor mode.
 - ◆ When the equipment is turned off, press it to turn on the equipment and enter the Monitor mode automatically.
- (3) Power switch
 - ◆ Press it to turn on the equipment, and enter the Manual Defib mode automatically.
 - ◆ When the equipment is on, press and hold it for 3 seconds to turn off the equipment.
- (4) Energy Select button
 - In the Manual Defib mode, press this button to select the energy level.
- (5) Charge button
 - Press this button to charge the defibrillator.
- (6) Shock button
 - Press this button to deliver a shock to the animal.

2.4.2 Left View



(1) Recorder

(3) Gas outlet

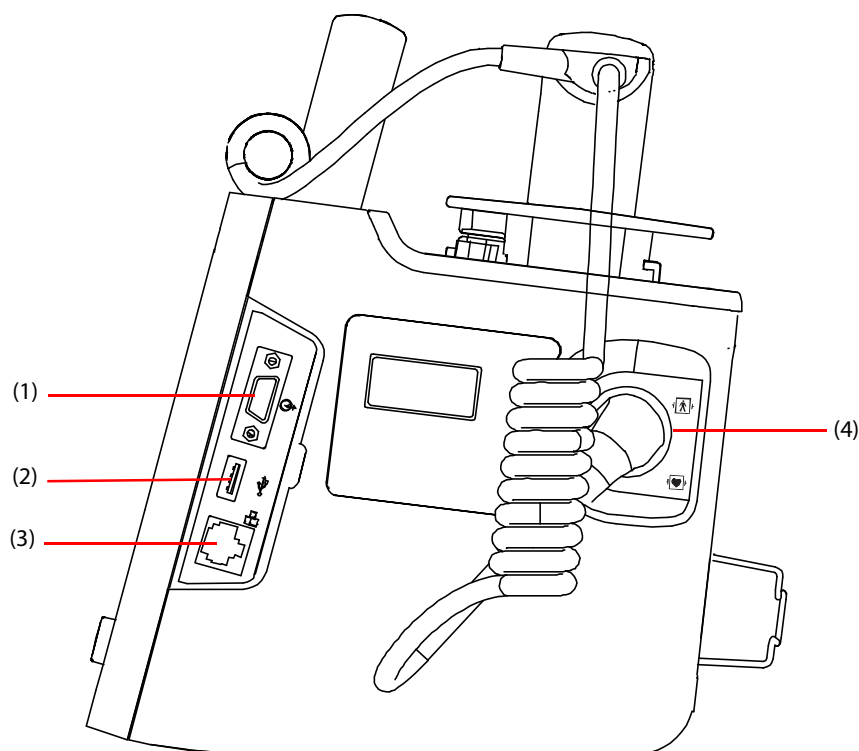
(5) SpO₂ sensor connector

(2) CO₂ connector

(4) ECG cable connector

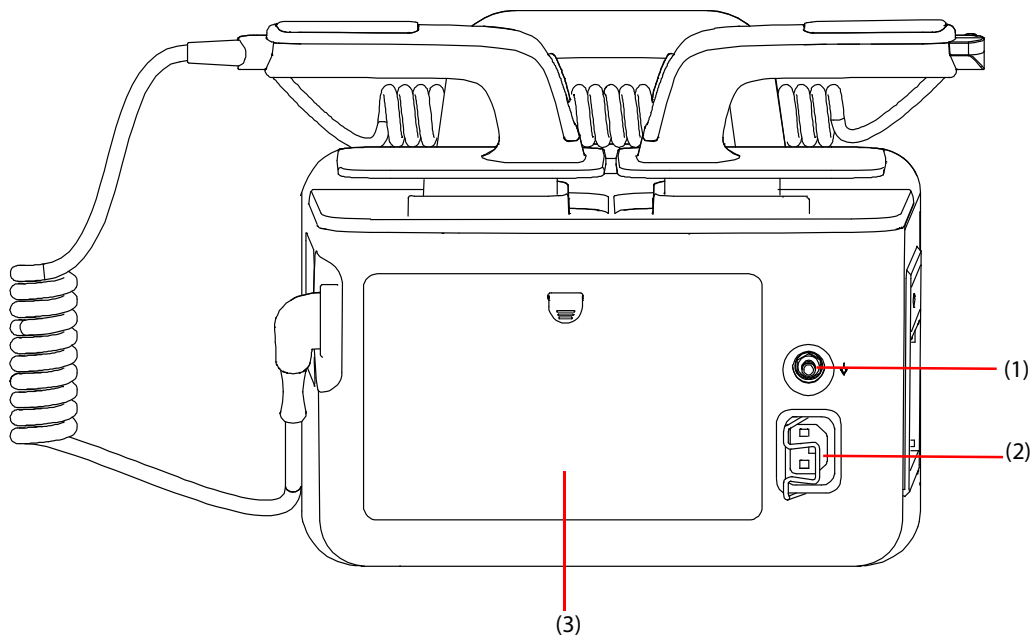
(6) NIBP cuff connector

2.4.3 Right View



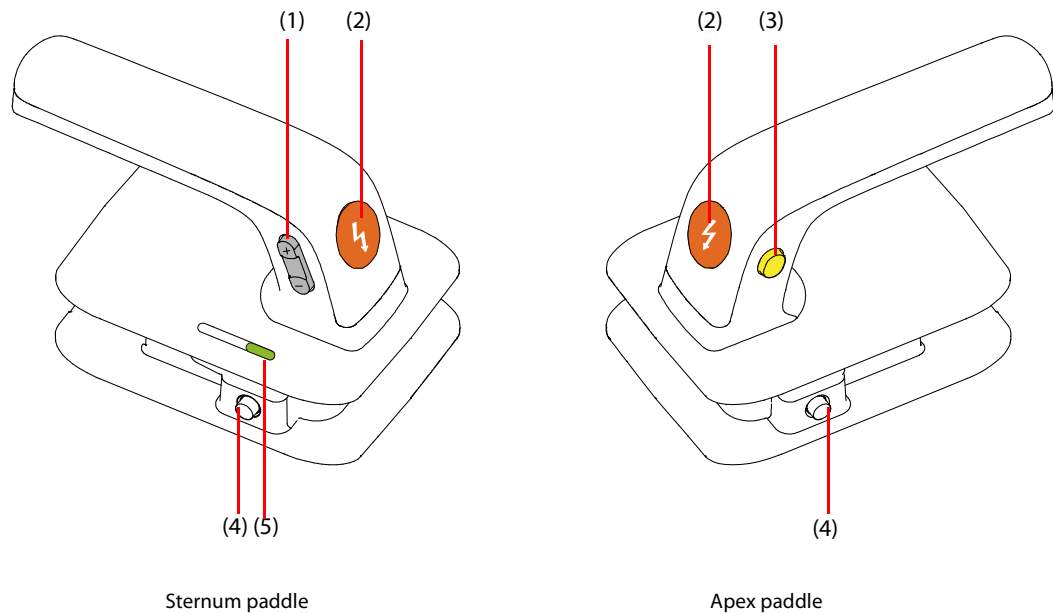
- (1) Multifunctional connector
It provides ECG output.
- (2) USB connector
It is used to export animal data, import and export configurations.
- (3) Network connector
It is a standard RJ45 connector, used for software upgrade.
- (4) Therapy port
It is used to connect the paddles cable or pads cable. When the equipment is configured with integrative external paddles, you cannot remove the paddles cable from this port and cannot connect the pads cable.

2.4.4 Rear View



- (1) Equipotential grounding terminal
When the equipment and other devices are to be used together, their equipotential grounding terminals should be connected together to eliminate the potential difference between them.
- (2) External power input
It connects an AC power cord to run the equipment on the external AC mains power supply.
- (3) Battery door

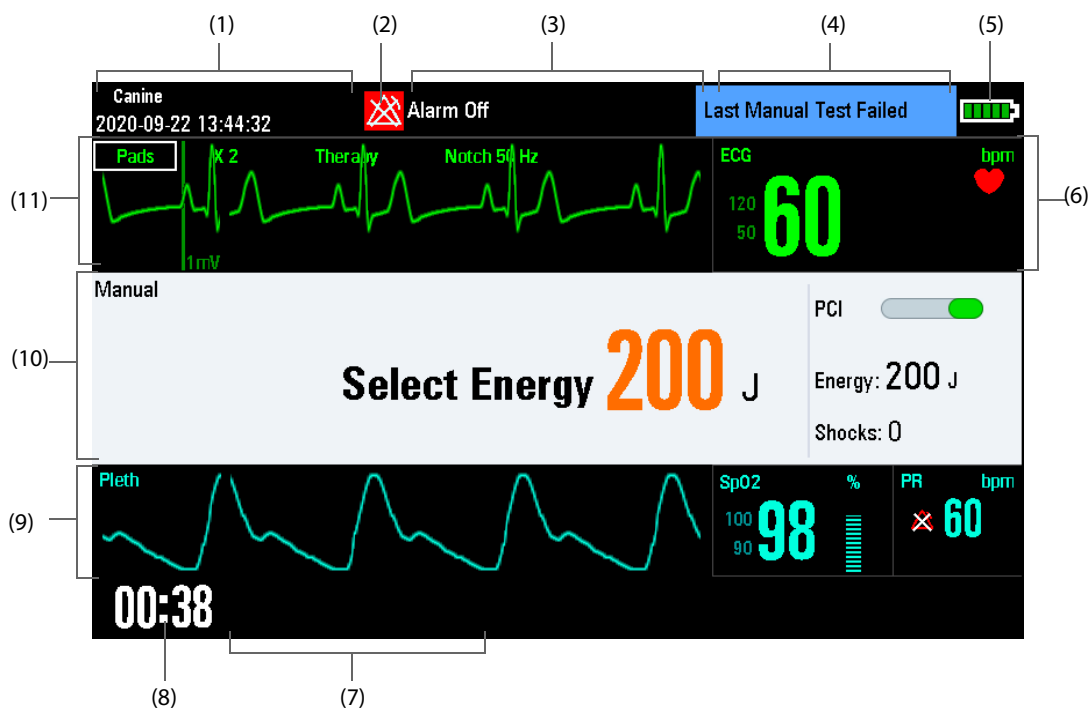
2.5 External Paddles



- (1) Energy Select button
- (2) Shock button
- (3) Charge button
- (4) Latch button
Press this button to get for smaller paddles. For details, refer to 6.4.2 *Using Small External Paddles*.
- (5) Animal contact indicator: indicates the contact status between the animal and external paddles. For details, refer to 6.6 *Animal Contact Indicator*.

2.6 Display Views

The following figure shows the screen in the Manual Defib mode.



- (1) Animal Information area
This area shows animal name, animal category, and current date and time.
 indicates that the animal has an implanted pacemaker.
- (2) Alarm status symbols
This area shows the alarm status. For details, refer to 4.3.5 Alarm Status Symbols.
- (3) Physiological Alarm area
This area shows physiological alarm messages. When multiple alarms occur, they will be displayed circularly.
- (4) Technical Alarm area
This area shows technical alarm messages and prompt messages. When multiple messages occur, they will be displayed circularly.
- (5) Battery Status indicator
It indicates battery status. For details, refer to 18 Battery.
- (6) Parameter area
This area shows measurement parameters. Each measurement module has a parameter block and the parameter name is displayed at the upper left corner.
- (7) Prompt area
This area shows the prompt information.
- (8) Runtime area
This area shows the operating time since the equipment is turned on.
- (9) Auxiliary Parameter area and/or waveform area
This area shows parameters that cannot be displayed in the parameter area. When this area cannot accommodate all parameters, the excess parameters will automatically occupy the area of last waveform.
- (10) Manual Defib information area
This area shows the selected defibrillation energy, shock counter as well as prompts related to manual defibrillation.
- (11) Waveform area
This area shows measurement waveforms. The waveform label is displayed at the upper left corner of the waveform.

3 Basic Operations and Settings

3.1 Equipment Installation

WARNING

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

3.1.1 Unpacking and Checking

Before unpacking, examine the packing case carefully for signs of damage. If any damage is detected, contact the carrier or the manufacturer. If the packing case is intact, open the package and remove the equipment and accessories carefully. Check all materials against the packing list and check for any mechanical damage. If you have any question, please contact us.

WARNING

- When disposing of the packaging material, be sure to observe the applicable waste control regulations and keep it out of children's reach.
 - The equipment might be contaminated during storage and transportation. 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.
-

NOTE

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

3.1.2 Environmental Requirements

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

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

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

NOTE

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

3.1.3 First Use Setup

Before putting the equipment into use for the first time, you should set the time zone and system time in accordance with your local time, and perform a simulation operation following the operation guide. Otherwise, the equipment cannot be started.

1. Press the power switch or a desired mode button to turn on the equipment.
2. Make settings as required in the [**First Setup**] menu.
3. Press the Navigation knob to experience the simulation operation.
4. Perform operations following the displayed instructions, and then press the Navigation knob for the next step.
5. Select [**Finished**] to complete the first setup.,
6. Select [**Replay**] if you want to experience the simulation operation again.

If the time zone or system time is found incorrect after the first setup, you can change the time zone by selecting [**General Setup**] through the Configuration Management Main menu, or change the system date and time by referring 3.3.1 *Setting the Date and Time*.

3.2 Basic Operation

3.2.1 Connecting the AC Mains

The equipment is powered by AC power supply. Before connecting the equipment to the AC mains, check that the voltage and frequency ratings of the power line are the same as those indicated besides the AC power input.

1. Connect the female end of the power cord with the AC power input of the equipment.
2. Connect the male end of the power cord with a wall AC outlet.
3. Check that the power indicator is on.

The AC power indicator is off if the AC mains is not connected. When AC mains is connected, the AC power indicator is illuminated in green.

WARNING

- **Always use the accompanying power cord delivered with the equipment.**
 - **Before connecting the equipment to the AC mains, check that the voltage and frequency ratings of the power line are the same as those indicated besides the AC power input.**
 - **Use the cable retainer to secure the power cord to prevent it from falling off.**
 - **Use the battery if the integrity of the protective earth conductor or the protective earthing system in the installation is in doubt.**
-

3.2.2 Installing the Battery

The equipment is designed to operate on battery power when external power supply is not available. For more information, refer to 18 *Battery*.

3.2.3 Turning On the Equipment

Before turning on the equipment, perform the following inspections:

1. Check for any mechanical damage and make sure that all external cables and accessories are properly connected.
2. Connect the power cord to the AC power source. If you run the equipment on battery power, ensure that the battery is sufficiently charged.

To turn on the equipment, press the power switch. Then the equipment automatically enters the Manual Defib mode with the Defib mode button illuminated. Or, you can directly press the desired mode button, and then the equipment automatically enters the desired mode with its button illuminated.

After the start-up screen is displayed, the equipment gives a beep, and meanwhile, the alarm lamp is illuminated in yellow, and then turns red, and then turns off.

- If the equipment is turned on by entering the Manual Defib mode, the alarm system is off when the alarm lamp turns off.
- If the equipment is turned on by entering the Monitor mode, the alarm system is activated when the alarm lamp turns off.

WARNING

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

3.2.4 Starting Learning the Operations

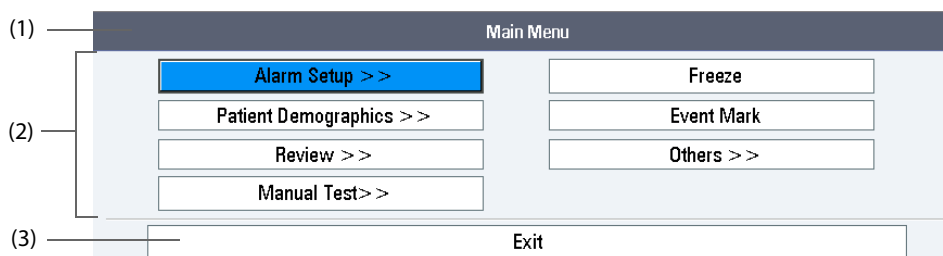
The equipment provides an intelligent learning guide, so as to help you to quickly get the basic operations.

1. Press the Main Menu button on the front panel.
2. Select [Others >>] → [Operation Guide].→ [Experience Now].
3. Perform operations following the instructions on the screen.

When the system reminds you have completed the learning, you can select [Replay] to restart the learning.

3.2.5 Using the Main Menu

To enter the main menu, press the Main Menu button  on the front panel.



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

- (1) Heading
- (2) Main body:
Displays options, buttons, prompt messages, etc. Pressing the menu button with ">>" enters a submenu with additional options or information.
- (3) Exit button

3.2.6 Using the Navigation knob

- Displaying a submenu

Rotate the Navigation knob to move the cursor on the desired item of the main menu, and then press the Navigation knob.

- Inputting information

1. Rotate the Navigation knob to move the cursor on the desired textbox of a menu, and then press the knob.
2. Rotate the Navigation knob to move the cursor on the desired character to be inputted, and then press the Navigation knob.

- ◆ Select **[DEL]** to delete the entire entry.

- ◆ Select  to access uppercase letters.

- ◆ Select **[OK]** to confirm the entry and close the on-screen keyboard.

3. Repeat step 2 to complete the information input.

4. Rotate the Navigation knob to move the cursor on **[Ok]**, and then press the Navigation knob to save the information inputted.

- Changing settings

Changing the ECG lead in the Monitor mode is taken as an example below:

1. Rotate the Navigation knob to move the cursor on the ECG lead label .
2. Press the Navigation knob to highlight the selection .
3. Rotate the Navigation knob until you find the desired item, and then press the Navigation knob to confirm the selection.

3.2.7 Editing Current Animal Information

The animal name, and animal category of the current animal are displayed in the upper left corner of the main screen.

1. Press the Main Menu button on the front panel, and then select **[Patient Demographics >>]**.
2. Make changes as desired.
 - ◆ Set **[Patient Cat.]** to change the animal category. You can also rotate the Navigation knob to move the cursor on the animal category of the main screen, press and rotate the Navigation knob to change the animal category.
 - ◆ Edit animal name.
 - ◆ Set paced status: when the **[Paced]** is set to **[Yes]**, a paced symbol  is displayed in the upper left corner of the main screen.
3. Select **[Others >>]** to edit more animal information.

3.2.8 Turning Off the Equipment

Turn off the equipment as the following steps:

1. Check that the animal monitoring or therapy is completed.
2. Disconnect the cables and sensors from the animal.
3. Press and hold the power switch for 3s to turn off the equipment.

NOTE

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

3.2.9 Auto Restoring to Last Configuration

During operation, you may make changes to some settings. However, these changes may not be saved as user configuration. To prevent the changes from losing in case of sudden power failure, the equipment saves the settings in real time. The saved settings are the latest configuration. In case of power failure, the equipment loads the latest configuration if restarts within 60 seconds; it load the user configuration if restarts 120 seconds

later after the power failure; it may load either the latest configuration or the user configuration if restarts between 60 and 120 seconds after the power failure.

3.3 Changing General Settings

3.3.1 Setting the Date and Time

To set the system time, you can choose any of the following ways:

- Using the Navigation knob
 1. Use the Navigation knob to move the cursor on the system time, and press the knob.
 2. Set the system time.
 3. Select [**Confirm**].
- Through the Configuration Main menu
 1. Press the Main Menu button on the front panel.
 2. Select [**Others >>**] → [**Configuration >>**] → enter the required password.
 3. Select [**General Setup**], and set the system time.
 4. Select [**Return**].
- Through the Configuration View menu
 1. Press the Main Menu button on the front panel.
 2. Select [**Others >>**] → [**Configuration >>**] → [**View Config**].
 3. Select [**General Setup**], and set the system time. You cannot select date format and time format in this case.
 4. Select [**Return**].

If the system time is changed through the Configuration Main menu or Configuration View menu, the equipment will restart. If the system time is changed by using the Navigation knob, the equipment will generate an event to remind you.

3.3.2 Adjusting the Screen Brightness

1. Press the Main Menu button on the front panel.
2. Select [**Others >>**].
3. Set [**Brightness**] to an appropriate level. 10 is the brightest, and 1 is the least bright.

You can also change the screen brightness by selecting [**Others**] from the Configuration Main menu.

3.3.3 Changing Key Volume

1. Press the Main Menu button on the front panel, and then select [**Others >>**].
2. Select [**Key Volume**] and then select an appropriate value. 0 means key volume off, and 10 is the maximum volume.

You can also change key volume by selecting [**Others**] from the Configuration Main menu.

3.3.4 Selecting High Contrast Display

The equipment has the function of high contrast display so that you can view the display under high ambient illumination.

To enable the high contrast display:

1. Press the Main Menu button on the front panel.
2. Select [**Others >>**]→[**High Contrast**].

To disable high contrast display:

1. Press the Main Menu button on the front panel.
2. Select [**Others >>**]→[**Full Color**].

Once [**High Contrast**] is selected, the high contrast display remains when you change the operating mode. However, the setting will not be saved if the equipment is turned off.

3.3.5 Adjusting Waveform Position

1. Press the Main Menu button on the front panel.
2. Select [**Others >>**]→ [**Waves >>**].
3. Set [**Wave 2**], [**Wave 3**] and [**Wave 4**]. [**Wave 1**] is always ECG1, which is unchangeable.

You can enable [**Wave 4**] and change waveform position by selecting [**Waveform Setup**] from the Configuration Main menu.

3.4 Analog Output

The equipment is configured with a multifunction connector for ECG analog output.

4 Alarms

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

WARNING

- **A potential hazard exists if different alarm presets are used for the same or similar device in any single area, e.g. an intensive care unit or cardiac operating room.**
- **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.**

4.1 Alarm Categories

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

1. Physiological alarms

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

2. Technical alarms

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

3. Prompt messages

As a matter of fact, prompt messages are not alarm messages. Apart from the physiological and technical alarms, the equipment also shows some messages indicating system status. Messages of this kind are usually displayed in the prompt area. Therapy-related prompts are shown in corresponding information area. Some special prompts are shown in dialog boxes.

4.2 Alarm Levels

By severity, alarms can be classified into three categories: high level alarms, medium level alarms and low level alarms.

	Physiological alarms	Technical alarms
High level	Indicate that your animal is in a life threatening situation, such as Asystole, Vfib/Vtac and so forth, and an emergency treatment is demanded.	Indicate a severe device malfunction or an improper operation, which may result that the equipment cannot detect critical animal status or may cause therapy failed, and thus threaten the animal's life, such as low battery.
Medium level	Indicate that your animal's vital signs appear abnormal and an immediate treatment is required.	Indicate a device malfunction or an improper operation, which may not threaten the animal's life but may compromise animal monitoring or therapy.
Low level	Indicate that your animal's vital signs appear abnormal and an immediate treatment may be required.	Indicate a device malfunction or an improper operation, which may compromise a certain function but will not threaten the animal's life.

4.3 Alarm Indicators

When an alarm occurs, the equipment indicates it to you through visual or audible alarm indications.

- Alarm lamp
- Alarm tones
- Alarm message
- Flashing numeric

NOTE

- **When multiple alarms of different levels occur simultaneously, the equipment will select the alarm of the highest level and give visual and audible alarm indications accordingly. Alarm messages will be displayed circularly.**
- **Some physiological alarms, such as Asystole, are exclusive. They have identical alarm tones and alarm lights with normal high level physiological alarms, but their alarm messages are displayed exclusively. That is to say, when an exclusive physiological alarm and a normal high level physiological alarms are triggered simultaneously, only alarm message of the exclusive physiological alarm is displayed.**

4.3.1 Alarm Lamps

If an alarm occurs, the alarm lamp will flash. The color and flashing frequency match the alarm level as follows:

- High level alarms: the lamp quickly flashes red with frequency of 1.4 to 2.8 Hz, duty ratio of 20 to 60%.
- Medium level alarms: the lamp slowly flashes yellow with frequency of 0.4 to 0.8 Hz, duty ratio of 20 to 60%.
- Low level alarms: the lamp lights yellow without flashing, with duty ratio of 100%.

4.3.2 Audible Alarms

The equipment uses different alarm tone patterns to match the alarm level:

- High level alarms: triple + double + triple + double beeps.
- Medium level alarms: triple beeps.
- Low level alarms: single beep.

4.3.3 Alarm Messages

When an alarm occurs, the alarm message will appear in the technical or physiological alarm area. For physiological alarms, the asterisk symbols (*) before the alarm message match the alarm level as follows:

- High level alarms: ***
- Medium level alarms: **
- Low level alarms: *

Additionally, the alarm message has different background color which matches the alarm level.

- For physiological alarms
 - ◆ High level alarms: red
 - ◆ Medium level alarms: yellow
 - ◆ Low level alarms: yellow

- For technical alarms

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

4.3.4 Flashing Numerics

If an alarm triggered by an alarm limit violation occurs, the numeric of the measurement in alarm will flash every second, and corresponding alarm limit will also flash at the same frequency indicating the alarm limit is violated.

4.3.5 Alarm Status Symbols

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

-  Alarm pause: indicates alarms are paused.
-  Alarm reset: indicates alarms are reset.
-  Audio off: indicates alarm sounds are turned off.
-  Alarm off: indicates the system is in alarm-off status.

4.4 Alarm Tone Configuration

4.4.1 Changing the Alarm Volume

1. Press the Main Menu button on the front panel.
2. Select **[Alarm Setup >>]**.
3. Set **[Alm Volume]** to an appropriate level.
 - ◆ If **[Audio Off]** is enabled, alarm volume can be set to a value between 0 and 10, in which 0 means audio off and 10 the maximum volume level.
 - ◆ If **[Audio Off]** is disabled, alarm volume can be set to a value between 1 and 10, in which 1 is the minimum volume level and 10 the maximum.

The setting of alarm volume will not be saved when the equipment is powered off.

You can also disable or enable **[Audio Off]**, set the alarm volume by selecting **[Alarm Setup]** from the Configuration Main menu. In this case, the setting will be saved.

NOTE

- You cannot adjust the alarm volume when an alarm is switched off.

4.4.2 Setting the Reminder Tones

When alarms or alarm sounds are turned off, the equipment gives a reminder tone of a single beep every 60 seconds.

The reminder tone is switched off by default. You can switch on **[Reminder Tone]** by selecting **[Alarm Setup]** from the Configuration Main menu. You can also change the reminder volume. The default reminder volume is **[Med]**.

4.4.3 Setting the Interval between Alarm Sounds

1. Press the Main Menu button on the front panel.
2. Select **[Others >>]** → **[Configuration >>]** → enter the required password.→ **[Alarm Setup]**.
3. Respectively set **[High Level Alarm (s)]**, **[Med Level Alarm (s)]** and **[Low Level Alarm (s)]**.

WARNING

- **Do not rely exclusively on audible alarm system. Setting alarm volume to a low level may result in a hazard to the animal. Always keep the animal under close surveillance.**
-

4.5 Understanding the Alarm Setup Menu

Press the Main Menu button on the front panel, and then select **[Alarm Setup >>]** to enter the **[Alarm Setup]** menu.

4.5.1 Setting Alarm Properties for All Parameters

In the main menu, select **[Alarm Setup >>]** → **[Para. Alarm >>]** to enter the **[Para. Alarm]** menu, where you can review and set alarm limits, alarm switches, alarm level and alarm recordings for all parameters.

- When a parameter alarm is switched on, the equipment gives alarm indications in accordance with the preset alarm level and stores related waveforms and parameter values.
- When a parameter alarm is switched off, the alarm off symbol  is displayed in the parameter window.
For NIBP, the alarm off symbol  is displayed only when all the NIBP alarms are switched off simultaneously.
- When the measurement's **[On/Off]** and **[Record]** are set to **[On]**, automatic recording of all the measurement numerics and related waveforms is possible when a measurement alarm occurs.
- When **[Defaults]** is selected, all settings restored to the defaults.

You can also set parameter alarm properties by selecting a parameter area and select **[Para. Alarm >>]** in the pop-up menu.

WARNING

- **Make sure that the alarm limits settings are appropriate for your animal before monitoring.**
 - **Setting the alarm limit to an extreme value may cause the alarm system to be ineffective. When monitoring patients that are not continuously attended by a clinical operator, properly configure the alarm system and adjust alarm settings as per the animal's condition.**
-

NOTE

- **You cannot simultaneously switch on HR and PR alarms. In the case that PR alarm is on, switching on HR alarm will automatically turn off PR alarm, and vice versa.**
-

4.5.2 Adjusting Alarm Limits Automatically

The equipment can automatically adjust the animal's alarm limits according to the measured vital signs. When **[Auto Limits]** is selected, the equipment automatically calculates alarm limits based on the latest measured parameter values.

To enable auto alarm limits, press the Main Menu button on the front panel, and then select **[Alarm Setup >>]** → **[Para. Alarm >>]** → **[Auto Limits]**. You can also enable auto alarm limits by selecting a parameter area and then select **[Para. Alarm >>]** → **[Auto Limits]**.

Before applying auto alarm limits, check if the alarm limits are appropriate for your animal. If not, you can manually adjust the limit values.

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

Module	Parameter	Low alarm limit	High alarm limit	Auto alarm limits range
ECG	HR	(HR-30) or 90 bpm (whichever is greater)	(HR+40) or 200 bpm (whichever is smaller)	55 to 225 bpm

Module	Parameter		Low alarm limit	High alarm limit	Auto alarm limits range
Resp	RR		(RR-10) or 30 rpm (whichever is greater)	(RR+25) or 85 rpm (whichever is smaller)	10 to 90 rpm
SpO ₂	SpO ₂ (%)		Same as default alarm limit	Same as default alarm limit	Same as the measurement range
	PR		(HR-30) or 90 bpm (whichever is greater)	(HR+40) or 200 bpm (whichever is smaller)	55 to 225 rpm
NIBP	NIBP-S	Weight: > 23kg	(SYS×0.68) + 10mmHg	(SYS×0.86) + 38mmHg	45 to 270
		Weight: 10-23kg			45 to 185
		Weight: < 10kg			45 to 185
	NIBP-D	Weight: > 23kg	(Dia×0.68) + 6mmHg	(Dia×0.86) + 32mmHg	25 to 225
		Weight: 10-23kg			25 to 150
		Weight: < 10kg			25 to 150
	NIBP-M	Weight: > 23kg	(Mean×0.68) + 8mmHg	(Mean×0.86) + 35mmHg	30 to 245
		Weight: 10-23kg			30 to 180
		Weight: < 10kg			30 to 180
CO ₂	EtCO ₂		0 to 32mmHg: remains the same	0 to 32mmHg: remains the same	Same as the measurement range
			32 to 35mmHg: 29mmHg	32 to 35mmHg: 41mmHg	
			35 to 45mmHg: (etCO ₂ - 6mmHg)	35 to 45mmHg: (etCO ₂ +6mmHg)	
			45 to 48mmHg: 39mmHg	45 to 48mmHg: 51mmHg	
			>48mmHg: remains the same	>48mmHg: remains the same	
	FiCO ₂		None	Same as the default alarm limit	10 to 90
	awRR		(awRR×0.5) or 6 rpm (whichever is greater)	(awRR×1.5) or 30 rpm (whichever is smaller)	

NOTE

- You can enable auto alarm limits only when the current parameter measurement is within the auto alarm limits range.

4.6 Pausing Alarms

You can temporarily disable alarm indicators by pressing the Alarm Pause button  on the front panel. When alarms are paused:

- For physiological alarms, no alarm indication is shown. New physiological alarm will not be presented.
- The remaining alarm pause time is displayed in the physiological alarm area.
- For technical alarms, alarm sounds are paused, but alarm lamps and alarm messages remain presented.
- The alarm pause symbol  is displayed in the sound symbol area. If a new technical alarm is triggered in the alarm paused period, the alarm message will be displayed.

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

The default alarm pause time is 2 minutes. To change alarm pause time:

1. Press the Main Menu button on the front panel.
2. Select [**Others >>**] → [**Configuration >>**] → enter the required password.
3. Select [**Alarm Setup**] → [**Alarm Pause Time**] and then select an appropriate value.

4.7 Switching Alarms Off

When an alarm is switched off, the alarm status is the same with that when an alarm is paused.

Alarms are switched off when:

- The Alarm Pause button  is pressed if the [**Alarm Pause Time**] is set to [**Permanent**].
- The operating mode is switched to the Manual Defib mode.

The alarm off status is exited when:

- The Alarm Pause button  is pressed.

4.8 Switching Off Alarm Sounds

In the event that [**Audio Off**] is enabled through the Configuration Main menu, to switch off the alarm tone, set [**Alm Volume**] to 0 while operating in the Monitor mode, or Manual Defib mode. In the audio off status, the audio off symbol  appears in the sound symbol area. In this case, the alarm status is the same with that when alarm tones are paused.

The audio off status is exited when:

- [**Audio Off**] is set to [**Disabled**] by selecting [**Alarm Setup**] from the Configuration Management Main menu.
- The Alarm Pause button  is pressed. In this case, the equipment enters the alarm paused status and the alarm volume is reset to the default level. the alarm pause symbol  is displayed in the sound symbol area.
- Operating mode is switched.
- Alarm volume is changed to a value between 1 and 10.

4.9 Resetting Alarms

By pressing the [**Alarm Reset**] soft key or selecting [**Alarm Reset**] in the [**Alarm Setup**] menu, you can reset the alarm system and enable the alarm system to respond to a subsequent alarm condition.

For physiological alarms, when the alarm system is reset:

- The alarm sound is reset.
- A √ appears before the alarm message.
- The alarm reset symbol  appears in the alarm symbol area.
- The parameter numeric and alarm limits still flash.

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

- For some technical alarms, including the NIBP-related alarms, a ✓ appears before the alarm message and the alarm reset symbol  appears in the alarm symbol area.
- Some technical alarms are changed to the prompt messages.
- Some technical alarms are cleared. The equipment gives no alarm indications.

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

4.10 Latching Alarms

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

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

To latch a physiological alarm:

1. Press the Main Menu button on the front panel.
2. Select **[Others >>]** → **[Configuration >>]** → enter the required password.
3. Select **[Alarm Setup]** and set **[Latching Alarms]** to **[Yes]**.

Only physiological alarms can be latched. You can clear the latched alarms by pressing the Alarm Pause button  on the front panel.

4.11 Clearing Technical Alarms

Technical alarms give different alarm indicators after the Alarm Pause button or **[Alarm Reset]** soft key is pressed. The technical alarms are classified into three categories for easy clarification:

- Technical alarms are cleared.

All alarm indications are cleared after the Alarm Pause button  or **[Alarm Reset]** soft key is pressed. After the equipment restores the normal alarm status, it can give alarm indications correctly in case these alarms are triggered again.
- Technical alarms are changed to the prompt messages.

The alarm lamp flashing and alarm tones are cleared and the alarm messages change to prompt messages after the Alarm Pause button  or **[Alarm Reset]** soft key is pressed. After the equipment restores the normal alarm status, it can give alarm indications correctly in case these alarms are triggered again.
- The alarm is silenced and a ✓ appears before the alarm message.

The alarm tones are cleared but the alarm lamp flashing and alarm messages remain after the Alarm Pause button  or **[Alarm Reset]** soft key is pressed. After the equipment restores the normal alarm status, all the alarm indications will continue if the alarm conditions still present.

4.12 Testing Alarms

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

For further testing of individual measurement alarms, perform the measurement on yourself (for example SpO₂ or CO₂) or use a simulator. Adjust alarm limits and check that appropriate alarm behaviour is observed.

4.13 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 alarm source.
4. Take proper action to eliminate the alarm condition.
5. Make sure the alarm condition is corrected.

For actions taken with regard to specific alarms, refer to *D Alarm Messages*.

5

Monitoring ECG

5.1 ECG Introduction

The electrocardiogram (ECG) measures the electrical activity of the heart and displays it as waveforms and numerics. The equipment enables ECG monitoring through 3-lead ECG sets, 5-lead ECG sets, external paddles and electrode pads. If both ECG sets and external paddles/electrode pads are connected, the configured ECG waveforms are displayed in the waveform area.

5.2 ECG Safety Information

WARNING

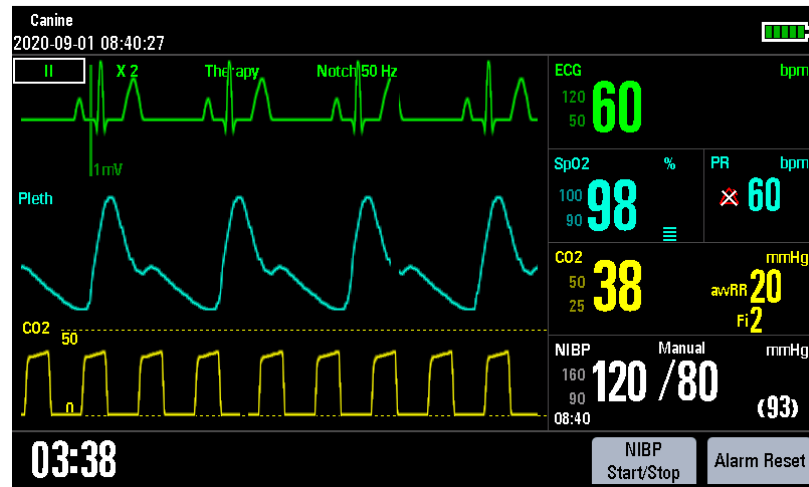
- ECG monitoring is not suitable for direct cardiac application.
 - Periodically inspect the electrode application site to ensure skin quality. If the skin quality changes, replace the electrodes or change the application site.
 - Use defibrillation-proof ECG cables during defibrillation.
 - When monitoring an animal implanted with a pacemaker, be sure to select correct paced status. Otherwise, the pace pulses may be counted in the case of cardiac arrest or some arrhythmias. Do not completely rely on the heart rate reading or the heart rate alarms. Always keep paced animals under close surveillance.
 - PACEMAKER PATIENTS – On ventricular paced patients, episodes of Ventricular Tachycardia may not always be detected. Do not rely entirely upon the system's automated arrhythmia detection algorithm.
-

CAUTION

- When connecting electrodes and/or cables, make sure that the connectors never come into contact with other conductive parts, or with earth. Particularly make sure that all of the ECG electrodes are attached to the animal.
 - Interference from a non-grounded instrument near the animal and electrosurgery interference can cause problems with the waveform.
 - If selected lead cannot provide valid ECG signals, a dash line is shown in the ECG waveform area.
 - Avoid using external paddles for ECG monitoring if possible.
 - Use the same type of ECG electrodes when monitoring ECG through ECG lead set.
-

5.3 Monitoring View

The following figure shows the screen in the Monitor mode.



You can enter the Monitor mode by pressing the Monitor Mode button. When operating in the Monitor mode, the equipment displays up to three ECG waveforms, the heart rate reading, other available parameter values and active alarm settings.

5.4 Preparing for ECG Monitoring and Measurement

5.4.1 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:

1. Shave hair from skin at chosen sites.
2. Gently rub skin surface at application sites to remove dead skin cells.
3. Thoroughly clean the sites with mild soap and water. We do not recommend using ether or pure alcohol, because this dries the skin and increases the resistance.
4. Dry the skin completely before applying the electrodes.

5.4.2 Using ECG Electrodes

5.4.2.1 Applying ECG Electrodes

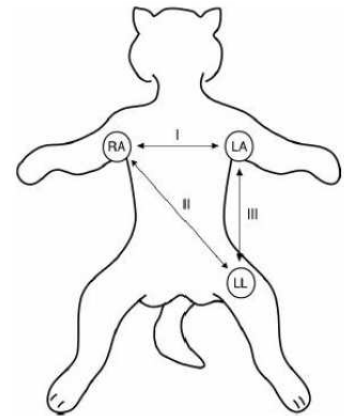
1. Attach the clips or snaps to the electrodes before placing them.
2. Place the electrodes on the animal.
3. Check that the lead wires are attached to the ECG trunk cable.
4. Plug the trunk cable into the ECG connector.
5. Press the Monitor Mode button.

5.4.2.2 ECG Electrode Placements

3-Lead Placement

The following is a typical AHA electrode placement for a 3-lead ECG set:

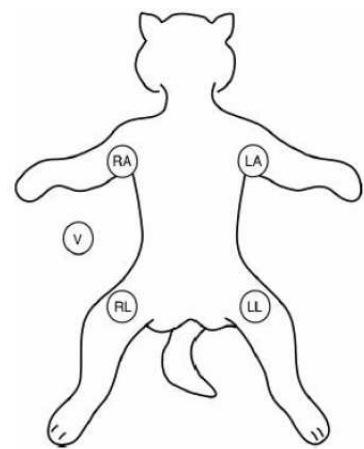
- RA placement: on the right foreleg.
- LA placement: on the left foreleg.
- LL placement: on the left hind leg.



5-Lead Placement

The following is a typical AHA electrode placement for a 5-lead ECG set:

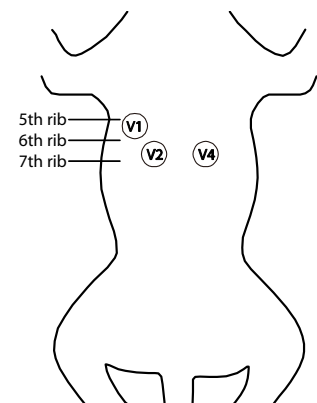
- RA placement: on the right foreleg.
- LA placement: on the left foreleg.
- RL placement: on the right hind leg.
- LL placement: on the left hind leg.
- V placement: on the chest, refer to .



Chest Electrode Placement

The chest electrodes most commonly used for patients are V1, V2, V4 and V10:

- V1 placement: fifth intercostal space on the right side near the sternum.
- V2 placement: sixth intercostal space on the left side near the sternum.
- V4 placement: sixth intercostal space on the left side at the costochondral junction.
- V10 placement: over the dorsal spine of the seventh thoracic vertebra.



Electrode Placement for Surgical Animals

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

WARNING

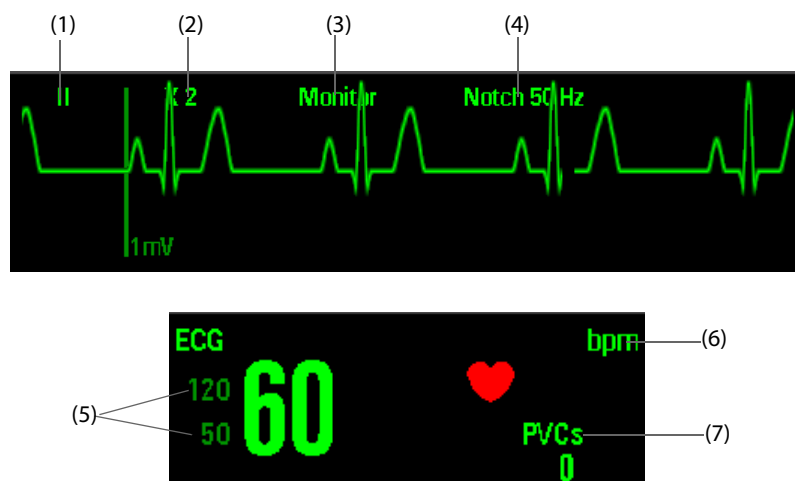
- When using electrosurgical units (ESU), place ECG electrodes between the ESU and its grounding plate to prevent unwanted burns. Never entangle ESU cable and ECG cable together.
 - When using electrosurgical units (ESU), never place ECG electrodes near to the grounding plate of the ESU, as this can cause a lot of interference on the ECG signal.
-

5.4.3 Using Electrode Pads/External Paddles

Electrode pads and external paddles can be also used for ECG measurement. For the placement details, refer to *6.4 Manual Defibrillation Procedure*.

5.5 ECG Display

The figure below shows the ECG monitoring view in 3-lead mode. It is for reference only. Your display may be configured to look slightly different.



(1) ECG lead label

(2) ECG waveform gain

(3) ECG filter mode

(4) Notch filter status

(5) HR alarm limits

(6) HR unit

(7) PVCs values: it is shown only when arrhythmia analysis is switched on.

When external paddles or electrode pads are used, the PVCs values is shown as "----".

5.6 Changing ECG Settings

5.6.1 Selecting the Lead Type

1. Select the ECG parameter area to enter the **[ECG Setup]** menu.
2. Select **[Lead Set]** and toggle between **[3-Lead]** and **[5-Lead]**.

You can also set lead type by selecting **[ECG Setup]** through the Configuration Main menu. The settings changed in the Configuration Main menu will be saved when the equipment is turned off.

5.6.2 Choosing the ECG Standard

1. Press the Main Menu button on the front panel.
2. Select **[Others >>]** → **[Configuration >>]** → enter the required password → Select **[ECG Setup]** → **[ECG Standard]**.
3. Select **[AHA]** or **[IEC]** according to the standard that is applied to your hospital.

5.6.3 Selecting the Lead of Displayed ECG Waveform

To compute heart rate and to detect and analyze arrhythmia more accurately, you can choose a lead of best quality signals as the HR calculation lead.

1. Rotate the Navigation knob to move the cursor on the ECG lead label.
2. Press the Navigation knob to highlight it.

3. Rotate the Navigation knob until you find the desired item, and then press the Navigation knob to confirm the selection.

The selected lead should have the following characteristics:

- The QRS should be either completely above or below the baseline and it should not be biphasic.
- The QRS should be tall and narrow.
- The P-waves and T-waves should be less than 0.2mV.

5.6.4 Setting the Cascading ECG Waveform

1. Select the ECG parameter area to enter the **[ECG Setup]** menu.
2. Select **[Cascade]** and toggle between **[On]** and **[Off]**.

5.6.5 Changing ECG Waveform Size

If the ECG waveform is too small or clipped, you change its size by using the Navigation knob.

1. Rotate the Navigation knob to move the cursor on the ECG waveform gain.
2. Press the Navigation knob to highlight it.
3. Rotate the Navigation knob until you find the desired item, and then press the knob to confirm the selection.

5.6.6 Changing ECG Waveform Speed

1. Select the ECG parameter area to enter the **[ECG Setup]** menu.
2. Select **[Sweep]**, and then choose an appropriate value. The faster the wave sweeps, the wider the wave is.

You can also set **[Sweep]** by selecting **[ECG Setup]** from the Configuration Main menu.

5.6.7 Setting the ECG Filter

- When monitoring ECG through 3/5- lead set, filter mode is displayed above the first ECG waveform. The available filter mode settings are **[Monitor]**, **[Therapy]**, and **[Diagnostic]**.
- When monitoring ECG through external paddles/electrode pads, filter mode is always **[Therapy]** and can not be changed.

To set the ECG filter mode:

1. Rotate the Navigation knob to move the cursor on the ECG filter mode.
2. Press the Navigation knob to highlight it.
3. Rotate the Navigation knob until you find the desired item, and then press the knob to confirm the selection.

5.6.8 Switching On or Off the Notch Filter

The notch filter removes the AC line noise. Switching on the notch filter is recommended when there is interference with the waveform.

- When the ECG filter mode is set to **[Monitor]** or **[Therapy]**, **[Notch Filter]** is always **[On]**.
- When the ECG filter mode is set to **[Diagnostic]**, **[Notch Filter]** can be switched on or off as required.

Set notch frequency according to the electric power frequency of your country. To switch on or off notch filter:

1. Select the ECG parameter area to enter the **[ECG Setup]** menu.
2. Select **[Others >>] → [Notch Filter]**, and toggle between **[On]** and **[Off]**.

You can also set the power frequency of notch filter by selecting **[ECG Setup]** through the Configuration Main menu.

NOTE

- The setting of [Notch Filter] will not be changed by restoring to factory default settings nor shutting down the system.

5.6.9 Adjusting the QRS Volume

In the case that ECG alarm is switched on, or both ECG alarm and PR alarm are switched off, heartbeat tone is issued.

To adjust the heartbeat volume:

1. Select the ECG parameter area to enter the [ECG Setup] menu.
2. Select [Others >>] → [QRS Volume]. The heartbeat volume can be set between 0 and 10, in which 0 means off, and 10 is the maximum volume.

You can also change the QRS volume by selecting [ECG Setup] through the Configuration Main menu.

When a valid SpO₂ value exists, the system will adjust the pitch of the heartbeat tone according to the SpO₂ value.

5.7 Arrhythmia Analysis

Arrhythmia analysis provides information about your animal's condition, including heart rate and arrhythmia alarms.

WARNING

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

5.7.1 Understanding the Arrhythmia Events

Arrhythmia event	Description	Category
Asystole	No QRS complex for 4 consecutive seconds (in absence of ventricular fibrillation or chaotic signals).	Lethal arrhythmia
V-Fib/V-Tach	A fibrillatory wave for 4 consecutive seconds. A dominant rhythm of adjacent Vs and a HR > the V-Tach Heart Rate Limit	
V-Tach	The consecutive PVCs > Vtac PVCs limit, and the HR > the Vtac HR limit.	
Vent. Brady	The consecutive PVCs ≥ the Vbrd threshold and the ventricular HR < the Vbrd Rate threshold.	
Extreme Tachy	The heart rate is greater than the extreme tachycardia limit.	
Extreme Brady	The heart rate is less than the extreme bradycardia limit.	

Arrhythmia event	Description	Category
PVCs/min	PVCs/min exceeds high limit	Nonlethal arrhythmia
PNP**	No pace pulse detected for 1.75 x average R-to-R intervals following a QRS complex (for paced animals only).	
PNC**	No QRS complex detected for 300 milliseconds following a pace pulse (for paced animals only).	
PVC	One PVC detected in normal heartbeats	
Couplet	Paired PVCs are detected.	
VT>2	More than 2 consecutive PVCs within the last minute.	
Bigeminy	A dominant rhythm of N, V,N, V, N, V.	
Trigeminy	A dominant rhythm of N, N, V,N, N, V, N, N, V.	
R ON T	R on T detected in normal heartbeats.	
Missed Beat*	No beat detected for 1.75x average R-R interval for HR <120, or No beat for 1 second with HR >120 (for non-paced animals only), or No beat detected for more than the set pause threshold.	
Brady	The average heart rate is less than 60 bpm.	
Tachy	The average heart rate is greater than 100 bpm.	
Vent Rhythm	The consecutive PVCs > the Vbrd PVCs limit, and the HR is between Vbrd Rate limit and the Vtac Rate limit.	
Multif. PVCs	Multiform PVCs detected in Multif. PVC's Window (which is adjustable).	
Nonsus. Vtac	The consecutive PVCs < the Vtac PVCs limit but > 2, and HR > the Vtac Rate limit.	
Pause*	No QRS detected within the set time threshold of pause.	
Irr. Rhythm	Consistently irregular rhythm.	

*: indicates that this arrhythmia alarm is not present when **[Paced]** is set to **[Yes]**.

.: indicates that this arrhythmia alarm is not present when **[Paced] is set to **[No]**.

- When electrode pads are used for ECG monitoring, the equipment provides only 4 arrhythmia alarms, including asystole, ventricular fibrillation/ventricular tachycardia, PNP, and PNC.
- When external paddles are used, the equipment provides only 3 arrhythmia alarms, including ventricular fibrillation/ventricular tachycardia, PNP, and PNC.

5.7.2 Switching Arrhythmia Analysis On and Off

To switch arrhythmia analysis on or off:

1. Select the ECG parameter area to enter the **[ECG Setup]** menu,.
2. Select **[Arrhythmia >>]** → **[Arrhythmia]**, and toggle between **[On]** and **[Off]**.

You can also switch on or off **[Arrhythmia]** by selecting **[ECG Setup]** from the Configuration Main menu.

5.7.3 Changing Arrhythmia Alarm Settings

To change arrhythmia alarm settings:

1. Select the ECG parameter area to enter the **[ECG Setup]** menu
2. Select **[Arrhythmia >>]** → **[Arrh. Alarm >>]**, where you can set alarm switch, alarm level and alarm record switch for all the arrhythmia events.

You can also set **[ARR Alm Lev]** by selecting **[ECG Setup]** from the Configuration Main menu.

NOTE

- The alarm level for asystole, ventricular fibrillation, ventricular tachycardia, ventricular bradycardia, extreme bradycardia, and extreme tachycardia alarms is always high and unchangeable. These alarms are always on. As long as the alarm condition occurs, corresponding alarm will be triggered whether arrhythmia analysis is switched on or off.

5.7.4 Changing Arrhythmia Threshold Settings

To change arrhythmia threshold settings:

1. Select the ECG parameter area to enter the [ECG Setup] menu.
2. Select [Arrhythmia >>] → [Arrh. Threshold >>].

In case an arrhythmia violates its threshold, an alarm will be triggered. The setting of [Asystole Delay] is relevant to ARR relearning. When HR is less than 30 bpm, it is recommended to set [Asystole Delay] to 10 seconds.

Arrh. Event	Range	Default	Step	Unit
PVCs High	1 to 10	10	1	/
Asystole Delay	3 to 10	5	1	s
Tachy	60 to 300	Canine: 180 Feline: 180 Other: 180	5	bpm
Brady	15 to 120	Canine: 50 Feline: 90 Other: 50	5	bpm
Extreme Tachy	60 to 300	Canine: 200 Feline: 200 Other: 200	5	bpm
Extreme Brady	15 to 120	Canine: 35 Feline: 70 Other: 35	5	bpm
Multif. PVCs Window	3 to 31	15	1	Beats
V-Tach Rate	100 to 200	160	5	bpm
V-Tach PVCs	3 to 99	3	1	Beats
Pause Time	1.5, 2.0, 2.5	2.0	/	s
Vbrd Rate	15 to 60	40	5	bpm
Vbrd PVCs	3 to 99	5	1	Beats

You can also set arrhythmia threshold by selecting [ECG Setup] from the Configuration Main menu.

5.7.5 Initiating Arrhythmia Relearning Manually

Normally arrhythmia relearning allows the equipment to learn new ECG patterns to correct arrhythmia alarms and heart rate value. We suggest you manually initiate arrhythmia relearning when you suspect the result of arrhythmia analysis.

To initiate relearning manually:

1. Select the ECG parameter area to enter the [ECG Setup] menu
2. Select [Arrhythmia >>] → [Relearn Arrh.].
3. When the equipment is learning, the message “Learning ECG” is displayed in the prompt area.

NOTE

- **Arrhythmia relearning in the case of ventricular tachycardia may affect correct arrhythmia alarm.**

5.7.6 Automatic Arrhythmia Relearn

Arrhythmia relearning is initiated automatically whenever:

- The ECG lead or lead label is changed
- The ECG lead is re-connected
- Animal category is changed
- The paced status is changed
- Arrhythmia analysis is switched on
- **[Stop Calibrating]** is selected after ECG calibration is completed.

5.8 Calibrating ECG

The ECG signal may be inaccurate due to hardware or software problems. As a result, the ECG wave amplitude becomes greater or smaller. In that case, you can perform ECG calibration to check if the ECG wave amplitude is in normal range.

1. On the ECG filter mode, rotate the Navigation knob until you find **[Diagnostic]**, and then press the Navigation knob to confirm the selection.
2. Select the ECG parameter area to enter the **[ECG Setup]** menu.
3. Select **[Others >>] → [Calibrate]**. In this case, a square wave appears on the screen and the message **"Calibrating ECG"** is displayed.
4. Compare the amplitude of the square wave with the 1mV wave scale. The difference should be within 5%.
5. After the calibration is completed, select **[Stop Calibrating]**.

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

5.9 ECG Troubleshooting

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

NOTE

- **For the physiological and technical alarm messages, refer to *D Alarm Messages*.**

Problem	Corrective Actions
Noisy ECG traces	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 cable or leadwires are routed too close to other electrical devices. Move the cable or leadwires away from electrical devices.
Excessive electrosurgical Interference	Use ESU-proof ECG cables. For details, refer to <i>21 Accessories</i> .
Muscle Noise	Inadequate skin preparation, tremors, tense subject, and/or poor electrode placement. 1. Perform skin preparation again and re-place the electrodes. For details, refer to <i>5.4 Preparing for ECG Monitoring and Measurement</i>. 2. Apply fresh, moist electrodes. Avoid muscular areas.

Problem	Corrective Actions
Intermittent Signal	1. Check that cables are properly connected. 2. Check that electrodes are not detached or dry. Perform skin preparation again as described in <i>5.4 Preparing for ECG Monitoring and Measurement</i>. 3. Check that the cable or leadwires are not damaged. Change them if necessary.
Excessive alarms: heart rate, lead fault	1. Check that electrodes are not dry. Perform skin preparation again and replace the electrodes. For details, refer to <i>5.4 Preparing for ECG Monitoring and Measurement</i>. 2. Check for excessive animal movement or muscle tremor. Reposition the electrodes. Replace with fresh and moist electrodes if necessary.
Low Amplitude ECG Signal	1. Check that the ECG gain is not set too low. Adjust the gain as required. For details, refer to <i>5.6.5 Changing ECG Waveform Size</i>. 2. Perform skin preparation again and re-place the electrodes. For more information, refer to <i>5.4 Preparing for ECG Monitoring and Measurement</i>. 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.
No ECG Waveform	1. Check that the ECG gain is not set too low. Adjust the gain as required. For details, refer to <i>5.6.5 Changing ECG Waveform Size</i>. 2. Check that the leadwires and cables are properly connected. Change cable and lead wires. 3. Check that the cable or leadwires are not damaged. Change them if necessary.
Base Line Wander	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 details, refer to <i>5.4 Preparing for ECG Monitoring and Measurement</i>. 3. Check for ECG filter setting. Set ECG Filter mode to [Monitor].

6 Manual Defibrillation

6.1 Manual Defibrillation Introduction

This chapter explains how to prepare for and perform asynchronous defibrillation by using electrode pads, external paddles and internal paddles.

In the Manual Defib Mode, you must assess the ECG waveforms, decide if defibrillation is indicated, select appropriate energy setting, charge the equipment, and deliver the shock. Text messages and animal contact indicator on the screen provide relevant information to guide your throughout the defibrillation process.

While operating manual defibrillation, besides ECG, you can select to monitor parameters from SpO₂, NIBP and CO₂. Alarms are turned off automatically when you enter the Manual Defib mode. Pressing the Alarm Pause button  on the front panel of the equipment can turn on the alarms.

6.2 Manual Defibrillation Safety Information

DANGER

- Defibrillation current can cause operator or bystander severe injury or even death. Never touch the animal or any metal objects connected to the animal (including the bed or gurney) during defibrillation.
- Avoid contact between parts of the animal's body such as exposed skin of head or limbs, conductive fluids such as gel, blood, or saline, and metal objects such as a bed frame or a stretcher which may provide unwanted pathways for the defibrillating current.
- Do not allow electrode pads and paddles to touch each other or to touch other ECG monitoring electrodes, lead wires, dressings, etc. Contact with metal objects may cause electrical arcing and animal skin burns during defibrillation and may divert current away from the heart.
- During manual defibrillation, make sure your hands are dry and free from conductive gel to avoid shock hazard.
- Use care when operating this equipment close to oxygen sources (such as bag-valve-mask devices or ventilator tubing). Turn off gas source or move source away from animal during defibrillation. This can cause an explosion hazard.

WARNING

- If your equipment is equipped with integrative external paddles, you cannot use internal defibrillation function.
 - Do not use conductive liquid. Use only conductive gel specified by the equipment manufacturer.
 - If external paddles are used for defibrillation, apply the external paddles tightly and evenly to the animal's chest to ensure good skin contact.
 - Never apply the paddles to animal body to verify paddle connection.
 - Clinicians must select an appropriate energy level for defibrillation of young animals.
 - Never charge and deliver shock frequently in non-clinical situations. Otherwise equipment damage could occur.
-

CAUTION

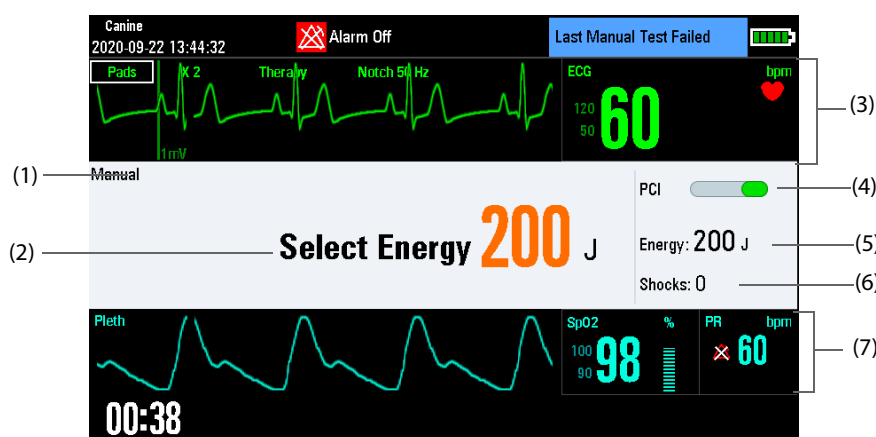
- If Manual Defib mode is enabled by password, make sure the operator knows and remembers the password as defined in Configuration. Failure to enter correct password will prevent the delivery of manual defibrillation therapy.
 - Clear the conductive gel from the external paddles at the completion of the therapy to prevent the paddles from being corroded.
 - Prior to using the equipment, disconnect the animal from all equipment that is not defibrillator-protected.
 - Never charge and deliver shock frequently in non-clinical situations. Otherwise equipment damage could occur.
-

NOTE

- Impedance is the resistance between the electrode pads/external paddles that the defibrillator must overcome to deliver an effective discharge of energy. The degree of impedance differs from animal to animal and is affected by several factors including the presence of chest hair, moisture, and lotions or powders on the skin. If the “Impedance Too High, Shock Not Delivered” message appears, make sure that the animal’s skin has been dried and that any chest hair has been clipped. If the message persists, change the electrode pads and/or the pads cable.
 - Alarms are switched off automatically and the “Alarm Off” message is displayed when the equipment enters the asynchronous defibrillation mode. Alarms remain off until toggled on by pressing the Alarm Pause button, the Monitor mode is entered.
 - Successful resuscitation is dependent on many variables specific to the animal’s physiological state and the circumstances surrounding the animal event. Failure to have a successful animal outcome is not a reliable indicator of equipment performance. The presence or absence of a muscular response to the transfer of energy during electrical therapy is not a reliable indicator of energy delivery or equipment performance.
-

6.3 Manual Defibrillation View

The following figure shows the screen in the Manual Defib mode.



- (1) Operating mode
- (2) Defibrillation prompt message
- (3) ECG parameter and waveform area
This area displays HR numeric and one ECG waveform acquired from the electrode pads, external paddles or internal paddles.
- (4) Animal contact indicator
It indicates the contact status between the animal and electrode pads/external paddles. For details, refer to 6.6 *Animal Contact Indicator*.
- (5) Selected energy

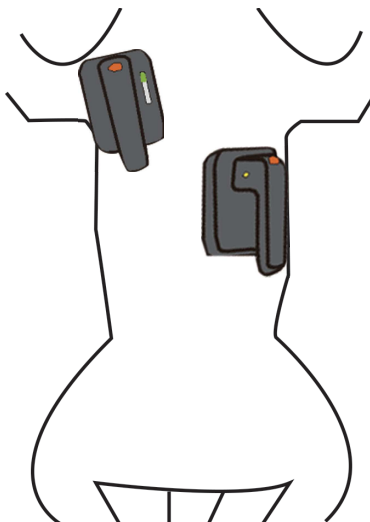
- (6) Shock counter
- (7) Auxiliary parameter and/or waveform area:
This area displays parameters from SpO₂, NIBP or CO₂. You can define the auxiliary parameter by selecting [**Manual Defib Setup**] from the Configuration Main menu.

6.4 Manual Defibrillation Procedure

6.4.1 Using Electrode Pads/External Paddles

When electrode pads/external paddles are used for manual defibrillation, you can use the smart analysis function. Smart analysis guides your throughout the defibrillation process. For details, refer to 6.5 *Using Smart Analysis*.

1. Prepare the animal skin. For details, refer to 5.4.1 *Preparing the Animal Skin*.
2. Select an appropriate therapy cable, and then plug it into the therapy port of the equipment.
3. Apply the electrode pads/external paddles to the animal.
 - If electrode pads are used, apply electrode pads to the animal.
 - If external paddles are used, remove the paddle set from the paddle tray by grasping the handles and pulling them out. Apply conductive gel on the electrode surface of each paddle, apply the external paddles to the animal by using anterior-lateral placement.



4. Press the Defib Mode button.
You can define [**Manual Therapy Access**] by selecting [**Manual Defib Setup**] from the Configuration Main menu.
5. Select energy.
The default energy level is automatically changed according to the animal category setting.
You can also select the desired energy level by the adjusting the Energy Select buttons on the front panel or on external paddles if external paddles are used.

The current energy selection is shown in the defibrillation information area as shown below.



6. Charge

Press the Charge button on the front panel. If external paddles are used, the Charge button on the paddles may be used instead. As the equipment charges, a progress bar is shown in the defibrillation information area. A charging tone sounds until desired energy level is reached, when you will hear a charge done tone.

If you have to increase or decrease the selected energy during charging or after charging is completed, adjust the Energy Select button to select the desired energy level as explained above. Then press the Charge button again to restart charging.

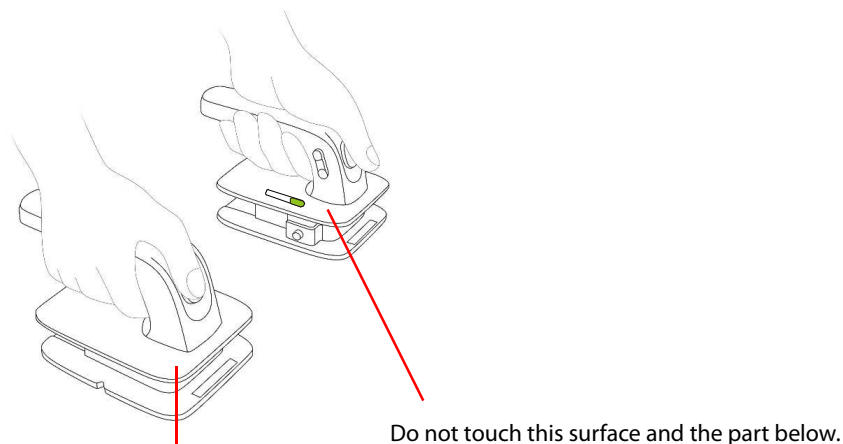
To remove the energy, press the **[Disarm]** soft key. If the Shock button is not pressed within the specified time period, the equipment disarms automatically. You can set **[Time to Auto Disarm]** to define the time period by selecting **[Manual Defib Setup]** from the Configuration Main menu.

7. Shock

Confirm that a shock is still indicated and that the equipment has charged to the selected energy level. Make sure no one is touching the animal, bed or any equipment connected to the animal. Call out clearly and loudly "Stay Clear".

- ◆ If electrode pads are used, press the flashing Shock button on the front panel to deliver a shock of the selected energy level.
- ◆ If external paddles are used, simultaneously press the Shock buttons located on the paddles to deliver a shock of the selected energy level.

When delivering the shock to the animal, the equipment delivers the shock of the default energy level. After three shocks, the equipment delivers the following shocks of **[Energy 3]** default energy level.



WARNING

- **Hold only the insulating parts of the paddle handles to avoid shock hazard during charging or shock delivery.**
-

NOTE

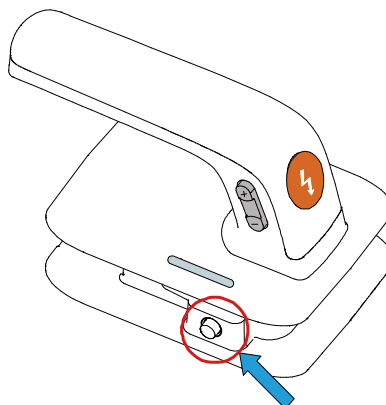
- Anterior - lateral placement is recommended placements for defibrillation with electrode pads.
- Anterior - lateral placement is the only placement for defibrillation with external paddles.
- Defibrillation is always performed through external paddles or electrode pads. However, during defibrillation, you may choose to monitor the ECG using an alternate ECG source (3- or 5-lead monitoring electrodes). If an alternate ECG source is connected, any available lead may be displayed.
- When external paddles are used, the Shock button on the front panel is disabled.
- For defibrillation of small size animal, small electrode pads should be used.
- If small electrode pads are not available, the large electrode pads may be used instead.
- Set the energy level according to the animal's clinical condition.

6.4.2 Using Small External Paddles

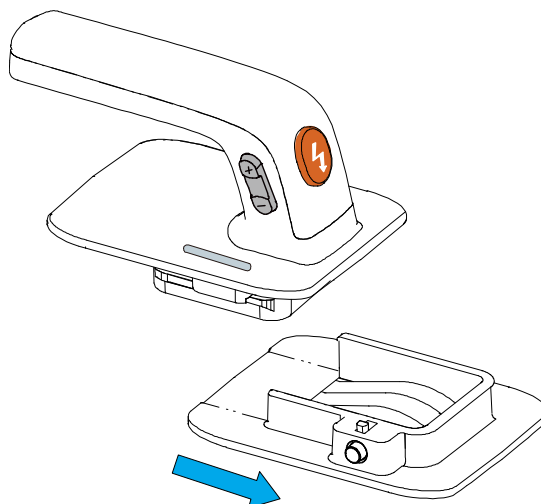
The external paddles provide both large paddle electrodes and small paddle electrodes included inside.

To use the small paddles:

1. Press the latch buttons on the external paddles.



2. Pull forward the large paddle electrodes to remove them.



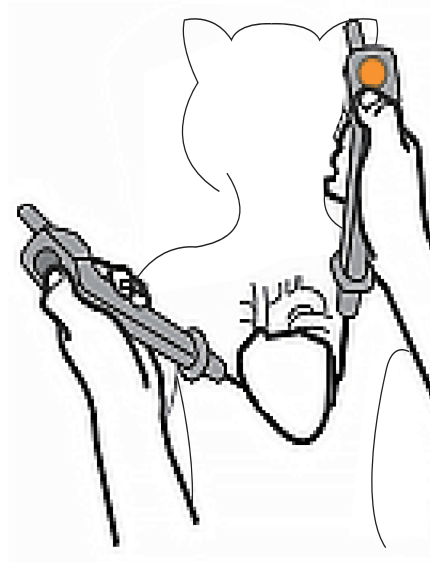
For details on the defibrillation procedures, refer to *6.4 Manual Defibrillation Procedure*.

6.4.3 Using Internal Paddles

To defibrillate using internal paddles:

1. Press the Defib Mode button.

2. Select the appropriate paddle size.
3. Connect the internal paddles to the defibrillator by aligning the white pointer on the paddles cable with the arrow on the therapy port. Push until you hear its click into place.
4. Select energy by pressing the Energy Select button on the front panel.
5. Place the conductive surface of paddle electrodes against the animal's right atrium and left ventricle.
6. Charge the defibrillator by pressing the Charge button on the front panel.
7. Make sure no one is touching the animal or anything connected to the animal.
8. Press the Shock button on the right paddle handle to deliver a shock to the animal.



NOTE

- When internal paddles are used for defibrillation, the energy selection is automatically limited to 50 joules because of possible cardiac damage from higher energies.
- Sterilize the internal paddles before each use. Otherwise, severe infection may result.
- Clean the internal paddles after each use.

6.5 Using Smart Analysis

Smart analysis is enabled by default during the manual defibrillation process. You can enable or disable it by selecting **[Manual Defib Setup]** from the Configuration Main menu.

Smart analysis detects the animal connection, analyzes the animal's heart rhythm, gives advices on charging the equipment and delivering a shock. You can perform operations following the prompts and pictures illustrated on the screen. When the message **"ECG signal is interfered"** displayed, there is signal interference or motion artifact. In this case, you should check the connection between electrode pads/external paddles and the animal.

Smart analysis stops during charging. After charging is completed, smart analysis restarts when you confirm a shock is still needed and press the Shock button.

6.6 Animal Contact Indicator

The animal contact indicator is used to indicate the contact status between the animal and electrode pads/external paddles in the Manual Defib mode.

The display of the contact impedance value is switched off by default. To switch it on, set **[Contact Impedance Value]** to **[On]** in the **[Manual Defib Setup]** menu through the Configuration Main menu.

The following table lists the contact status of the animal contact indicator and the corresponding actions:

Animal Contact Indicator	Description	Corrective Actions
 (illuminated in green)	Indicates the animal contact is good, the impedance is suitable for the defibrillation.	/
 (illuminated in orange)	Indicates the animal contact is not good, the impedance is slightly higher for the defibrillation.	Firmly attach the electrode pads or external paddles to the animal. or adjust the placements of electrode pads or external paddles until the indicator is illuminated in green. If the indicator is still illuminated in orange, it also can be used for the defibrillation. However, the expected effects may not be achieved in this condition.
 (illuminated in red)	Indicates the animal contact is very poor, or there is a short circuit between electrode pads or external paddles. The impedance is completely not suitable for the defibrillation.	Firmly attach the electrode pads or external paddles to the animal. or adjust the placements of electrode pads or external paddles until the indicator is illuminated in green or orange.
 (off)	Indicates the therapy cable falls off.	Check whether the therapy cable is properly connected to the equipment.

NOTE

- It is recommended to perform the defibrillation on an animal when the animal contact indicator is illuminated in green. If the animal contact indicator is illuminated in orange, it also can be used for the defibrillation. However, the expected effects may not be achieved in this condition.

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7 Monitoring Resp

7.1 Resp 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 equipment screen.

7.2 Resp Safety Information

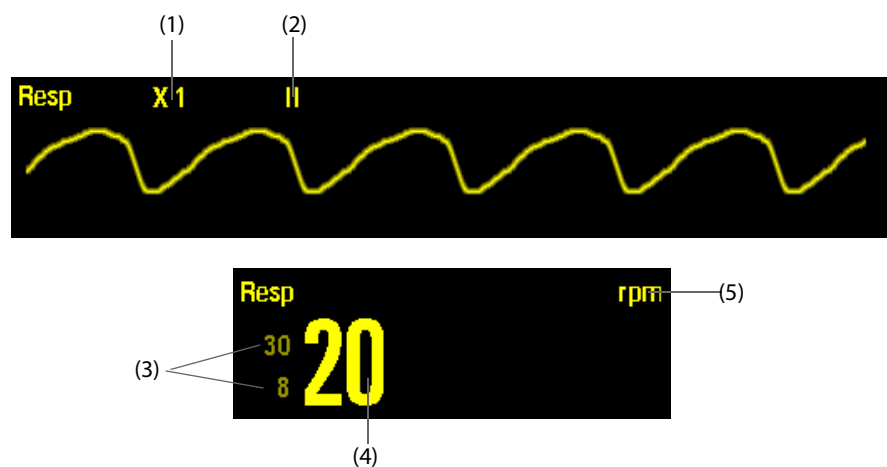
WARNING

- When monitoring the animal's respiration, do not use ESU-proof ECG cables.
- The respiration measurement does not recognize obstructive and mixed apneas: it only indicates an alarm when a pre-adjusted time had elapsed since the last detected breath.

NOTE

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

7.3 Resp Display



(1) Resp waveform gain

(2) Resp lead label

(3) Resp alarm limits

(4) Respiration rate (RR)

(5) RR unit

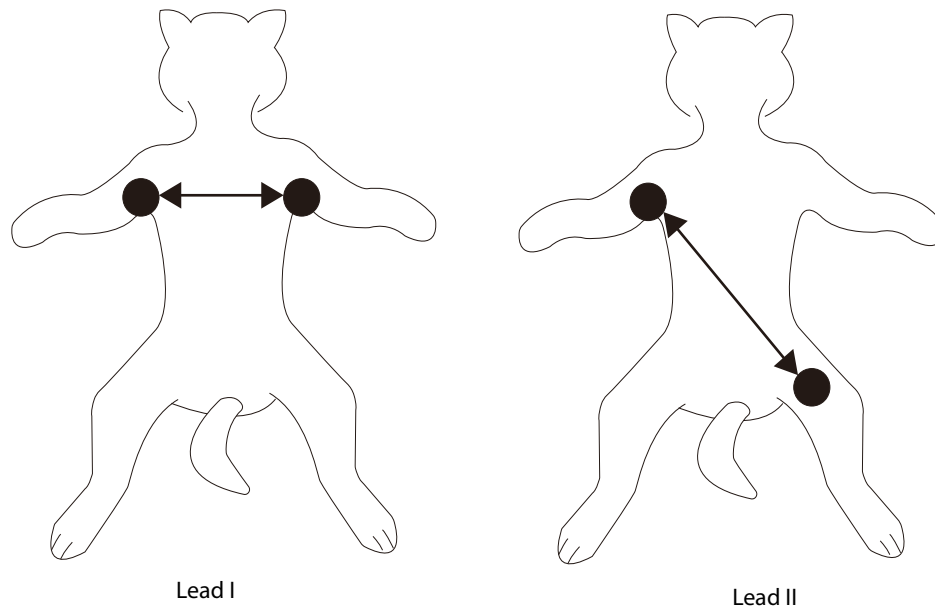
7.4 Placing Resp Electrodes

As the skin is a poor conductor of electricity, preparing the skin is necessary for a good respiration signal. For details, refer to 5.4.1 *Preparing the Animal Skin*.

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

NOTE

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



7.4.1 Optimizing Lead Placement for Resp

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

- 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.
- Some animals with restricted movement breathe mainly abdominally. In these cases, you may need to place the left hind leg electrode on the left abdomen at the point of maximum abdominal expansion to optimize the respiratory wave.
- In clinical applications, 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.

NOTE

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

7.4.2 Changing Resp Settings

1. Select the Resp parameter area to enter the **[Resp Setup]** menu.
2. Make the following settings:
 - ◆ Select **[Gain]** and then choose an appropriate setting. The bigger the gain is, the larger the wave amplitude is.
 - ◆ Select **[Sweep]** and then choose an appropriate setting. The faster the wave sweeps, the wider the wave is.
 - ◆ Select **[Lead]** to set lead for Resp monitoring.
 - ◆ Select **[Apnea Time]** to define the time.

7.5 Resp Troubleshooting

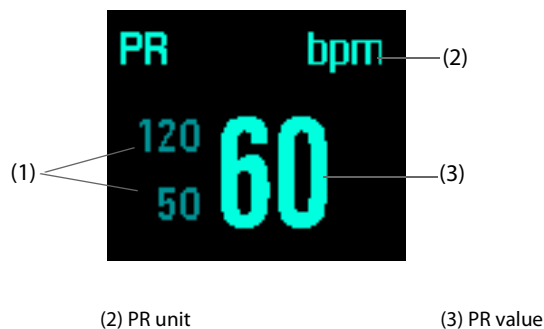
For details, refer to *D Alarm Messages*.

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8 Monitoring PR

8.1 PR Introduction

The pulse numeric counts the arterial pulsations that result from the mechanical activity of the heart. You can display a pulse from SpO₂.



8.2 Adjusting Pulse Tone Volume

When PR alarm is switched on, the equipment gives out pulse tone.

To change the volume of pulse tone:

1. Select the PR parameter area to enter the **[PR Setup]** menu.
2. Set **[QRS Volume]**.

When a valid SpO₂ value exists, the system will adjust the pitch of pulse tone according to the SpO₂ value.

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9 Monitoring SpO₂

9.1 SpO₂ Introduction

SpO₂ monitoring is a non-invasive technique used to measure the amount of oxygenated haemoglobin and pulse rate by measuring the absorption of selected wavelengths of light. The light generated in the probe passes through the tissue and is converted into electrical signals by the photodetector in the probe. The SpO₂ module processes the electrical signal and displays a waveform and digital values for SpO₂ and pulse rate.

This equipment is calibrated to display functional oxygen saturation.

9.2 SpO₂ Safety Information

WARNING

- Use only SpO₂ sensors specified in this manual. Follow the SpO₂ sensor's instructions for use and adhere to all warnings and cautions.
 - 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 potentially cause burns.
 - Prolonged continuous monitoring may increase the risk of undesirable changes in skin characteristics, such as irritation, reddening, blistering or burns. Inspect the sensor site every two hours and move the sensor if the skin quality changes. Change the application site every four hours. For animals with poor peripheral blood circulation or sensitive skin, inspect the sensor site more frequently.
 - If the sensor is too tight because the application site is too large or becomes too large due to edema, excessive pressure for prolonged periods may result in venous congestion distal from the application site, leading to interstitial edema and tissue ischemia.
 - When animals are undergoing photodynamic therapy they may be sensitive to light sources. Pulse oximeter may be used only under careful clinical supervision for short time periods to minimize interference with photodynamic therapy.
 - Setting alarm limits to extreme values may cause the alarm system to become ineffective.
 - To protect from electric shock, always remove the sensor and completely disconnect the pulse oximeter before bathing the animal.
 - The pulse oximeter is not an apnea monitor.
 - The pulse oximeter should not be used for arrhythmia analysis.
-
- The SpO₂ extension cable should be compatible with the SpO₂ connectors. For example, you can only connect the Mindray SpO₂ extension cable to the Mindray SpO₂ connectors.
 - The SpO₂ simulator can be used to verify the accuracy of the SpO₂ sensor.
-

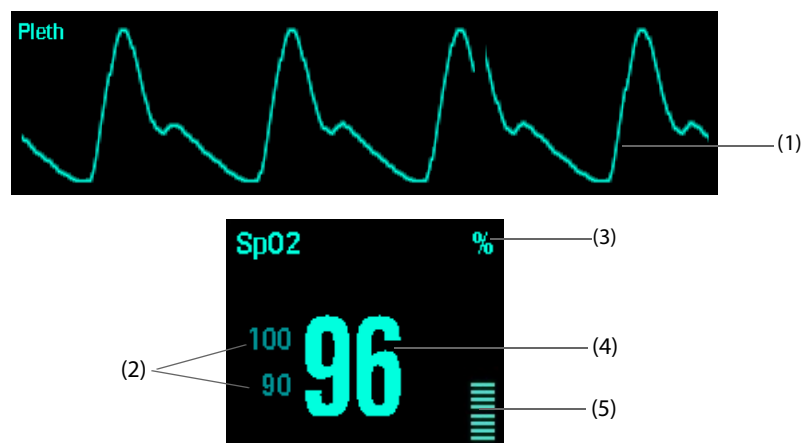
9.3 SpO₂ Measurement Limitations

The following factors may influence the accuracy of SpO₂ measurement:

- Animal physiological characteristics:
 - ◆ Cardiac arrest
 - ◆ Hypotension
 - ◆ Darkly pigmented skin
 - ◆ Shock
 - ◆ Severe vasoconstriction

- ◆ Hypothermia
- ◆ Severe anemia
- ◆ Ventricular septal defects (VSDs)
- ◆ Venous pulsations
- ◆ Poor perfusion
- ◆ Dysfunctional hemoglobin, such as carboxyhemoglobin (COHb) and methemoglobin (MetHb)
- ◆ Elevated levels of bilirubin
- ◆ Vasospastic disease, such as Raynaud's, and peripheral vascular disease
- ◆ Hemoglobinopathies and synthesis disorders such as thalassemias, Hb s, Hb c, sickle cell, etc.
- ◆ Hypocapnic or hypercapnic conditions
- ◆ Birthmark(s), tattoos, skin discolorations, moisture on skin, deformed or abnormal fingers. etc.
- Interfering substances:
 - ◆ Intravascular dyes (such as indocyanine green, methylene blue, indigo carmine, etc.)
 - ◆ Dyes in the measure site
- Environmental conditions:
 - ◆ Excessive ambient light
 - ◆ Electrosurgery equipment. The pulse oximeter may be used during electrocautery, but this may affect the accuracy or availability of the parameters and measurements.
 - ◆ Defibrillation (may cause inaccurate reading for a short amount of time)
 - ◆ Excessive animal/sensor motion
 - ◆ Electromagnetic field
 - ◆ Arterial catheters and intra-aortic balloon
- Others:
 - ◆ Inappropriate positioning of the SpO₂ sensor, or use of incorrect SpO₂ sensor
 - ◆ Cuff or arterial blood pressure measurement device on the same limb as the SpO₂ sensor.

9.4 SpO₂ Display



- (1) Pleth waveform (Pleth): visual indication of animal's pulse. The waveform is not normalized.
- (2) SpO₂ alarm limits
- (3) SpO₂ unit
- (4) Oxygen saturation of arterial blood (SpO₂): percentage of oxygenated hemoglobin in relation to the sum of oxyhemoglobin and deoxyhemoglobin.
- (5) Perfusion indicator: the pulsatile portion of the measured signal caused by arterial pulsation.

9.5 SpO₂ Monitoring Procedure

1. Select an appropriate sensor according to the animal category and weight.
2. Clean the application site.
3. Apply the sensor to the animal.
4. Connect the extension cable with the equipment.
5. Connect the sensor cable to the extension cable.
6. Press the Monitor Mode button.

9.6 Changing SpO₂ Settings

You can enter the **[SpO₂ Setup]** menu by selecting the SpO₂ parameter area.

9.6.1 Changing the Speed of the Pleth Wave

In the **[SpO₂ Setup]** menu, you select the appropriate setting from **[Sweep]**. The faster the wave sweeps, the wider the wave is.

9.6.2 Monitoring SpO₂ and NIBP on the Same Limb

When monitoring SpO₂ and NIBP on the same limb simultaneously, you can enable **[NIBP Simul]** from the **[SpO₂ Setup]** menu to lock the SpO₂ alarm status until the NIBP measurement ends. If you disable **[NIBP Simul]**, low perfusion caused by NIBP measurement may lead to inaccurate SpO₂ readings and therefore cause false physiological alarms.

9.6.3 Setting SpO₂ Sensitivity

You can set **[Sensitivity]** to **[High]**, **[Med]** or **[Low]** from the **[SpO₂ Setup]** menu.

- **[High]**: the equipment responding to changes in the animal's oxygen saturation level is quick, but the measurement accuracy is relatively low. For the monitoring to critical ill animals, selecting high sensitivity level will help understanding the animal's condition.
- **[Low]**: the equipment responding to changes in the animal's oxygen saturation level is slow, but the measurement accuracy is improved.

9.7 SpO₂ Desat Alarm

The equipment provides a SpO₂ Desat alarm. The SpO₂ Desat alarm provides an additional limit setting below the SpO₂ low limit setting to notify you of potentially life threatening decreases in oxygen saturation. The SpO₂ Desat alarm is a high-level exclusive alarm. You cannot change its alarm level.

To set the Desat alarm:

1. Enter the **[Para. Alarm]** menu by either of the following ways.
 - ◆ Press the Main Menu button on the front panel, and then select **[Alarm Setup >>]** → **[Para. Alarm >>]**.
 - ◆ Select the SpO₂ parameter area and then select **[Para. Alarm >>]**.
2. Set **[Desat]**.

NOTE

- In the case that the SpO₂ low limit alarm value is set below the Desat limit, the SpO₂ low limit is automatically adjusted to the Desat value.

9.8 Pitch Tone

The pitch tone function enables the equipment to give variable pitches of heartbeat tone or pulse tone as the animal's SpO₂ level changes. This equipment provides two modes of pitch tones. The pitch of heartbeat tone or pulse tone rises as SpO₂ level increases and falls as SpO₂ level decreases.

There are two pitch tone modes. You can set **[Pitch Tone]** to select the pitch tone mode by selecting **[SpO₂ Setup]** from the Configuration Main menu.

If the SpO₂ is disabled, the pitch tone function will be disabled also.

9.9 SpO₂ Troubleshooting

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

NOTE

- **For the physiological and technical alarm messages, refer to *D Alarm Messages*.**

Problem	Corrective Actions
SpO ₂ parameter area or waveform area is not displayed on the screen	Check that the cable connections of SpO ₂ sensor and the extension cable are tight. Replace the SpO ₂ sensor or the extension cable if needed.
Dashes "--" display in place of numerics	1. Check that the cable connections of SpO₂ sensor and the extension cable are tight. Replace the SpO₂ sensor or the extension cable if needed. 2. Reconnect the SpO₂ sensor if the alarm "SpO₂ Sensor Off" appears.
Low amplitude SpO ₂ signal	1. The SpO₂ sensor and NIBP cuff are placed on the same limb. Change a monitoring site if necessary. 2. Check the sensor and its application site.
SpO ₂ value is inaccurate	1. Check the animal's vital signs. 2. Check for conditions that may cause inaccurate SpO₂ readings. For details, refer to <i>9.3 SpO₂ Measurement Limitations</i>. 3. Check the equipment and the SpO₂ module for proper functioning.

10 Monitoring NIBP

10.1 NIBP Introduction

Automatic non-invasive blood pressure monitoring uses the oscillometric method of measurement. To understand how this method works, we'll compare it to the auscultative method.

With auscultation, the clinician listens to the blood pressure and determines the systolic and diastolic pressures. The mean pressure can then be calculated with reference to these pressures as long as the arterial pressure curve is normal.

Since the equipment cannot hear the blood pressure, it measures cuff pressure oscillation amplitudes. Oscillations are caused by blood pressure pulses against the cuff. The oscillation with the greatest amplitude is the mean pressure. Once the mean pressure is determined, the systolic and diastolic pressures are calculated with reference to the mean.

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

As specified in IEC 80601-2-30, NIBP monitoring is allowed while an electrosurgical operation is in progress or a defibrillation shock is being delivered.

NOTE

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

10.2 NIBP Safety Information

WARNING

- **Be sure to select the correct animal category setting for your animal before measurement. Otherwise it may present a safety hazard.**
 - **Do not measure NIBP on animals with sickle-cell disease or any condition where skin damage has occurred or is expected.**
 - **Use clinical judgment to determine whether to perform frequent unattended blood pressure measurements on 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 readings, determines the animal's vital signs by alternative means and then verify that the equipment is working correctly.**
 - **Do not use the NIBP cuff on the arm on the side of a mastectomy or lymph node clearance.**
 - **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 physician.**
-

10.3 NIBP Measurement Limitations

Measurements are impossible with heart rate extremes of less than 30 bpm or greater than 300 bpm, or if the animal is on a heart-lung machine.

The measurement may be inaccurate or impossible in the following situations:

- 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.

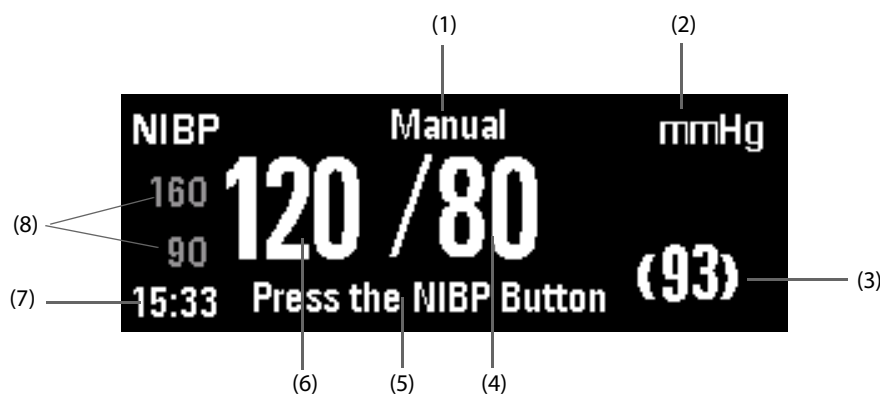
10.4 Measurement Modes

There are three modes of measuring NIBP:

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

10.5 NIBP Display

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



(1) Measurement mode

(2) NIBP unit: mmHg or kPa

(3) Mean pressure at the completion of measurement, or cuff pressure during the measurement.

(4) Diastolic pressure

(5) NIBP prompt message

(6) Systolic pressure

(7) Time of last measurement

(8) NIBP alarm limits

10.6 NIBP Measurement Procedure

10.6.1 Preparing the Animal

In normal use, perform NIBP measurement on an animal who is in comfortably still.

NOTE

- It is recommended that 5 min should elapse before the first reading is taken.
- A wrong cuff size and a folded or twisted bladder can cause inaccurate measurements.
- Do not touch or apply external pressure against the cuff and air tubing during NIBP measurement. This may cause inaccurate blood pressure values.

10.6.2 NIBP Cuff Placement

Before using NIBP cuff, you need to select NIBP parameter area to enter **[NIBP Setup]** menu so as to check if the weight range of animal is set properly. The cuff placement depends on the animal category and weight.

■ For a canine

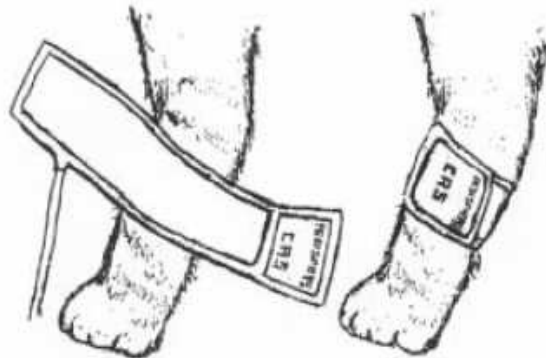
For measurements in canines, it is preferable to use the right lateral, sternal or dorsal recumbent position. If the canine is in a sitting position, place the front paw on your knee and then take measurements.

The metacarpus, metatarsus and anterior tibial are recommended for the cuff placement. For anesthetized animals, most surgeries are done on the posterior part of the body so the metacarpal area of the forelimb is most convenient. In situations where this is not possible, place the cuff around the metatarsus just proximal to the tarsal pad or around the hind leg next to the hock. For conscious animals, measurements from the coccygeal artery can be used over the tail site.



■ For a feline

For conscious animals, measurements from the coccygeal artery can be taken by wrapping the cuff around the base of the tail. For anesthetized animals, measurements from the median artery on the foreleg can be used by wrapping the cuff around the forelimb, between the elbow and carpus. For felines less than 5 lb when measurements are difficult to obtain, place the cuff around the leg above the elbow to obtain measurements from the brachial artery. Hair need not be clipped except when heavily matted.



■ For larger animals

It is preferable for a large animal, such as a horse and a cow, to be in a stock, standing still. Measurements from the coccygeal artery on the ventral surface may be used by placing the cuff around the base of the tail.

follow this procedure to place the NIBP cuff after the NIBP placement position is confirm:

1. Select an appropriately sized cuff for the animal, and then wrap it around the limb directly over the animal's skin as follows:
 - a Determine the animal's limb circumference.
 - b Select an appropriate cuff by referring to the limb circumference marked on the cuff. The width of the cuff should be 50% of the limb circumference, or 2/3 of the limb length. The inflatable part of the cuff should be long enough to overlap at least 50% to 80% of the limb.
 - c Apply the cuff to the animal's limb and make sure the Φ marking on the cuff matches the artery location. The cuff should fit snugly, but with little or no air present within the cuff. Otherwise it may cause discoloration and ischemia of the extremities. Make sure that the cuff index line falls within the range markings on the cuff. If it does not, use a cuff that fits better.
 - d Middle of the cuff should be at the level of the right atrium of the heart. If it is not, use the measurement correction formula to correct the measurement. For more information, see *10.6.4 Correcting the Measurement*.
2. Connect the air tubing to the NIBP connector on the equipment.
3. Connect the cuff to the air tubing. Avoid compression or restriction of pressure tubes. Air must pass unrestricted through the tubing.
4. Press the Monitor Mode button.

CAUTION

- **Incorrect sized cuff or bent cuff may cause wrong results.**
 - **Do not touch or apply external pressure against the cuff and air tubing during NIBP measurement. This may cause inaccurate blood pressure values.**
 - **Use care when placing the cuff on an extremity used for monitoring other animal parameters.**
-

10.6.3 Starting and Stopping NIBP Measurements

You can start and stop NIBP measurements by selecting the [NIBP Start/Stop] soft key.

10.6.4 Correcting the Measurement

The cuffed limb should be at the same level as the animal's heart. If not, correct the measurement by:

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

10.6.5 Starting Auto NIBP Measurements

1. Select the NIBP parameter area to enter the [NIBP Setup] menu.
2. Select [Interval] and then select a desired time interval except [Manual].
3. Press the [NIBP Start/Stop] soft key. The equipment will then automatically repeat NIBP measurements at the set time interval.

WARNING

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

10.6.6 Starting a STAT Measurement

1. Select the NIBP parameter area to enter the **[NIBP Setup]** menu.
2. Select **[NIBP STAT]**. The STAT mode initiates a 5-minute continuous, automatic NIBP measurement.

10.7 Setting Initial Cuff Inflation Pressure

You can set the initial cuff inflation pressure manually.

1. Select the NIBP parameter area to enter the **[NIBP Setup]** menu.
2. Select **[Initial Pressure]** and then select the appropriate setting. The cuff is inflated accordingly at the next NIBP measurement.

NOTE

- **Setting initial cuff inflation pressure is disabled during NIBP measurement.**
 - **The initial cuff inflation pressure is restored to the default setting if NIBP module has been reset or weight range has been changed.**
-

10.8 Setting Pressure Unit

You can set **[Press. Unit]** to change NIBP unit only by selecting **[NIBP Setup]** from the Configuration Main menu.

10.9 NIBP Troubleshooting

For details, refer to *D Alarm Messages*.

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11 Monitoring CO₂

11.1 CO₂ Introduction

CO₂ monitoring is a continuous, non-invasive technique for determining the concentration of CO₂ in the animal's airway by measuring the absorption of infrared (IR) light of specific wavelengths. The CO₂ has its own absorption characteristic and the amount of light passing the gas probe depends on the concentration of the measured CO₂. When a specific band of IR light is passed through respiratory gas samples, some of IR light will be absorbed by the CO₂ 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 CO₂ is calculated.

11.2 CO₂ Safety Information

WARNING

- **Route all tubing away from the animal's throat to avoid strangulation.**
-

CAUTION

- **Remove the airway sampling line from the animal's airway while nebulized medications are being delivered.**
 - **Leakage in the breathing or sampling system may cause the displayed EtCO₂ values to be significantly low. Always make sure that all components are securely connected.**
 - **EtCO₂ values measured from the CO₂ 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 sampling line during the CO₂ measurement may cause inaccurate CO₂ reading or no reading.**
-

11.3 CO₂ Measurement Limitations

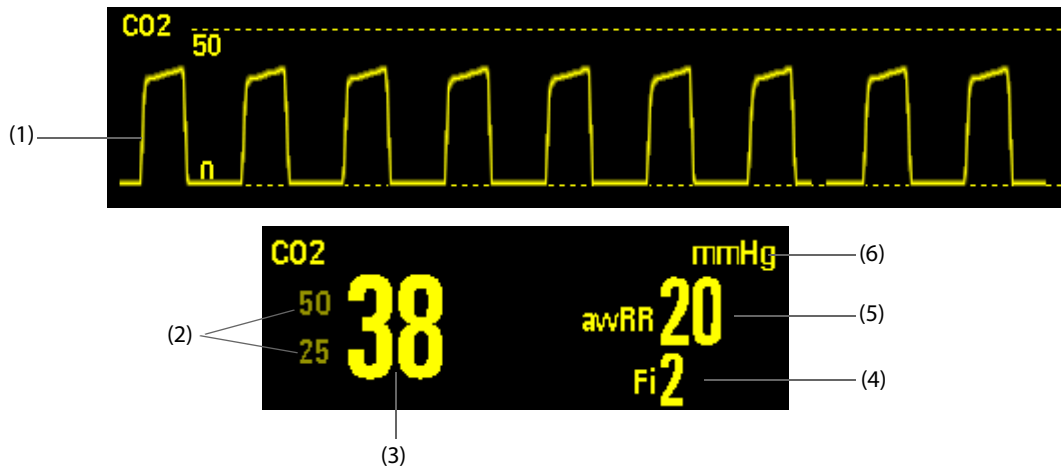
The following factors may influence the accuracy of measurement:

- Leakage or internal venting of sampled gas
- Mechanical shock
- Cyclic pressure higher than 10 kPa (100 cmH₂O) or abnormal change to airway pressure
- Other sources of interference, if any.

Measurement accuracy of the CO₂ module may be affected by the breath rate and inspiration/expiration (I/E) ratio. For details, refer to *A.3.7 CO₂ Specifications*.

11.4 CO₂ Display

The CO₂ parameter and waveform areas provide FiCO₂ measurement, EtCO₂ measurement, awRR measurement, and a CO₂ waveform.

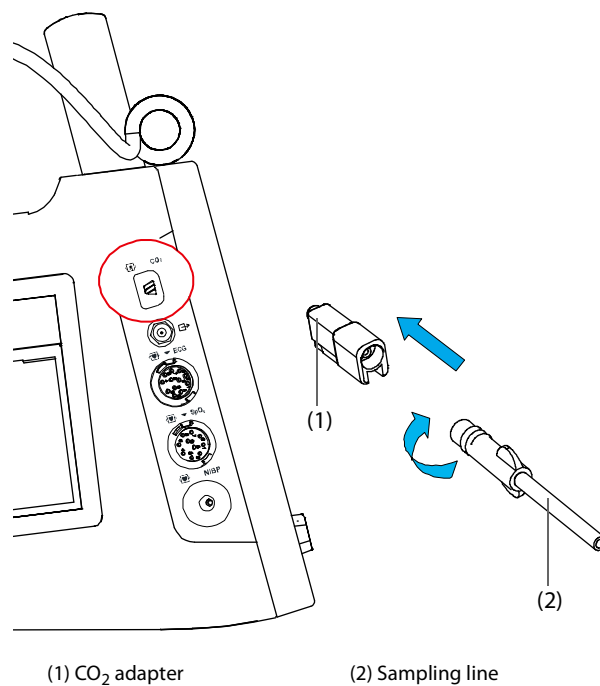


- (1) CO₂ waveform
- (2) CO₂ alarm limits
- (3) End tidal CO₂ value (EtCO₂): the highest CO₂ value measured during expiration.
- (4) Fraction of inspired CO₂ (FiCO₂): the lowest CO₂ value measured during inspiration.
- (5) Airway respiration rate (awRR)
- (6) CO₂ unit

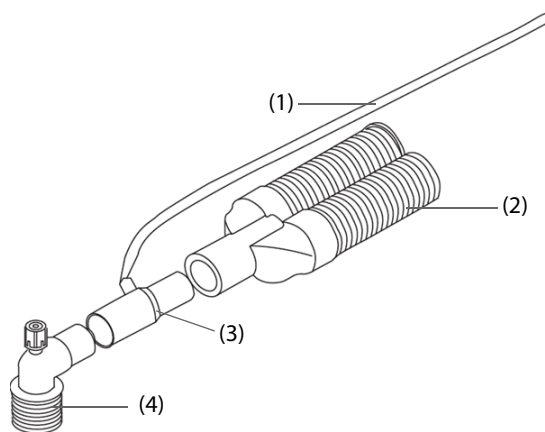
11.5 Preparing for Measuring CO₂

11.5.1 Measuring CO₂ Using the CO₂ Module

1. Select an appropriate sampling line according to the animal category.
2. Connect the sampling line to the CO₂ adapter installed on the equipment.



3. Connect the other end of the sampling line to the animal.
 - ◆ For intubated animals requiring an airway adapter, install the airway adapter between the animal circuit and the ventilator Y-piece.



- | | |
|--------------------|-------------------------------|
| (1) Sample line | (2) Connect to the ventilator |
| (3) Airway adapter | (4) Connect to the animal |

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

After the CO₂ module is connected, it enters measure mode by default and the equipment displays **"CO₂ Startup"**. CO₂ can be measured after the start-up is completed.

CAUTION

- Choose appropriate sampling line according to animal category. Otherwise, animal injury may occur.
 - Always connect the gas outlet to the scavenging system while measuring CO₂.
-

NOTE

- CO₂ operating mode should be set as Standby to raise the module and sampling line life if the CO₂ monitoring function is not used.
 - If not necessary, do not disconnect the CO₂ adapter from the equipment after the first installation. This reduces the risk of the CO₂ adapter of becoming lost or damaged.
 - When sample gas of 37 °C, sample flowrate of 50 ml/min, room temperature of 23 °C, 100% RH, the sampling line with a general type should be replaced once at most every 8 hours, and the sampling line with a humidified type should be replaced once at most every 72 hours.
-

11.5.2 Zeroing the CO₂ Module

The zero calibration eliminates the effect of baseline drift during CO₂ measurement exerted on the readings and therefore maintains the accuracy of the CO₂ measurements.

A zero calibration is carried out automatically when necessary. Disconnecting the animal airway is not required when performing a zero calibration.

You can also start a manual zero calibration if necessary. To manually start a zero calibration:

1. Press the Main Menu button on the front panel.
2. Select [**Others >>**] → [**Maintenance >>**] → [**Installation Mode >>**] → enter the required password.
3. Select [**Maintain CO₂**] → [**Zero**].

After the zero calibration is completed, the CO₂ module reacquires the CO₂ readings. During the reacquisition period, **"Zero Recovering"** is displayed in the CO₂ numeric area. Valid data will reappear 30 seconds after the zero calibration is started. You can hide the display of the **"Zero Recovering"** message by selecting [**CO₂ Setup**] from the Configuration Main men, but values displayed during the reacquisition period may not be accurate.

The automatic zero calibration will not start under the following conditions:

- Physiological alarms related to CO₂ are active.
- An apnea alarm is active.

- No breath has been detected for over 30 seconds.

NOTE

- The CO₂ module temporally stops measuring during zeroing.

11.6 Changing CO₂ Settings

11.6.1 Changing CO₂ Alarm Settings

1. Select the CO₂ parameter area to enter the [CO₂ Setup] menu.
2. Select [Para. Alarm >>]
3. Set the following alarm properties:
 - ◆ Switch on or switch off the alarms or alarm recording.
 - ◆ Adjust the alarm limits or alarm priority.

11.6.2 Setting CO₂ Unit

1. Press the Main Menu button on the front panel.
2. Select [Others >>] → [Configuration >>] → enter the required password.
3. Select [CO₂ Setup].
4. Set [Press. Unit].

11.6.3 Changing CO₂ Wave Settings

1. Select the CO₂ parameter area to enter the [CO₂ Setup] menu.
2. Set the wave sweep and scale.
 - ◆ Select [Sweep] and then choose an appropriate setting. The faster the wave sweeps, the wider the wave is.
 - ◆ Select [Scale] and adjust the upper scale to change the amplitude of CO₂ waveform.
3. Select [Others >>] and set the wave type:
 - ◆ [Draw]: The CO₂ wave is displayed as a curved line.
 - ◆ [Fill]: The CO₂ wave is displayed as a filled area.

11.6.4 Changing CO₂ Operating Mode

To change CO₂ operating mode:

1. Select the CO₂ parameter area to enter the [CO₂ Setup] menu
2. Set [Operating Mode].
 - ◆ [Measure]: only in the Measure mode can you start the CO₂ module.
 - ◆ [Standby]: in the standby mode, the gas intake pump, infrared light source, etc. are automatically switched off to reduce power consumption and extend the lifetime of the CO₂ module.

11.6.5 Setting the Auto Standby Time

The equipment enters the standby mode automatically after the configured period of time if no breath is detected since the last detected breath.

To set auto standby time:

1. Select the CO₂ parameter area to enter the [CO₂ Setup] menu.
2. Select [Others >>].
3. Set [Auto Standby].

11.6.6 Setting the Apnea Alarm Delay

To set the apnea alarm delay:

1. Select the CO₂ parameter area to enter the [CO₂ Setup] menu.
2. Set [Apnea Time]. The equipment gives an apnea alarm if the animal has stopped breathing for longer than the preset apnea time.

11.6.7 Selecting Gas Compensations

WARNING

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

1. Select the CO₂ parameter area to enter the [CO₂ Setup] menu.
2. Select [Others >>].
3. Respectively select:
 - ◆ [O₂ Compen]: 0 to 100%
 - ◆ [N₂O Compen]: 0 to 100%
 - ◆ [AA Compen]: 0 to 24%

The sum of the three compensations should not be greater than 100%.

11.6.8 Setting Humidity Compensation

The CO₂ module is configured to compensate CO₂ reading for either Body Temperature and Pressure Saturated (BTPS) gas, to account for humidity in the animal's breath, or Ambient Temperature and Pressure Dry (ATPD) gas.

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

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

You can set the humidity compensation on or off according to the actual condition.

To set the humidity compensation:

1. Select the CO₂ parameter area to enter the [CO₂ Setup] menu.
2. Select [Others >>] → [BTPS Compensation].
3. Select either [On] for BTPS or [Off] for ATPD.

11.6.9 Barometric Pressure Compensation

The CO₂ module has the function of automatic barometric pressure compensation. That is to say, the system automatically measures the barometric pressure which the equipment is exposed to.

11.7 Removing the Exhaust Gases from the System

WARNING

- **When taking the CO₂ measurement on animals who are receiving or have recently received anesthetics, connect the outlet to a scavenging system, or to the anesthesia machine/ventilator, to avoid exposing medical staff to anesthetics.**
-

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

11.8 CO₂ Calibration

CO₂ calibration should be performed by Mindray Animal Medical-qualified service personnel only once a year or when the readings go far beyond the range. For details, refer to the relevant service manual.

CAUTION

- **Connect the gas outlet to the scavenging system when calibrating CO₂.**
-

11.9 CO₂ Troubleshooting

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

NOTE

- **For the physiological and technical alarm messages, refer to *D Alarm Messages*.**
-

Problem	Corrective Actions
EtCO ₂ measurements too low	1. Ventilate the room if the environmental CO₂ concentration is too high. 2. Check the sample line and connectors for leakage. 3. Check the animal status.

12 Marking Events

During animal monitoring or therapy, some events may exert effects on the animal and as a result change related waveforms and parameter values. To help analyzing the waveforms or numerics at that time, you can mark these events.

Before marking an event, you can define events A to F, for example, define event D as injecting Atropine. You can only define events by selecting **[Mark Event Setup]** from the Configuration Main menu. Event A is always **[Generic]** and cannot be changed.

To mark an event,

1. Press the Main Menu button on the front panel, and then select **[Mark Event]**.
2. Select an event you want to mark from **[A]** to **[H]**, or select **[Exit]** to return to the main screen.

When you mark an event, the event name and the time when the event is triggered will be displayed at the prompt information area. This information disappears automatically after a period of 5 seconds.

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13 Freezing Waveforms

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. Besides, you can select any frozen waveform for recording. Waveforms can be frozen only in the Monitor mode.

13.1 Freezing Waveforms

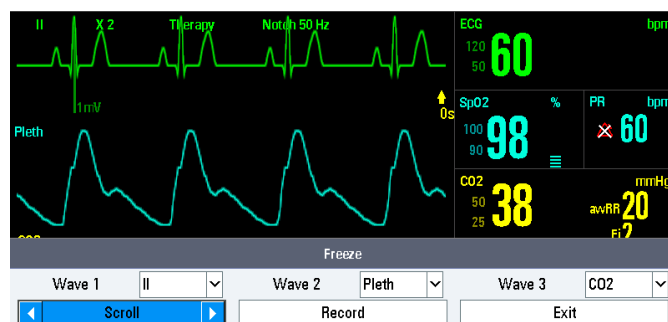
In the Monitor mode, you can press the Main Menu button on the front panel, and then select **[Freeze]** to freeze the currently displayed waveforms on the screen. All waveforms on the screen stop refreshing or scrolling and the **[Freeze]** window pops up. The parameter area remains refreshing properly.

The equipment can freeze the waveforms for 120 seconds.

13.2 Reviewing Frozen Waveforms

When waveforms are frozen, you can view the waveforms by selecting the **[Scroll]** button and then rotating the Navigation knob clockwise or counterclockwise to move the frozen waveforms right or left.

At the lower right corner of the bottommost waveform, there is an upward arrow. The frozen time is displayed below the arrow. With each step or click, the frozen time changes at intervals of 1 second. The time can be applied to all the waveforms on the screen.



13.3 Unfreezing Waveforms

To unfreeze the frozen waveforms, choose any of the following ways:

- In the **[Freeze]** window, select **[Exit]**.
- Press the Main Menu button on the front panel.

13.4 Recording Frozen Waveforms

1. In the Monitor mode, press the Main Menu button on the front panel, and then select **[Freeze]**.
2. Select **[Wave 1]**, **[Wave 2]** or **[Wave 3]**, and then respectively set the desired waveforms.
3. Select **[Record]**. The selected waveforms and all numerics at the frozen time will be printed out by the recorder.

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14 Review

14.1 Reviewing Events

The equipment can automatically record and save animal events.

To review events, press the Main Menu button and then select **[Review >>]** → **[Review Events >>]**.

The following figure shows the **[Review Events]** menu.

Review Events					
Time	Event				
2020-09-01 08:53:34	Recorder Comm Err				
2020-09-01 08:53:32	Pads/Paddles Off				
2020-09-01 08:53:20	Switch to Manual Mode				
Event Type	All	^	Prev/Next	↓	Index
					2020-09-01 08:53:41
					Record
Previous Menu			Exit		

In the **[Review Events]** menu, you can:

- Select **[Event Type]**, and then select **[User Initiated]**, **[Phys. Alarm]**, **[Arrhythmia]**, **[NIBP Meas.]**, **[Tech. Alarm]** or **[All]** to review events as desired.
- Select **[Prev/Next]** to page up/down to view more events.
- Select **[Index]** to enter the **[Index]** menu. In this menu, you can set the time span in which the events happened.
- Select **[Record]** to print out the current event list.
- Select **[Previous Menu]** to return to the previous menu.
- Select **[Exit]** to return to the main screen.

Animal events will be saved as archived events when the equipment is turned off. In case of power failure, the saved animal events will not be cleared or lost; they will be turned into archived events instead.

NOTE

- **Pausing or switching off alarms will not be recorded as events.**
- **A total loss of power has no impact on the saved events.**
- **Earlier-recorded events might be overwritten by later ones if it reaches capacity.**

14.2 Reviewing Tabular Trends

To review events, press the Main Menu button and then select **[Review >>]** → **[Trends >>]**.

Tabular Trends					
Time	Event	HR (bpm)	SpO2 (%)	PR (bpm)	EtCO2 (mmHg)
(01)09:00		60	98	60	---
(01)08:55		60	98	60	---
^ Prev/Next ↓		< Left/Right >	Interval	5 min	Record >>
Previous Menu			Exit		

14.3 Reviewing Rescue Records

To review rescue records, press the Main Menu button and then select **[Review >>]** → **[Rescue Record Review]**.

Rescue Record Review	
Time	Event
2020-10-21 11:44:45	Pacer in Demand Mode
2020-10-21 11:44:01	Power On
^ Prev/Next v Record	
Previous Menu Exit	

15 Data Management

15.1 Data Management Overview

The equipment provides the data management function for archived animals. The data management function enables you to:

- Edit archived animal information
- Review animal events
- Export animal data to USB memory

You can set whether a password is required for entering the Archives Main menu by selecting **[Others]** from the Configuration Main menu. Password and modifying method in the Archives Main menu and the Configuration Main menu are the same. For details, refer to *17.2 Modifying Configuration Management Password*.

15.2 Generating Animal Data

Archive ID is created automatically when the equipment is turned on. It is unchangeable. When the equipment is turned off, the current animal is discharged and the archive ID turns to be historical archive ID.

For a new animal, if animal category is changed, the system will restore the default alarm settings of this animal category; if animal category is not changed, the alarm settings remain unchanged. If you restart the equipment after normal power-off, the default alarm settings will be loaded.

15.3 Editing Archived Animal Information

You can edit the archived animal information when the information is incomplete or changed. **[Archives ID]** and **[Patient Cat.]** are unchangeable.

1. Press the Main Menu button on the front panel, and then select **[Others >>]**.
2. Select **[Archives >>]** → **[Yes]**.
3. Select the desired archive ID, and select **[Patient Info]**
4. Edit the animal information as desired.

15.4 Reviewing Animal Events

1. Press the Main Menu button on the front panel, and then select **[Others >>]**.
2. Select **[Archives >>]** → **[Yes]**.
3. Select the desired archive ID, and select **[Patient Info]**
4. Select **[Review Events]**

15.5 Exporting Animal Data

1. Press the Main Menu button on the front panel.
2. Select **[Others >>]** → **[Archives >>]** → **[Yes]**.
3. Select **[Export Data]** → **[USB Memory]**.
4. Select the desired archive ID, and then select **[Export]**.
5. If necessary, you can set whether this prompt is provided by selecting **[Others]** from the Configuration Main menu. When **"Export Patient Info.?"** appears, select **[Yes]** to confirm exporting data.

During data export, the message **"Exporting Data. Please Wait..."** appears in the prompt information area and a progress bar is displayed. If an exception happens, data export stops automatically and the reason for interruption is presented in the prompt information area.

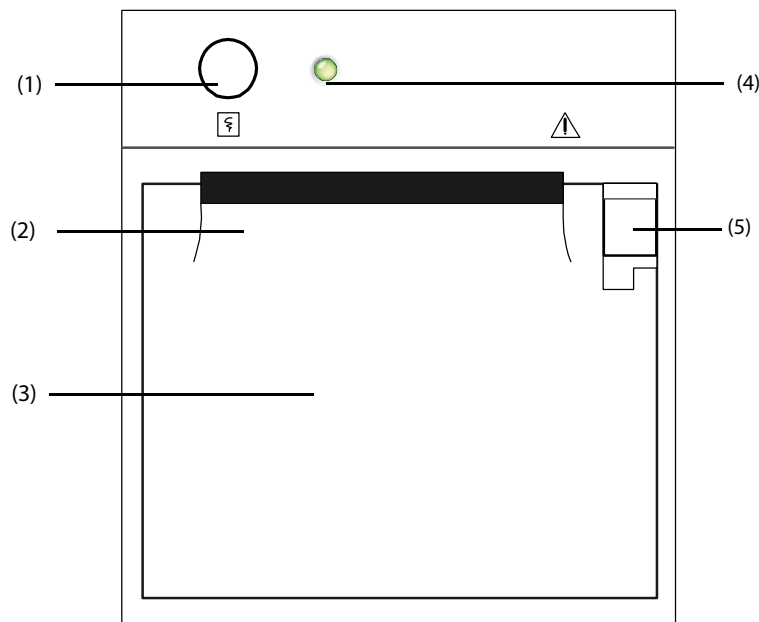
NOTE

- **Do not remove the USB flash memory from the equipment before data is completely exported.**
-

16 Recording

16.1 Using a Recorder

The thermal recorder records animal information, measurement numerics and waveforms, reviewed data, auto test report, manual test report and equipment configurations.



- (1) Start/Stop key
Press this key to start a recording or stop the current recording.
- (2) Paper outlet
- (3) Recorder door
- (4) Indicator
 - ◆ Illuminated: when the recorder works correctly.
 - ◆ Flashes: when an error occurred to the recorder, or the recorder runs out of paper.
 - ◆ Off: when the equipment is turned off.
- (5) Latch: pull out to open the recorder door

16.2 Recording Types

The equipment provides the following recordings.

- Manually-triggered realtime waveform recordings.
- Event-triggered recordings.
- Alarm recordings triggered by an alarm limit violation or an arrhythmia event.
- Manually-triggered, task-related recordings.
 - ◆ Frozen wave recording
 - ◆ Tabular trends recording
 - ◆ Event recording
 - ◆ Parameter alarm recording
 - ◆ Event review recording

- ◆ Rescue review recording
- ◆ Event summary report
- ◆ Check report
- ◆ Configuration recording

For details about alarm recording, refer to *4 Alarms*.

For details about task-related recordings, refer to respective sections of this manual.

16.3 Starting Recordings

Recordings can be started manually or automatically.

16.3.1 Manually Starting Recordings

To manually start a recording, you can either:

- Press the Record button  on the front of the recorder,
- Select **[Record]** from the current display.

At the completion of recording, two columns of "*" marks will be printed to indicate the end of recording.

16.3.2 Automatic Recordings

Automatic recordings will be triggered in the following conditions:

- If both **[Alarm]** and **[Alm Rec]** for a measurement are switched on, an alarm recording will be triggered automatically when an alarm occurs.
- When related event is triggered.

16.4 Stopping Recordings

Recordings can be stopped manually or automatically.

16.4.1 Stopping Recordings Manually

To manually stop a recording, you can either:

- Press the Record button  again.
- Select **[Clear All Tasks]** in the **[Record Setup]** menu.

16.4.2 Stopping Recordings Automatically

Recordings stop automatically when:

- A recording is completed.
- The recorder runs out of paper.
- The recorder has a failure.
- Operating mode is changed.

16.5 Setting the Recorder

16.5.1 Selecting Waveforms for Recording

1. Press the Main Menu button on the front panel.
2. Select [**Others >>**] → [**Record Setup >>**].
3. Select the desired waveforms. Select [**Off**] to switch off a waveform.

The selected waveforms and all numerics at the frozen time will be printed out by the recorder.

16.5.2 Setting the Realtime Recording Length

1. Press the Main Menu button on the front panel.
2. Select [**Others >>**] → [**Record Setup >>**].
3. Select [**Wave Length**] and toggle between [**8 s**], [**16 s**], [**32 s**] and [**STAT**].
 - ◆ [**8 s**]: record a waveform 4 seconds before and 4 seconds after the current moment.
 - ◆ [**16 s**]: record a waveform 8 seconds before and 8 seconds after the current moment.
 - ◆ [**32 s**]: record a waveform 16 seconds before and 16 seconds after the current moment.
 - ◆ [**STAT**]: record a waveform from the current moment until stopped manually.

16.5.3 Changing the Recording Speed

1. Press the Main Menu button on the front panel.
2. Select [**Others >>**] → [**Record Setup >>**].
3. Set [**Paper Speed**].

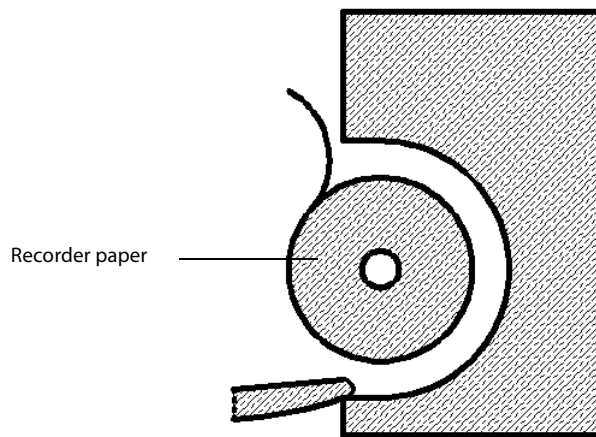
16.5.4 Switching Gridlines On or Off

1. Press the Main Menu button on the front panel.
2. Select [**Others >>**] → [**Record Setup >>**].
3. Select [**Gridlines**] and toggle between [**On**] and [**Off**].
 - ◆ [**On**]: show gridlines when recording waveforms.
 - ◆ [**Off**]: hide gridlines when recording waveforms.

This setting is for all recordings containing waveforms.

16.6 Loading Paper

1. Use the latch at the upper right of the recorder door to pull the door open.
2. Insert a new paper roll into the compartment as shown below.
3. Close the recorder door.
4. Check if paper is loaded correctly and the paper end is feeding from the top.



CAUTION

- **Use only specified thermal paper. Otherwise, it may cause damage to the recorder's print head, the recorder may be unable to print, or poor print quality may result.**
 - **Never pull the recorder paper with force when a recording is in process. Otherwise, it may cause damage to the recorder.**
 - **Do not leave the recorder door open unless you have to reload paper or remove troubles.**
-

16.7 Removing Paper Jam

If the recorder works incorrectly or produces unusual sounds, check if there is a paper jam first. If a paper jam is detected, follow this procedure to remove it:

1. Open the recorder door.
2. Take out the paper and tear off the draped part.
3. Reload the paper and close the recorder door.

17 Configuration Management

17.1 Configuration Management Introduction

The configuration management enables you to customize your equipment to best meet your needs. With this function, you can:

- View system configurations
- Change system configurations
- Record system configurations
- Export configurations
- Import configurations
- Restore the factory default configurations

After the system configurations have been changed, the equipment restarts and new configuration settings take effect immediately.

WARNING

- **Entering the Configuration Main menu is password protected. Animal monitoring and therapy automatically ends when you access the configuration management.**
 - **The configuration management tasks must be performed by clinical professionals.**
 - **Never connect the equipment with the animal when accessing the configuration management.**
-

17.2 Modifying Configuration Management Password

The required password for entering the Configuration Main menu is set to 315666. You can also modify the configuration password.

1. Press the Main Menu button on the front panel.
2. Select [**Others >>**] → [**Configuration >>**] → enter the required password.
3. Select [**Others >>**] → [**Modify Password**].
4. Respectively input the old password and new password. The maximum length of a new password can be set to 32 characters.
5. Select [**Confirm**].

17.3 Viewing Configurations

Password is not required when you view configurations.

1. Enter the Manual Defib mode, or the Monitor mode, and press the Main Menu button on the front panel.
2. Select [**Others >>**] → [**Configuration >>**].
 - ◆ Selecting [**View Config**] can view the configurations.
 - ◆ Selecting [**View Config**] → [**General Setup**] can change the system time.
 - ◆ Selecting [**View Config**] → [**Record**] can record all the configurations.
 - ◆ Selecting [**Exit**] can close the dialog box and return to the normal operating mode.

17.4 Exporting Configurations

1. Connect the USB flash memory to the equipment's USB connector.
2. Enter the Manual Defib mode, or the Monitor mode. and press the Main Menu button on the front panel.
3. Enter the Configuration Main menu by either of the following ways:
 - ◆ Select [**Others >>**] → [**Configuration >>**] → [**View Config**].
 - ◆ Select [**Others >>**] → [**Configuration >>**] → enter the required password
4. Select [**Config. Export**].

17.5 Importing Configurations

It is not necessary to configure each equipment separately when installing several equipments with identical configurations. A USB flash memory can be used to import configurations from one equipment to another.

1. Prepare a USB flash memory with desired configurations.
2. Connect the USB flash memory to the target equipment's USB connector.
3. Enter the Manual Defib mode, or the Monitor mode. and press the Main Menu button on the front panel.
4. Enter the Configuration Main menu by either of the following ways:
 - ◆ Select [**Others >>**] → [**Configuration >>**] → [**View Config**].
 - ◆ Select [**Others >>**] → [**Configuration >>**] → enter the required password
5. Select [**Config. Import**]

17.6 Changing Configurations

You can change configurations either by changing settings in each configuration setup menu, or restoring to factory defaults.

1. Enter the Manual Defib mode, or the Monitor mode, and press the Main Menu button on the front panel.
2. Select [**Others >>**] → [**Configuration >>**] → enter the required password.
 - ◆ Selecting [**Factory Default**] can restore all the current settings to factory defaults.
 - ◆ Select the desired setup menu, and change the settings.
 - ◆ Selecting [**Record**] can record all the current settings.

17.6.1 General Setup Menu

Menu Item	Options/Range	Default	Description
Device Name	20 characters	/	Inputs the relevant information. The characters are included in the keyboard. Restoring factory default configurations does not change these settings.
Institution	20 characters	/	
Department	20 characters	/	
Bed No.	20 characters	/	
Patient Cat.	Canine, Feline, Other	Canine	Sets the default animal category.
Height Unit	cm, inch	cm	Sets the default measurement unit for the animal.
Weight Unit	kg, lb	kg	
Language	/	/	Sets the language for voice and text prompts.
Date Format	yyyy-mm-dd, mm-dd-yyyy, dd-mm-yyyy	yyyy-mm-dd	Sets the system date format.
Time Format	12 h, 24 h	24 h	Sets the system time format.

Menu Item		Options/Range	Default	Description
Time Zone		/	/	Sets the system time zone.
System Time	Year	2007 to 2099	2007	Sets the system date. Configurable range: 2007-01-01 to 2099-05-31.
	Month	01 to 12	01	
	Day	01 to 31	01	
	Hour	24 h: 00 to 23 12 h: 12AM to 11PM	24 h: 00 12 h: 12AM	Sets the system time.
	Minute	00 to 59	00	
	Second	00 to 59	00	

17.6.2 Manual Defib Setup Menu

Menu Item	Options/Range	Default	Description
Manual Therapy Access	Direct, Confirmed, Password	Direct	Sets the way you access the Manual Defib mode. • [Direct]: you can directly access the Manual Defib mode. • [Confirmed]: a dialog box pops up for the confirmation when you access the Manual Defib mode. • [Password]: a dialog box pops up requiring the password when you access the Manual Defib mode.
Set Password	4 digits	0000	[Set Password] is active only when [Manual Therapy Access] is set to [Password] .
Energy 1 (Canine)	5 J, 10 J, 15 J, 20 J, 30J, 50J, 70J, 100J, 150J, 170J, 200J, 300 J, 360 J	20 J	Sets the defibrillation energy level for the first shock on the canine.
Energy 2 (Canine)	Energy 1 (Canine) to 360J	30 J	Energy 1 ≤ configurable value ≤ Energy 3
Energy 3 (Canine)	Energy 2 (Canine) to 360J	50 J	Energy 2 ≤ configurable value
Energy 1 (Feline)	5 J, 10 J, 15 J, 20 J, 30J, 50J, 70J, 100J, 150J, 170J, 200J, 300 J, 360 J	20 J	Sets the defibrillation energy level for the first shock on the Feline.
Energy 2 (Feline)	Energy 1 (Feline) to 100 J	30 J	Energy 1 ≤ configurable value ≤ Energy 3
Energy 3 (Feline)	Energy 2 (Feline) to 100 J	50 J	Energy 2 ≤ configurable value
Internal Default	2 J, 5 J, 10 J, 20 J, 30 J, 50 J	10 J	Sets the energy level for the internal defibrillation.
Time to Auto Disarm	30 s, 60 s, 90 s, 120 s	60 s	Sets the time the equipment automatically removes the stored energy internally.
Monitor Para.	SpO2, NIBP, CO2, Off	Off	Sets the parameter monitored in the auxiliary parameter area of the Manual Defib mode.
Charge Tone Vol	High, Med, Low	Med	Sets the tone volume during the charge, and when the charge is completed.

Menu Item	Options/Range	Default	Description
Contact Impedance Value	On, Off	Off	Sets whether to display the contact impedance value.
Maximum Defib. Energy	360 J	360 J	Sets the maximum energy level for the delivered shock.
Energy Delivered Output	On, Off	Off	Sets whether the energy level of a delivered shock is displayed in the event recording.

17.6.3 ECG Setup Menu

Menu Item	Options/Range	Default	Description
ECG Standard	AHA, IEC	AHA	Sets the ECG standard according to the leadwires you are using.
Notch Filter	50 Hz, 60 Hz	50 Hz	The notch filter removes the line frequency interference. Sets notch filter frequency according to the power line frequency of your country.
ECG Bandwidth	Monitor, Therapy	Therapy	Sets the filter frequency for 3-/5-lead ECG cable.
Lead Set	3-Lead, 5-Lead	3-Lead	Sets the ECG lead type. This setting affects the default waveform position of the [Waveform Setup] menu.
QRS Volume	0 to 10	2	This setting is linked with the [QRS Volume] setting in the [SpO2 Setup] menu
ECG1	3-Lead: I, II, III	II	Available options are defined by the current setting of [Lead Set] .
	5-Lead: I, II, III, aVL, aVR, aVF, V		
ECG2	3-Lead: I, II, III	/	- If 3-lead is used, the default setting of this item is blank and this item is inactivate. - The options of [ECG1] are not available for [ECG2].
	5-Lead: I, II, III, aVL, aVR, aVF, V	V	
ECG3	3-Lead: I, II, III	/	- If 3-lead is used, the default setting of this item is blank and this item is inactivate. - The options of [ECG1] and [ECG2] are not available for [ECG3].
	5-Lead: I, II, III, aVL, aVR, aVF, V, Off	Off	
Sweep	6.25 mm/s, 12.5 mm/s, 25 mm/s, 50 mm/s	25 mm/s	Sets the ECG waveform speed.
HR Alarm	On, Off	On	/
HR Alm Lev	High, Med	Med	/

Menu Item		Options/Range		Default	Description
HR High		Canine	(Low+2) to 300	180	Step: 1 bpm
		Feline	(Low+2) to 300	180	
		Other		180	
HR Low		Canine	15 to (High-2)	50	
		Feline		90	
		Other		50	
Arrhythmia		On, Off		Off	Sets whether to enable the arrhythmia analysis.
ARR Alarm		On, Off		On	/
ARR Alm Lev	PVCs/min	High, Med, Low		Med	/
	R ON T				
	VT>2				
	Couplet				
	PVC				
	Vent Rhythm				
	Bigeminy				
	Trigeminy				
	Tachy				
	Brady				
	PNP				
	PNC				
	Missed Beat				
	Multif. PVCs				
	Nonsus. Vtac				
	Pause				
	Irr. Rhythm				
Asystole Delay		3 to 10		5	/
V-Tach Rate		100 to 200		130	/
V-Tach PVCs		3 to 99		6	/
Vbrd Rate		15 to 60		40	/
Vbrd PVCs		3 to 99		5	/
Extreme Tachy	Canine	60 to 300		200	/
	Feline	60 to 300		200	/
	Other	60 to 300		200	/
Extreme Brady	Canine	15 to 120		35	/
	Feline	15 to 120		70	/
	Other	15 to 120		35	/
PVCs High		1 to 10		10	/

Menu Item		Options/Range	Default	Description
Tachy	Canine	60 to 300	180	/
	Feline	60 to 300	180	/
	Other	60 to 300	180	/
Brady	Canine	15 to 120	50	/
	Feline	15 to 120	90	/
	Other	15 to 120	50	/
Multif. PVCs Window		3 to 31	15	/
Pause Time		1.5, 2.0, 2.5	2.0	/

17.6.4 Resp Setup Menu

Menu Item		Options/Range	Default	Description
RR Alarm		On, Off	Off	/
RR Alm Lev		High, Med, Low	Med	/
Sweep		6.25 mm/s, 12.5 mm/s, 25 mm/s	6.25 mm/s	Sets the Resp waveform speed.
RR High	Canine	(Low+2) to 100	20	Step: 1 rpm
	Feline		20	
	Other	(Low+2) to 150	20	
RR Low	Canine	6 to (High-2)	5	
	Feline		5	
	Other		5	
Apnea Time		10 s, 15s, 20s, 25s, 30s, 35s, 40s	15 s	/

17.6.5 SpO₂ Setup Menu

Menu Item		Options/Range	Default	Description
SpO ₂ Alarm		On, Off	On	/
SpO ₂ Alm Lev		High, Med	Med	/
Sweep		12.5 mm/s, 25 mm/s	25 mm/s	Sets the SpO ₂ waveform speed.
SpO ₂ High	Canine	(Low+1) to 100	100	Step: 1%
	Feline		100	
	Other		100	
SpO ₂ Low	Canine	Desat Limit to (High-1)	90	
	Feline		90	
	Other		90	
Desat	Canine	50 to (High-1)	80	
	Feline		80	
	Other		80	
Pitch Tone		Mode 1, Mode 2	Mode 1	Sets the SpO ₂ tone mode.

Menu Item	Options/Range	Default	Description
Sensitivity	High, Med, Low	Med	/

17.6.6 PR Setup Menu

Menu Item	Options/Range	Default	Description
PR Alarm	On, Off	Off	/
PR Alm Lev	High, Med, Low	Med	/
PR High	Canine	(Low+2) to 300	Step: 1 bpm
	Feline		
	Other		
PR Low	Canine	15 to (High-2)	
	Feline		
	Other		
QRS Volume	0 to 10	2	This setting is linked with the [QRS Volume] setting in the [ECG Setup] menu

17.6.7 NIBP Setup Menu

Menu Item	Options/Range	Default	Description
Interval	Manual, 1 min, 2 min, 2.5 min, 3 min, 5 min, 10 min, 15 min, 20 min, 30 min, 1 h, 1.5 h, 2 h, 3 h, 4 h, 8 h	Manual	Sets the interval between NIBP measurements.
Press. Unit	mmHg, kPa	mmHg	Sets the NIBP measurement unit. Alarm limits are refreshed in real time when pressure unit is changed.
Alarm	NIBP-Sys	On, Off	/
	NIBP-Dia		
	NIBP-Mean		
Alm Lev	High, Med	Med	/

Menu Item	Options/Range		Default	Description
Sys High	>23kg	(Low+5) to 290	160	Step: 1 mmHg
	10-23kg	(Low+5) to 240	120	
	<10kg	(Low+5) to 140	120	
Sys Low	>23kg	25 to (High-5)	90	
	10-23kg		70	
	<10kg		70	
Mean High	>23kg	(Low+5) to 260	110	
	10-23kg	(Low+5) to 215	90	
	<10kg	(Low+5) to 125	90	
Mean Low	>23kg	15 to (High-5)	60	
	10-23kg		50	
	<10kg		50	
Dia High	>23kg	(Low+5) to 250	90	Step: 1 mmHg
	10-23kg	(Low+5) to 200	70	
	<10kg	(Low+5) to 115	70	
Dia Low	>23kg	10 to (High-5)	50	
	10-23kg		40	
	<10kg		40	

17.6.8 CO₂ Setup Menu

Menu Item	Options/Range		Default	Description
Alarm	On, Off		On	/
Alm Lev	High, Med		Med	/
Press. Unit	mmHg, kPa, %		mmHg	Sets the CO ₂ measurement unit. Alarm limits are refreshed in real time when pressure unit is changed.
Sweep	6.25 mm/s, 12.5 mm/s, 25 mm/s		6.25 mm/s	Sets the CO ₂ waveform speed.
Scale	mmHg	15, 20, 25, 40, 50, 60, 80	50	Different options are available to match the selected pressure unit.
	kPa	2, 2.5, 3.5, 5, 7, 8, 10	7	
	%	2, 2.5, 3.5, 5, 7, 8, 10	7	

Menu Item	Options/Range		Default	Description
EtCO ₂ High	Canine	(Low+2) to 99	55	Step: 1 mmHg The range is different according to the selected pressure unit. The default pressure unit is mmHg.
	Feline		50	
	Other		55	
EtCO ₂ Low	Canine	1 to (High-2)	35	
	Feline		30	
	Other		35	
FiCO ₂ High	Canine	1 to 99	4	
	Feline		4	
	Other		4	
awRR High	Canine	(Low+2) to 100	30	Step: 1 rpm
	Feline		30	
	Other	(Low+2) to 150	100	
awRR Low	Canine	6 to (High-2)	8	
	Feline		8	
	Other		30	
Apnea Time	10 s, 15s, 20s, 25s, 30s, 35s, 40s		15s	The equipment gives an apnea alarm if the animal has stopped breathing for longer than the preset apnea time.
Zero Recover for 30s	On, Off		On	Sets whether “ Zero Recovering ” is displayed in the CO2numeric area after the zero calibration is completed.

17.6.9 Alarm Setup Menu

Menu Item	Options/Range	Default	Description
Alarm Pause Time	1, 2, 3, 5, 10, 15 min, Permanent	2 min	Sets the alarm pause time.
Audio Off	Enabled, Disabled	Disabled	Sets whether the audible alarm tones are turned off.
Alm Volume	[Audio Off] is enabled: 0 to 10. [Audio Off] is disabled: 1 to 10.	2	Sets the alarm volume level.
Reminder Tone	On, Off	Off	Sets whether the equipment gives a reminder tone when alarm or alarm sounds are turned off.
Reminder Volume	High, Med, Low	Med	Sets the reminder tone volume.
Latching Alarms	Yes, No	No	Sets how alarm indicators behave if you do not reset the physiological alarms.
Displaying Alarm Limits	Yes, No	Yes	Sets whether to display the alarm limits.
ECGLeadOff Lev.	High, Med, Low	Low	Sets the alarm level for “ECG Lead Off” .

Menu Item		Options/Range	Default	Description
SpO2SensorOff Lev.		High, Med, Low	Low	Sets the alarm level for “ SpO2 Sensor Off ”.
No Battery		Status Indicator On, Status Indicator Off	Status Indicator On	Sets how the status indicator behaves if no battery is installed.
Alarm Tone Interval	High Level Alarm (s)	3 to 15s	10s	Sets the interval between alarm tones.
	Med Level Alarm (s)	3 to 30s	20s	
	Low Level Alarm (s)	16 to 30s	20s	

17.6.10 Waveform Setup Menu

Menu Item		Options		Default	Description
Wave 1		/	ECG1	ECG1	Unchangeable
Wave 2		3-Lead	Pleth, CO2, Resp	Pleth	For optional parameters, options of waveforms are available only when the parameters are configured.
		5-Lead	ECG2, Pleth, CO2, Resp	ECG2	
Wave 3		3-Lead	Pleth, CO2, Resp	Resp	
		5-Lead		Pleth	
Wave 4		3-Lead	Pleth, CO2, Resp	Off	
		5-Lead			
CO2 Wave Type		Draw, Fill		Draw	Set the CO ₂ waveform type.
Parameter/ Wave Color	ECG	Green, Yellow, Cyan, White, Red, Blue, Purple, Orange		Green	Sets the parameter color.
	Resp			Yellow	
	SpO2			Cyan	
	NIBP			White	
	CO2			Yellow	

17.6.11 Mark Event Setup Menu

Menu Item	Options/Range	Default	Description
Event A	Generic	Generic	Unchangeable
Event B	Adrenalin, Lidocaine, Atropine, Nitroglycerin, Morphine, Intubation, IV Access, Adenosine, Amiodarone, Vasopressin, Isoprenaline, Dopamine, Aspirin, Oxygen	Adrenalin	Event names that have been selected by previous events will not be included in the options of later events.
Event C		Lidocaine	
Event D		Atropine	
Event E		Nitroglycerin	
Event F		Morphine	
Custom Event 1	Options: entering event name using the keyboard included in the [Mark Event Setup] menu. Range: 1 to 20 characters	/	After being defined, custom event is refreshed in real-time in the Mark Event list.
Custom Event 2			

17.6.12 Record Setup Menu

Menu Item		Options/Range	Default	Description
Wave Length		8s, 16s, 32s, STAT	8s	Sets the recording time of recorded waveform.
Paper Speed		6.25 mm/s, 12.5 mm/s, 25mm/s, 50mm/s	25mm/s	Sets the recording speed.
Gridlines		On, Off	On	
Auto Record	Charge Event	On, Off	Off	Sets whether the event is automatically recorder when the related event is triggered.
	Shock Event		On	
	Marked Event		Off	
	Auto Test Report	On, Off, Only if Failed	Off	Sets whether the auto test report is automatically recorded when the auto test is completed. • [On]: the auto test report is automatically recorded when the auto test is completed. • [Off]: the auto test report is not recorded when the auto test is completed. • [Only if Failed]: the auto test report is automatically recorded when the auto test is completed and the auto test fails.
Alm Rec	HR	On, Off	Off	Sets whether the parameter is automatically recorded when the related alarm is triggered.
	ARR			
	PVCs			
	Resp			
	SpO2			
	PR			
	NIBP			
	CO2			

17.6.13 Data Management Setup Menu

Menu Item	Options/Range	Default	Description
Tabular Trends Interval	1 min, 2 min, 5 min, 10 min, 15 min, 30 min, 60 min	5 min	Sets the interval that trends are stored.
Event Wave Length	8s, 16s, 32s	16 s	Sets the length that events are stored.

17.6.14 Test Setup Menu

Menu Item	Options/Range	Default	Description
Manual Test Prompt	On, Off	Off	Sets whether the equipment reminds to perform the manual test if the recommended test time is reached.

Menu Item	Options/Range	Default	Description
Auto Test Time	24 h: 00 to 23 12 h: 12AM to 11PM	3:00	Sets the initiated time for auto test performed every day.
Auto Selftest Energy	10 J, 20 J, 30 J, 50 J, 70 J, 100 J	10 J	Sets the energy level delivered by the auto test.
Report Custom	Battery, Defib Function, External Paddles, Energy Accuracy, Energy Delivery Test, Monitor Function, Mainboard, Controls Test, Audio, Display, Status Indicator, Contact Indicator	Battery, External Paddles, Energy Accuracy	Sets the test items displayed in the [Test Summary] menu

17.6.15 Others Menu

Menu Item		Options/Range	Default	Description
Brightness		1 to 10	8	Sets the display brightness.
Key Volume		0 to 10	2	Sets the key volume.
Wave Line		Thick, Medium, Thin	Medium	Sets the thickness of displayed waveform.
Draw Wave		Mono, Color	Color	Sets the color mode of displayed waveform.
Modules	SpO2	On, Off	On	Sets whether to enable the parameter module.
	NIBP			
	CO2			
	Resp			
Archives Password Setup		On, Off	Off	Sets whether a password is required for entering the Archives Main menu.
Patient Info. Export Setup		On, Off	Off	Sets whether a prompt is provided when exporting the animal information.
Modify Password		0 to 32 characters	/	The characters are included in the keyboard. Restoring factory default configurations does not change this setting.

18 Battery

18.1 Battery Introduction

The equipment is designed to operate on battery power when external power supply is not available. The battery is charged whenever the equipment is connected to AC mains, regardless of whether or not the equipment is currently turned on. In case of power failure, the equipment will automatically run power from internal batteries. So we recommend you always connect the equipment to the AC mains with a battery installed.

The equipment is configured with one smart lithium ion battery which is free of maintenance.

On-screen battery symbol and corresponding power bars indicate the current battery charge status:

- Five bars () and four bars () indicate that the battery power is sufficient.
- Three bars () and two bars () indicate that the battery power is low and needs to be charged.
- 0 bar () indicates that the battery power is low and needs to be charged immediately.
-  indicates that no battery is installed, or the battery has a failure.

18.2 Battery Safety Information

WARNING

- **The batteries should be charged in this equipment or only.**
 - **Keep the batteries out of children's reach.**
 - **Use only specified batteries.**
-

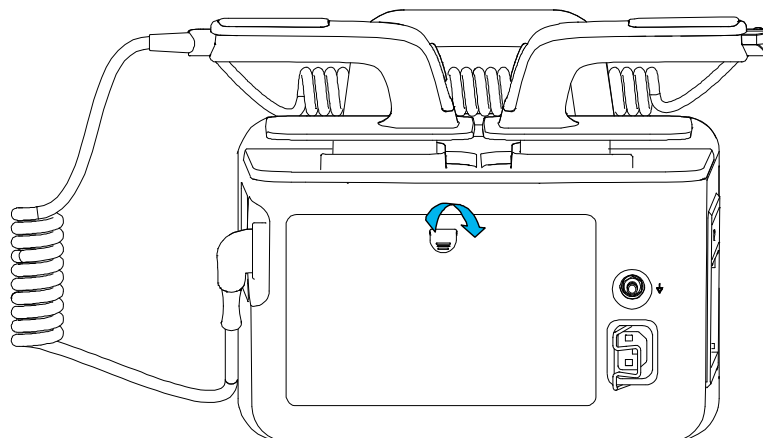
NOTE

- **Always connect the equipment to AC mains whenever it is possible.**
 - **Always install a fully charged battery in the equipment.**
 - **After long term use, the power capacity indicated by the battery symbol may be different from the actual capacity. Always observe the alarm information displayed on the screen.**
 - **Remove the battery before transporting the equipment or if the equipment will not be used for a long time.**
-

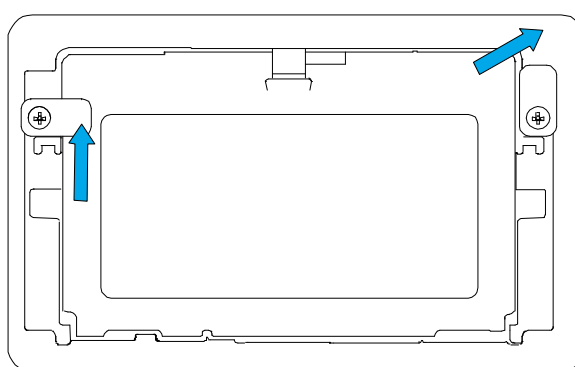
18.3 Installing the Battery

To install the battery:

1. Place the equipment on the worktable.
2. Open the battery door as indicated below.



3. Turn the latch aside.



4. Insert the battery into the battery compartment with the battery terminal inwards.
5. Turn the latch back to the middle.
6. Close the battery door.

18.4 Battery Alarms

18.4.1 No Battery Alarm

You can configure the status of status indicator when no battery is installed from the Configuration Main menu.

1. Press the Main Menu button on the front panel of the equipment.
2. Select [**Others >>**] → [**Configuration >>**] → enter the required password.
3. Select [**Alarm Setup**].
4. Set [**No Battery**].
 - ◆ [**Status Indicator On**]: when the battery is not installed, a message “**No Battery**” is presented and the status indicator flashes in red.
 - ◆ [**Status Indicator Off**]: when the battery is not installed, a message “**No Battery**” is presented but the status indicator is not illuminated.

18.4.2 Low Battery Alarm

When the equipment operates on battery and the battery charge is indicated with three power bars or less, a message “**The battery capacity is less than 60%**” will be displayed. When the battery symbol displayed as , a technical alarm “**Low Battery**” will be triggered. In this case, connect the equipment to the AC mains immediately.

If the battery is almost depleted, a prompt “**Battery depleted!**” pops up. In the Monitor mode, and Manual Defib mode, additional alarm lights and alarm tones are provided. In this case, take appropriate actions immediately.

This prompt will not disappear until the equipment is connected to the external power supply. The equipment automatically shuts down if no action is taken within a period of about 3 minutes.

NOTE

- **The alarm “Low Battery” means that the battery is beginning to weaken, you should connect the equipment to the AC mains immediately. At least 20 minutes of monitoring and six 360J shocks can be performed when “Low Battery” is triggered.**
-

18.4.3 Battery Aged Alarm

If the battery runtime is significantly shorter than the specification, a low level technological alarm “**Battery Aged**” will be presented. We recommend you to replace with a new one.

18.4.4 Battery Error Alarm

In the situation that the battery has a failure, a high level technological alarm “**Battery Err**” will be presented. In this case, replace the battery or contact your service personnel.

18.5 Conditioning the Battery

The performance of batteries deteriorates over time. To extend the battery service life, you are recommended to condition the batteries every three months.

If the battery is not conditioned for a prolonged time, its charge indication may not be accurate and you may wrongly evaluate the remaining battery runtime.

To condition a battery:

1. Disconnect the equipment from the animal and stop all performances.
2. Allow the battery to be charged uninterruptedly till it is fully charged.
3. Allow the equipment to operate on the battery until the battery is completely depleted and the equipment automatically shuts down.
4. Fully charge the battery again for use or charge it to 40 to 60% for storage.

NOTE

- **Do not use the equipment during battery conditioning.**
 - **Do not interrupt battery conditioning.**
-

18.6 Checking Battery Performance

The performance of a rechargeable battery deteriorates over time. To extend the battery service life, you are recommended to check the battery performance every three months or if you doubt that the battery may fail.

See steps 1 to 3 of *18.5 Conditioning the Battery* to check battery performance. The operating time of the batteries reflects their performance directly. If the operating time of a battery is noticeably shorter than that stated in the specifications, the battery may reach its service life or malfunction. If the battery performance meets the requirement, fully charge the battery again for use or charge it to 40 – 60% for storage.

NOTE

- **Life expectancy of a battery depends on how frequent and how long it is used. When properly used, the lithiumion battery has a useful life of approximately two years. If improperly used, its life expectancy can be shorten. We recommend replacing lithium-ion batteries every two years.**
 - **Battery operating time depends on the device configuration and operation. For example, measuring NIBP repeatedly will shorten the battery operating time.**
-

18.7 Charging the Battery

The battery can be charged in this equipment only when the external power supply is connected. Batteries charge at a lower rate with the equipment turned on.

18.8 Storing Batteries

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

Condition the stored batteries every three months. For details, refer to *18.5 Conditioning the Battery*.

NOTE

- **Remove the battery from the equipment if the equipment is not used for a prolonged time (for example, several weeks). Otherwise the battery may overdischarge.**
 - **Storing batteries at high temperature for an extended period of time will significantly shorten their life expectancy.**
 - **The battery storage temperature is between -20°C (-4°F) and 60°C (140°F). Storing batteries in a cool place can slow the aging process. Ideally the batteries should be stored at 15 °C.**
-

18.9 Recycling the Batteries

A battery should be discarded if there are visual signs of damage, the battery fails, the battery aged alarm is presented, or the batteries has been used for more than two years. Properly dispose of batteries according to local regulations.

WARNING

- **Do not disassemble, puncture or incinerate batteries. Do not short the battery terminals. They may ignite, explode, or leak, causing personal injury.**
-

19 Care and Cleaning

19.1 Care and Cleaning Introduction

In this chapter we only describe cleaning and disinfection of the equipment and certain accessories. For the cleaning and disinfection of other reusable accessories, refer to their instructions for use.

19.2 Care and Cleaning Safety Information

WARNING

- Use only Mindray Animal Medical approved cleaners, disinfectants and methods listed in this chapter to clean or disinfect your equipment or accessories. Warranty does not cover damage caused by unapproved substances or methods.
 - Do not mix disinfecting solutions, as hazardous gases may result.
 - 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.
 - Be sure to turn off the system and disconnect all power cables from the outlets before cleaning the equipment.
 - The responsible hospital or institution shall carry out all cleaning and disinfection procedures specified in this chapter.
-

CAUTION

- Never immerse any part of the equipment or accessories in liquids or allow liquid to enter the interior.
 - Any contact of cleaners or disinfectants with connectors or metal parts may cause corrosion.
 - Do not pour or spray any liquid directly on the equipment or accessories or permit fluid to seep into connections or openings.
 - If you spill liquid on the equipment or accessories, disconnect the power supply, dry the equipment, and contact your service personnel.
 - Never use abrasive materials (such as steel wool or silver polish), or erosive cleaners (such as acetone or acetone-based cleaners).
 - Dilute and use the cleaners or disinfectants according to the manufacturer's instructions.
 - Check the equipment after cleaning and disinfecting. If there is any sign of damage, remove it from use.
-

19.3 Cleaning the Equipment

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

To clean the equipment, follow this procedure:

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

19.4 Disinfecting the Equipment

Disinfect the equipment as required in your hospital's servicing schedule. Cleaning the equipment before disinfecting is recommended. Always dilute and use disinfectants according to the manufacturer's instructions. The following table lists approved disinfectants:

Product Name	Product Type	Manufacturer
Alpet® D2 Surface Sanitizing Wipes	Wipes	BEST SANITIZERS INC™.
CIDEX® OPA	Liquid	Gilag GmbH International Advanced Sterilization products
Clorox Dispatch® Hospital Cleaner Disinfectant Towels with Bleach	Wipes	Clorox professional products company
Clorox Healthcare® Bleach Germicidal Wipes	Wipes	Clorox professional products company
Clorox Healthcare® Hydrogen Peroxide Cleaner Disinfectant Wipes	Wipes	Clorox professional products company
Diversey Oxivir® TB Wipes	Wipes	Diversey Inc
Metrex CaviCide1™	Liquid, spray	METERX® RESEARCH
Metrex CaviWipes™	Wipes	METERX® RESEARCH
PDI Sani-Cloth® AF3 Germicidal Disposable Wipe	Wipes	PDI Inc.
PDI Sani-Cloth® Bleach Germicidal Disposable Wipe	Wipes	PDI Inc.
PDI Sani-Cloth® HB Germicidal Disposable Wipe	Wipes	PDI Inc.
PDI Sani-Cloth® Plus Germicidal Disposable Cloth	Wipes	PDI Inc.
PDI Super Sani-Cloth® Germicidal Disposable Wipe	Wipes	PDI Inc.
VIRAGUARD® Hospital Surface Disinfectant Towelette	Wipes	VERIDIEN corporation
Virex® II 256 (1:256)	Liquid	Diversey Inc
Virex® TB	Liquid, spray	Diversey Inc
JIAN ZHI SU Disinfectant Tablets	Tablet	Beijing ChangJiangMai Medical Science Technology Co. Ltd
JIAN ZHI SU Surface Disinfectant Spray	Liquid, spray	Beijing ChangJiangMai Medical Science Technology Co. Ltd
JIAN ZHI SU Disinfectant, Double-chain Quaternary Ammonium	Liquid	Beijing ChangJiangMai Medical Science Technology Co. Ltd
DIAN'ERKANG Surface Wipes	Wipes	Shanghai Likang Disinfectant Hi-Tech Co., Ltd
DIAN'ERKANG Surface Disinfectant	Liquid	Shanghai Likang Disinfectant Hi-Tech Co., Ltd
DIAN'ERKANG Disinfectant Spray	Liquid, spray	Shanghai Likang Disinfectant Hi-Tech Co., Ltd

Product Name	Product Type	Manufacturer
Clinell® Universal Wipes	Wipes	GAMA Healthcare Ltd
Clinell® Sporidical Wipes	Wipes	GAMA Healthcare Ltd
Tristel Duo™	Liquid, foam	Tristel solutions Limited
Tristel Jet	Liquid, spray	Tristel solutions Limited
Tristel Fuse For Surfaces, 196ppm	Liquid	Tristel solutions Limited
Surfanios Premium, 0.25%	Liquid	ANIOS LABORATORIES
Surfa 'safe	Liquid, spray	ANIOS LABORATORIES
Wip' Anios premium	Wipes	ANIOS LABORATORIES
Aniosurf ND premium, 0.25%	Liquid	ANIOS LABORATORIES
Mikrobac® Tissues	Wipes	BODE Chemie GmbH
Cleanisept® Wipes	Wipes	Dr. Schumacher GmbH
mikrozid® PAA Wipes	Wipes	Schülke & Mayr GmbH
mikrozid® Sensitive Wipes	Wipes	Schülke & Mayr GmbH
Ecolab Incidin® OxyWipe S	Wipes	Ecolab Deutschland GmbH
Glutaraldehyde, 2%	Liquid	/
Ethanol, 70%	Liquid	/
Isopropanol, 70%	Liquid	/
Sodium hypochlorite bleach, 0.5%	Liquid	/
Hydrogen peroxide, 3%	Liquid	/
Rely+On™ Virkon® High Level surface Disinfectant, 1%	Powder	Antec International Ltd
1-Propanol, 50%	Liquid	/
Descosept® forte	Liquid	Dr. Schumacher GmbH
Descosept® AF	Liquid	Dr. Schumacher GmbH
Dismozon® plus, 0.4%	Powder	BODE Chemie GmbH
mikrozid® AF Wipes	Wipes	Schülke & Mayr GmbH
Terralin® Liquid	Liquid	Schülke & Mayr GmbH
Perform® Classic Concentrate OXY, 0.5%	Powder	Schülke & Mayr GmbH

19.5 Cleaning and Disinfecting the Accessories

For the NIBP air hose, SpO₂ cable, external paddles and ECG pouch, you should clean and disinfect them using the cleaners and disinfectants and methods listed in this section. For other accessories, you should consult the instructions delivered with the accessories.

CAUTION

- **Fluids entering the NIBP air hose can damage the equipment. When cleaning 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 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.**

19.5.1 Cleaning the Accessories

You should clean the accessories (NIBP air hose, SpO₂ cable, external paddles and ECG pouch) on a regular basis. Before cleaning the accessories, consult your hospital's regulations for cleaning the accessories.

To clean the accessories, follow this procedure:

1. Clean the accessories with a soft cloth moistened with water or ethanol (70%). You can also wash the ECG pouch by hand with mild soap or washing powder.
2. Wipe off all the cleaner residue with a dry cloth.
3. Allow the accessories to air dry.

19.5.2 Disinfecting the Accessories

We recommend that the accessories (NIBP air hose, SpO₂ cable and external paddles) should be disinfected only when necessary as determined by your hospital's policy. Disinfecting the ECG pouch is not need. Cleaning the accessories before disinfecting is recommended.

19.5.2.1 Disinfectants for the NIBP Air Hose

The following table lists approved disinfectants for the NIBP air hoses:

Product Name	Product Type	Manufacturer
Alpet® D2 Surface Sanitizing Wipes	Wipes	BEST SANITIZERS INC™.
CIDEX® OPA	Liquid	Gilag GmbH International Advanced Sterilization products
Clorox Dispatch® Hospital Cleaner Disinfectant Towels with Bleach	Wipes	Clorox professional products company
Metrex CaviCide1™	Liquid, spray	METERX® RESEARCH
Metrex CaviWipes™	Wipes	METERX® RESEARCH
PDI Sani-Cloth® AF3 Germicidal Disposable Wipe	Wipes	PDI Inc.
PDI Sani-Cloth® Plus Germicidal Disposable Wipe	Wipes	PDI Inc.

Product Name	Product Type	Manufacturer
PDI Super Sani-Cloth® Germicidal Disposable Wipe	Wipes	PDI Inc.
VIRAGUARD® Hospital Surface Disinfectant Towelette	Wipes	VERIDIEN corporation
Virex® TB	Liquid, spray	Diversey Inc
Clinell® Universal Wipes	Wipes	GAMA Healthcare Ltd
Surfa 'safe	Liquid, spray	ANIOS LABORATORIES
Aniosurf ND premium, 0.25%	Liquid	ANIOS LABORATORIES
mikrozyd® Tissues	Wipes	Schülke & Mayr GmbH
Glutaraldehyde, 2%	Liquid	/
Ethanol, 70%	Liquid	/
Isopropanol, 70%	Liquid	/
Rely+On™ Virkon® High Level surface Disinfectant, 1%	Powder	Antec International Ltd
1-Propanol, 50%	Liquid	/

19.5.2.2 Disinfectants for the SpO₂ Cable

The following table lists approved disinfectants for the SpO₂ cables:

Product Name	Product Type	Manufacturer
CIDEX® OPA	Liquid	Gilag GmbH International Advanced Sterilization products
Clorox Dispatch® Hospital Cleaner Disinfectant Towels with Bleach	Wipes	Clorox professional products company
Clorox Healthcare® Bleach Germicidal Wipes	Wipes	Clorox professional products company
Clorox Healthcare® Hydrogen Peroxide Cleaner Disinfectant Wipes	Wipes	Clorox professional products company
Diversey Oxivir® TB Wipes	Wipes	Diversey Inc
PDI Super Sani-Cloth® Germicidal Disposable Wipe	Wipes	PDI Inc.
VIRAGUARD® Hospital Surface Disinfectant Towelette	Wipes	VERIDIEN corporation
Virex® TB	Liquid, spray	Diversey Inc
Glutaraldehyde, 2%	Liquid	/
Ethanol, 70%	Liquid	/
Isopropanol, 70%	Liquid	/
Sodium hypochlorite bleach, 0.5%	Liquid	/
Hydrogen peroxide, 3%	Liquid	/

Product Name	Product Type	Manufacturer
Rely+On™ Virkon® High Level surface Disinfectant, 1%	Powder	Antec International Ltd
1-Propanol, 50%	Liquid	/

19.5.2.3 Disinfectants for External Paddles

The following table lists approved disinfectants for the external paddles:

Product Name	Product Type	Manufacturer
Alpet® D2 Surface Sanitizing Wipes	Wipes	BEST SANITIZERS INC™.
CIDEX® OPA	Liquid	Gilag GmbH International Advanced Sterilization products
Metrex CaviCide1™	Liquid, spray	METERX® RESEARCH
Metrex CaviWipes™	Wipes	METERX® RESEARCH
PDI Sani-Cloth® AF3 Germicidal Disposable Wipe	Wipes	PDI Inc.
PDI Sani-Cloth® Bleach Germicidal Disposable Wipe	Wipes	PDI Inc.
PDI Sani-Cloth® HB Germicidal Disposable Wipe	Wipes	PDI Inc.
PDI Sani-Cloth® Plus Germicidal Disposable Cloth	Wipes	PDI Inc.
PDI Super Sani-Cloth® Germicidal Disposable Wipe	Wipes	PDI Inc.
VIRAGUARD® Hospital Surface Disinfectant Towelette	Wipes	VERIDIEN corporation
Virex® II 256 (1:256)	Liquid	Diversey Inc
Virex® TB	Liquid, spray	Diversey Inc
Clinell® Universal Wipes	Wipes	GAMA Healthcare Ltd
mikrozyd® Sensitive Wipes	Wipes	Schülke & Mayr GmbH
Glutaraldehyde, 2%	Liquid	/
Ethanol, 70%	Liquid	/
Isopropanol, 70%	Liquid	/
1-Propanol, 50%	Liquid	/

19.6 Sterilization

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

19.7 Cleaning the Thermal Print Head

Dirty print head deteriorates printing quality. Check the printout to ensure the printing is legible and dark. Light printing may indicate a dirty print head.

To clean the thermal print head, follow this procedure:

1. Take measures against the static electricity, such as the wrist strap.
2. Open the recorder door and remove the recording paper.
3. Gently wipe the print head with cotton swabs dampened with ethanol to remove the dust and foreign particles.
4. Wipe off excess moisture with dry cotton swabs.
5. Allow the print head air dry.
6. Reload the recording paper and close the recorder door.

CAUTION

- **Do not use anything that may destroy the thermal element.**
 - **Do not add unnecessary force to the thermal head.**
 - **The thermal print head gets hot when recording. Do not clean the print head immediately after recording.**
-

19.8 Impact of Improper Cleaning

Using cleaners other than those recommended may have the following impact:

- Product discoloration
- Metal part corrosion
- Brittle and breaking wires, connectors, and equipment housing
- Reduced cable and leadwire life
- Overall system performance degradation
- Equipment malfunction or failure

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20 Maintenance

20.1 Maintenance Introduction

The equipment must be maintained to be ready for immediate use. To ensure proper performance of the equipment, you should strictly perform the maintenance in this chapter. After the equipment has been used for 12 months, or whenever the equipment is repaired or upgraded, a thorough inspection should be performed to ensure the reliability.

Make sure to clean and disinfect the equipment before any test and maintenance.

In case of any damage or abnormality, remove the equipment from use. Contact the hospital's biomedical engineers or your service personnel immediately.

20.2 Maintenance Safety Information

WARNING

- **Failure for the responsible individual, hospital or institution employing this equipment to implement a satisfactory maintenance schedule may cause undue equipment failure and possible health hazards.**
 - **The safety checks or maintenance involving any disassembly of the equipment should be performed by professional servicing personnel. Otherwise, undue equipment failure and possible health hazards could result.**
 - **If you find a problem with any of the equipment, contact your service personnel or the manufacturer.**
 - **No modification of this equipment is allowed.**
 - **The service personnel must be properly qualified and thoroughly familiar with the operation of the equipment.**
 - **Do not touch any connected electrode pads or external paddles with hands during auto test and manual test. Otherwise, electric shock could result.**
 - **Do not open the equipment housings. All servicing and future upgrades must be carried out by the service personnel.**
-

20.3 Routine Maintenance

The routine maintenance should be periodically performed in conjunction with the assurance program of the hospital where the equipment is used. The following test are recommended:

Maintenance Item	Recommend Frequency	Test Item
Shift check	Every shift, or at least every day.	For details, consult your institution or refer to <i>F Defibrillator Shift Checklist</i> .

Maintenance Item	Recommend Frequency	Test Item
Auto test	Automatically, whenever the equipment is turned on.	Performs tests of the main control board, therapy module, monitor module, batteries.
	Every day, 3:00 am by default	Performs tests of the main control board, therapy module, monitor module, batteries, 1 J internal discharge, 10 J internal charge/external discharge* (configurable by selecting [Test Setup] through the Configuration Main menu).
	Every week	Performs tests of the main control board, therapy module, monitor module, batteries, 1 J internal discharge, 10 J internal charge/external discharge* (configurable by selecting [Test Setup] through the Configuration Main menu), 200 J and 360 J internal discharges.
Manual test	Once a quarter	Performs tests of the main control board, therapy module, monitor module, battery, 1 J internal discharge, 200 J internal charge/external discharge*, 360 J internal charge/external discharge*, external paddles connection, all buttons on the front panel, the audio, display, animal contact indicator and status indicator.
* If the pads cable is connected with 50 Ω test load or external paddles are placed in the paddle tray, an external discharge is performed. Otherwise, an internal discharge is performed.		

External paddles and pads cable are critical parts for defibrillation but damageable. It is recommended to inspect the appearance and performance of these parts every day and replace them every 3 years.

The ECG cables are critical parts for data acquisition and analysis but damageable. It is recommended to inspect the appearance and performance of the cable every day as described in *F Defibrillator Shift Checklist*

20.3.1 Auto Test

The equipment with AC mains or battery connected carries out auto test at the configured time even when turned off to check the equipment's operational performance and alert the operator if a problem exists.

The auto test is initiated at 3:00 am every day by default. You can change the initiated time by selecting **[Test Setup]** through the Configuration Main menu.

The equipment displays no information on the screen during the auto test.

You can check the auto test result according to the following table:

From	Pass	Fail
Status indicator and alarms	- The status indicator is illuminated in green. - No alarms are displayed on the screen.	- The status indicator flashes in red. - The alarm "Last Auto Test Failed" is displayed.
[Test Summary] menu	From the [Test Summary] menu, select the [History] soft key to check the test result. For details, refer to 20.3.3 <i>Checking the Test Results</i> .	

It is recommended to perform the manual test if the auto test failed. For details, refer to 20.3.2 *Manual Test*.

When the auto test is completed, an auto-test report is saved automatically. You can select **[Record Setup]** through the Configuration Main menu to choose whether to automatically record the auto-test report or not when the auto test is completed.

NOTE

- If turned off, the auto test is performed only when AC mains or battery is connected.
- The auto test simulates the discharge test through impedances in the paddle tray. The auto test passes only when external paddles properly contact the metal parts of the paddle tray.

- Thoroughly clean the external paddles and properly place them in the paddle tray after each use. Otherwise, the auto test may fail or damaged external paddles may result.
- The auto test reduces the battery power. If the equipment is not connected to the AC mains immediately, low battery may result.
- Before the auto test, check that the equipment is connected to the AC mains with a battery installed, and external paddles are properly placed in the paddle tray or the equipment is connected with the pads cable and 50 Ω test load. If the pads cable is not connected with the 50 Ω test load, the message “Test load not connected with cable” appears when the auto test passes. This means that the equipment only passes the internal discharge test, but not pass the external discharge test connected with the test load.

20.3.2 Manual Test

If the auto test fails, you should check the equipment connection and perform the manual test to clear the faults.

Each time when the equipment is turned on, the time to manual test is checked automatically. The equipment can be configured to give a “**Manual Test Due**” message to remind performing the manual test. You can enable it by selecting [**Test Setup**] through the Configuration Main menu.

You can start the manual test while operating in the Monitor, or Manual Defib. Animal monitoring and therapy automatically end when you start the manual test.

You can perform all test items of the manual test at one time.

1. Press the Main Menu button on the front panel
2. Select [**User Test >>**] → [**Yes**].
3. Perform operations following the displayed instructions.

The message “**Test completed**” will be presented when selected tests have been finished. Then you can select the [**Record**] soft key to record the test result.

If the manual test fails, the status indicator will flash in red and the alarm “**Last Manual Test Failed**” will be displayed when the equipment is restarted.

WARNING

- Do not perform the manual test when an animal is connected to the equipment.
-

NOTE

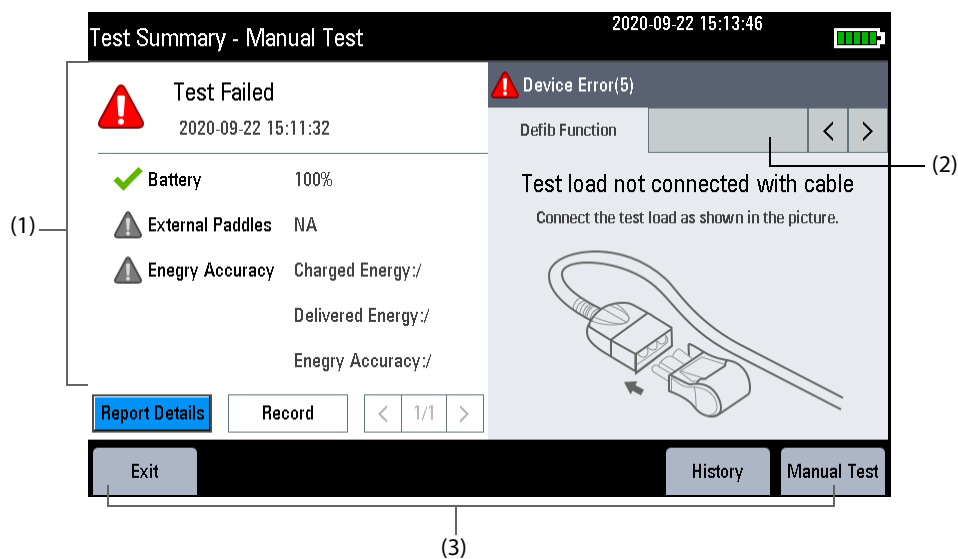
- Before the manual test or after each use, thoroughly clean the external paddles and properly place them in the paddle tray. The manual test passes only when external paddles properly contact the metal parts of the paddle tray.
 - If the impedance value indicated by animal contact indicator changes greatly, check that external paddles and metal parts of the paddle tray are clean.
 - Install at least one battery and properly place the external paddles in the paddle tray or connect the pads cable and 50 Ω test load. Otherwise the manual test will fail.
 - The power switch is not tested during the buttons test. If you press and hold the power switch for more than 3 seconds, the equipment will be turned off.
 - The tested buttons are indicated in green during the buttons test.
-

20.3.3 Checking the Test Results

When the status indicator flashes in red, and the alarm “**Last Auto Test Failed**” or “**Last Manual Test Failed**” is displayed, the last test fails. In this case, you should check the test result and clear the faults.

20.3.3.1 Entering the Test Summary Menu

To enter the **[Test Summary]** menu, press the Test Report () button on the front panel and select **[Yes]**.



- (1) Last test summary
The test summary displays tests results of battery, external paddles and energy accuracy by default. You can customize the test items displayed by selecting **[Test Setup]** through the Configuration Main menu.
 - ◆ Select **[Report Details]** to view more details about last test result.
 - ◆ Select **[Record]** to record the last test summary.
 - ◆ Select  to turn the page.
- (2) Test fault tab
The corresponding page displays the detailed fault item, and gives corrective instructions with text and picture.
Select  to turn the page.
- (3) Soft key
 - ◆ Select **[Exit]** to exist the **[Test Summary]** menu.
 - ◆ Select **[History]** to view the historical test results.
 - ◆ Select **[Manual Test]** to starts a manual test after last test faults are cleared.

20.3.3.2 Viewing Last Test Result

1. Enter the **[Test Summary]** menu.
2. View the last test summary. Rotate the Navigation knob to move the cursor on , press the knob and rotate it to turn the page.
3. If necessary, select **[Report Details]** to view more details.

NOTE

- **If the routine test item (external discharge) of the auto test, or the energy delivery test item (external discharge) of the manual test is passed, the delivered energy and accuracy are displayed, but results are for your reference only.**

20.3.3.3 Clearing Last Test Faults

If the last test fails, you should clear the fault item and perform a successful manual test.

1. Enter the **[Test Summary]** menu.
2. Rotate the Navigation knob to move the cursor on the desired fault tab under **[Device Error]**, and press the knob.

3. If necessary, rotate the Navigation knob to move the cursor on , press the knob and rotate it to display more test fault tabs.
4. Clear the faults following the displayed instructions.
5. Select [**Manual Test**], and perform the manual test.

20.3.3.4 Viewing Historical Test Results

1. Enter the [**Test Summary**] menu.
2. Select [**History**].

To print out more than one test reports by the recorder at a time, you can select [**Record**], then select the desired tests from the report list and press the Navigation knob.

3. If necessary, select one desired test for more test details.

20.4 Function Checks

The function checks enhance the auto test that helps the equipment to ensure the readiness. It is recommended to perform the function checks once a year. The function checks, except the recorder check, should be performed by Mindray Animal Medical-qualified service personnel only.

20.4.1 Recorder Check

1. Press the Monitor Mode button.
2. Start recording to check that the recorder works properly and the printout is legible and correct.
3. Simulate errors, such as removing the paper roll and losing the latch, check that correct information is displayed in the prompt area. The recorder works properly after the faults are cleared.

20.4.2 ECG Cable Test

Test tool: ECG simulator

1. Press the Monitor Mode button.
2. Connect the ECG cable to the equipment, and connect the electrodes to the simulator.
3. Turn on the simulator and select a normal ECG rhythm.
4. Wait for a few seconds. Check that the waveform is displayed normally and no lead-off alarms displayed in the alarm information area.

20.4.3 Manual Defibrillation Test

Test tools: defibrillator/pacer analyzer

Charge/Discharge

1. Remove the batteries from the equipment, and connect the equipment with AC mains.
2. Press the Defib Mode button.
3. Connect the electrode pads/external paddles to the equipment, and place the electrode pads/external paddles on the defibrillator/pacer analyzer.
4. Press the Main Menu button on the front panel, and then select [**Others >>**] → [**Configuration >>**] → enter the required password.
5. Select [**Record Setup**] and set [**Shock Event**] to [**On**].
6. Set the analyzer to Energy Measurement mode. In this case, the energy value displayed should be 0 or blank.
7. Select the energy level to 1J.
8. Charge or discharge the equipment, and check that the energies measured by the analyzer meet the following accuracy:

Selected Energy (J)	Measured Value (J)
1	0 to 3
100	85 to 115
360	306 to 414

- Set the energy to 100J and 360J respectively, and repeat step 8.
- Disconnect the equipment from the AC mains, and connect the equipment with fully charged battery.
- Press the Defib Mode button.
- Repeat steps 3 to 9, and check that the equipment records the shock events automatically and correctly.

Energy Disarming

- Disconnect the equipment from the AC mains, and connect the equipment with fully charged battery.
- Press the Defib Mode button.
- Connect the electrode pads/external paddles to the equipment, and place the electrode pads/external paddles on the defibrillator/pacer analyzer.
- Set the analyzer to Energy Measurement mode, and check that the energy value is 0 or blank.
- Select the energy level to 360J.
- Charge the equipment, and check that the charge tone is issued during charging.
- Press the **[Disarm]** soft key to discharge the energy internally.
- Check that a prompt **"Charge Removed"** appears on the screen and the charge done tone stops, the value measured by the analyzer is 0J or blank.
- Press the Main Menu button on the front panel, and then select **[Others >>]** → **[Configuration >>]** → enter the required password.
- Select **[Manual Defib Setup]** and set **[Time to Auto Disarm]** to **[60s]**.
- Set the analyzer to Energy Measurement mode, and check that the energy value is 0 or blank.
- Select the energy level to 360J.
- Charge the equipment. After charging is completed, wait 60 seconds to check that the prompt **"Charge Removed"** appears on the equipment and the energy measured by the analyzer is 0J or blank.

20.5 Preventive Maintenance

The preventive maintenance should be performed every year by Mindray Animal Medical-qualified service personnel only. The preventive tests includes tests performed in the installation mode, Resp test, SpO₂ test, and electrical safety tests. For details about the preventive tests, refer to the relevant service manual.

20.5.1 Performing Tests in the Installation Mode

You can enter the installation mode while operating in the Monitor, or Manual Defib. Animal monitoring and therapy automatically end when you enter the installation mode.

- Press the Main Menu button on the front panel.
- Select **[Others >>]** → **[Maintenance >>]** → **[Installation Mode >>]** → enter the required password.
- Select the desired item and perform the test as recommended in the following table.

Test Item	Description	Recommended Frequency
Maintain NIBP	Performs the NIBP leakage test and NIBP accuracy test.	Every year, or whenever you doubt the NIBP reading
Maintain CO ₂	Calibrates the CO ₂ module.	Every year, or when the readings go far beyond the range.
Version	Displays the equipment information.	/

Test Item	Description	Recommended Frequency
Format Data Card	Formats the storage card.	Every year, data in the storage card is useless, or the card has a failure.
Watchdog Test	Checks if the equipment can be normally restarted.	Every year.
Modify Password	Modifies the password for entering the installation mode.	/

20.5.2 Electrical Safety Tests

For details, refer to *E Electrical Safety Inspection*.

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21 Accessories

WARNING

- Use accessories specified in this chapter. Using other accessories may cause damage to the equipment or not meet the claimed specifications.
- Single-use accessories are not designed to be reused. Reuse may cause a risk of contamination and affect the measurement accuracy.
- Check the accessories and their packages for any sign of damage. Do not use them if any damage is detected.

NOTE

- The ECG accessories should be placed in the ECG pouch after each use.
- At the end of its service life, the equipment, as well as its accessories, must be disposed of in compliance with the guidelines regulating the disposal of such products to avoid contaminating the environment.
- When using the accessories, consider the accessories' operating temperature. Refer to corresponding accessory's instruction for use for details.

21.1 SpO₂ Accessories

Wavelength emitted by the sensors is between 600 nm and 1000 nm. The maximum photic output consumption of the sensor is less than 18 mW.

The information about the wavelength range and maximum photic output consumption can be especially useful to clinicians, for example, when photodynamic therapy is performed.

Model	Description	Applicable to
562A	7-pin, Mindray	All

21.2 NIBP Accessories

Model	Description	Applicable to
CM1901	Reusable NIBP hose	Animal
CM1903	Reusable NIBP hose	Animal

21.3 CO₂ Accessories

Model	Description	Applicable to
GA3501	Reusable CO ₂ adapter	/
MVIIHL	Disposable airway sampling line, long, humidified	Animal
MVAIHL	Disposable airway sampling line, long, humidified	Animal
MVAIL	Disposable airway sampling line, humidified	Animal
MVIIH	Disposable airway sampling line, humidified	Animal
MVAIH	Disposable airway sampling line, humidified	Animal
MVAI	Disposable airway sampling line	Animal

21.4 Therapy Accessories

Model	Part No.	Description	Applicable to
MR6601	125-000135-00	Separable external paddles, Reusable	Animal
MR6602	040-006083-00	Integrative external paddles, Reusable	Animal
MR6701	115-006578-00	Reusable pads cable with 50Ω test load	Animal

21.5 Other Accessories

Model	Description	Applicable to
LI24I002H	Li-ion battery 14.4V 5600mAh LI24I002H	Animal

21.6 Miscellaneous Accessories

Following accessories can be used with the equipment. Contact our company to purchase them if you need.

Model	Description	Length	Applicable to
EL6302A	ECG leadwires, 3-lead, IEC, clip, Vet	0.6 m	Animal
EL6301A	ECG leadwires, 3-lead, AHA, clip, Vet	0.6 m	Animal
EL6303A	ECG leadwires, 3-lead, AHA, clip, long, Vet	1 m	Animal
EL6304A	ECG leadwires, 3-lead, IEC, clip, long, Vet	1 m	Animal
EL6301B	ECG leadwires, 3-lead, AHA, snap, long, Vet	1 m	Animal
EL6302B	ECG leadwires, 3-lead, IEC, snap, long, Vet	1 m	Animal
EL6503A	ECG leadwires, 5-lead, AHA, clip, long, Vet	1m to 1.4m	Animal

Model	Description	Length	Applicable to
EL6504A	ECG leadwires, 5-lead, IEC, clip, long, Vet	1m to 1.4m	Animal
EL6501B	ECG leadwires, 5-lead, AHA, snap, Vet	1m to 1.4m	Animal
EL6502B	ECG leadwires, 5-lead, IEC, snap, Vet	1m to 1.4m	Animal
EL6502A	ECG leadwires, 5-lead, IEC, clip, Vet	0.6m to 1m	Animal
EL6501A	ECG leadwires, 5-lead, AHA, clip, Vet	0.6m to 1m	Animal

Model	Description	Type
EV6201	12Pin 3/5-Lead ECG Host Cable, Vet	Reusable

Model	Description	Type
551B	Veterinary SpO2 Sensor (Reusable, 2-Clips)	Reusable

Model	Description	Type
MR6501	Internal Paddles	Reusable
MR6502		
MR6503		

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A Specifications

A.1 General Specifications

A.1.1 Safety Specifications

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

Type of protection against electrical shock	Class I, equipment energized from an external and internal electrical power source. If you suspect the integrity of the external protective earthing or the protective earthing wire, you should run the equipment on internal electrical power supply (battery).
Degree of protection against electric shock	Type BF defibrillation proof for CO ₂ monitoring and external defibrillation. Type CF defibrillation proof for ECG, Resp, SpO ₂ , NIBP and internal defibrillation
Mode of operation	Continuous
Degree of protection against harmful ingress of solid	IP4X
Degree of protection against harmful ingress of water	IPX4 (when running on battery) IPX2 (when running on AC power supply)
Degree of mobility	Portable

A.1.2 Physical Specifications

Size (Width × depth × height)	≤275 mm×205 mm×190 mm, excluding external paddles and handle
Maximum weight	≤5.3 kg, including a battery and external paddles

A.1.3 Display Specifications

Type	TFT Color LCD
Size	7 inch
Resolution	800×480 pixels
Viewed waveforms	4 at maximum
Wave viewing time	16s at maximum (ECG)

A.1.4 Audio Indicators

Speaker	Gives alarm tones (45 to 85 dB), key tones, QRS tones Supports PITCH TONE and multi-level tone modulation Alarm tones comply with IEC 60601-1-8
Audio signal	Alarm tone: ISO mode with frequency of 600 Hz QRS tone: short beep with frequency of 650 Hz Charge tone: long beep with frequency of 400 Hz Charge done tone: double beeps with frequency of 870 Hz Key tone: short beep with frequency of 1000 Hz

A.1.5 Interface Specifications

USB connector	Connects USB flash memory
RJ45 connector	Connects standard network cable.
Multifunctional connector	Connects a cable for analog output.

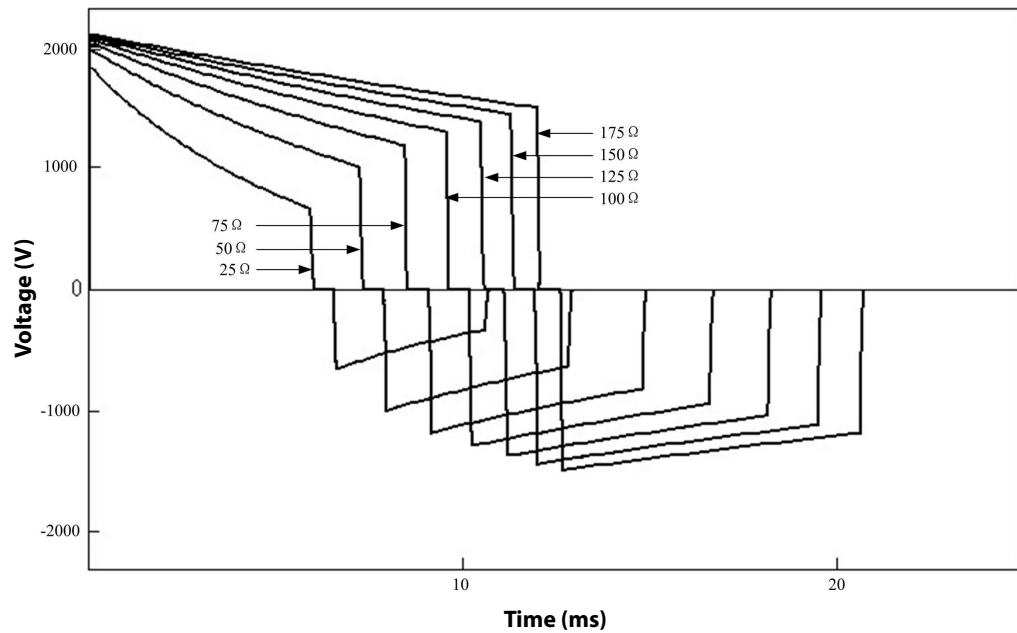
A.1.6 Signal Outputs Specifications

Multifunctional connector	
Standard	Meets the requirements of IEC 60601-1 for short-circuit protection and leakage current
ECG Analog Output (only ECG lead set)	
Bandwidth (-3 dB; reference frequency: 10 Hz)	Diagnostic mode: 0.05 to 150 Hz Monitor mode: 0.5 to 40 Hz Therapy mode: 1 to 20 Hz
Maximum QRS delay	25 ms (in diagnostic mode, and with Notch off)
Sensitivity	1 V/mV $\pm$ 5%
Alarm output	
Alarm signal sound pressure level range	45 db(A) to 85 db(A) within a range of one meter

A.2 Defibrillator Specifications

Standards	Meet standards of IEC 60601-2-4
Defibrillation mode	Manual defib,
Defibrillation waveform	Biphasic truncated exponential (BTE) waveform, auto-compensation according to animal impedance
Defibrillation electrodes	External paddles set coming with small paddles included, multifunction electrode pads and internal paddles
Controls and indicators on external paddles	Charge button, Shock buttons, Energy Select buttons, charge done indicator and animal contact indicator
Shockable rhythm analysis time	< 8s
Range of selected energy	
External defibrillation	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 30, 50, 70, 100, 150, 170, 200, 300, 360 J
Internal defibrillation	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 30, 50 J
Impedance range	
External defibrillation	25 to 300 Ω
Internal defibrillation	15 to 300 Ω

360 J defibrillation waveform into impedance of 25Ω, 50Ω, 75Ω, 100Ω, 125Ω, 150Ω, 175Ω



Impedance Selected energy	25Ω	50Ω	75Ω	100Ω	125Ω	150Ω	175Ω	Accuracy
1 J	1	1	1	0.9	0.9	0.9	0.8	±15% or ±2J, whichever is greater
2 J	2	2	2	1.9	1.8	1.7	1.6	
3 J	2.9	3	2.9	2.8	2.7	2.6	2.4	
4 J	3.9	4	3.9	3.7	3.6	3.4	3.2	
5 J	4.9	5	4.9	4.7	4.5	4.3	4.1	
6 J	5.8	6	5.8	5.6	5.3	5.1	4.9	
7 J	6.8	7	6.8	6.6	6.3	6	5.7	
8 J	7.8	8	7.8	7.4	7.1	6.8	6.5	
9 J	8.8	9	8.8	8.4	8	7.7	7.3	
10 J	9.7	10	9.7	9.3	8.9	8.5	8.1	
15 J	15	15	15	14	13	13	12	
20 J	20	20	20	19	18	17	16	
30 J	29	30	29	28	27	25	24	
50 J	49	50	49	47	45	43	41	
70 J	68	70	68	65	62	60	57	
100 J	97	100	97	93	89	85	81	
150 J	146	150	146	140	134	128	122	
170 J	166	170	166	159	151	145	138	
200 J	195	200	195	187	178	170	163	
300 J	292	300	292	280	267	255	244	
360 J	351	360	350	336	321	306	293	

Charge time (Note: at 20 ±5 °C of ambient temperature)						
	Manual Defib					
	Charge time		From initial power on (from cold start) to charge done		From initial power on (from fast startup mode) to charge done	
	200J	360J	200J	360J	200J	360J
With a new, fully charged battery	<3 s	<7 s	<13 s	<16 s	<6 s	<10 s
With a new, fully charged battery, depleted by 15 360 J discharges	<4 s	<8 s	<13 s	<16 s	<7 s	<11 s
With AC mains	<8 s	<14 s	<16 s	<21 s	<11 s	<17 s

NOTE

- The equipment startup time in the fast startup mode is less than 2s.

A.3 Monitor Specifications

A.3.1 ECG Specifications (from ECG Lead Set)

Standards	Meet standards of IEC 60601-2-27
Animal connection	3-lead ECG cable, 5-lead ECG cable
ECG inputs	3-lead ECG set: I, II, III 5-lead ECG set: I, II, III, aVR, aVL, aVF, V
Gain	2.5 mm/mV (×0.25), 5 mm/mV (×0.5), 10 mm/mV (×1), 20 mm/mV (×2), 40mm/mV (×4), Auto. Error less than ± 5%
Sweep speed	6.25mm/s, 12.5 mm/s, 25 mm/s, 50 mm/s. Error no more than ± 5%
Bandwidth (-3dB)	Diagnostic mode: 0.05 to 150 Hz Monitor mode: 0.5 to 40 Hz Therapy mode: 1 to 20 Hz
Common mode rejection	Diagnostic mode: >90 dB Monitor mode: >105 dB Therapy mode: >105 dB
Notch filter	50/60Hz, In Monitor and Therapy modes: notch filter turns on automatically In Diagnostic mode: notch filter is turned on manually
ECG signal range	±8mV (peak-to-peak value)
Calibration signal	1mV (peak-to-peak value) ±5%
Differential input impedance	≥5 MΩ
Electrode offset potential tolerance	±500mV
Defibrillation protection	Enduring 5000V (360 J) charge without data loss or corruption Baseline recovery time: <2.5 s (after defibrillation) Polarization recovery time: <10 s Defibrillation energy absorption: ≤10% (100Ω load)
ESU protection	Cut mode: 300 W Coagulate mode: 100 W Recovery time: ≤10 s In compliance with the requirements in clause 202.6.2.101 of IEC 60601-2-27
Pace Pulse	

Pace pulse markers	Pace pulses meeting the following conditions are labelled with a PACE marker: Amplitude: ± 2 to ± 700 mV Width: 0.1 to 2 ms Rise time: 10 to 100 μs
Pace pulse rejection	When tested in accordance with the IEC 60601-2-27: 201.12.1.101.13, the heart rate meter rejects all pulses meeting the following conditions. Amplitude: ± 2 to ± 700 mV Width: 0.1 to 2 ms Rise time: 10 to 100 μs Input slew rate: 2.2 V/s $\pm$ 15% RTI
HR	
Measurement range	Other: 15 to 350 bpm Feline: 15 to 350 bpm Canine: 15 to 350 bpm
Accuracy	$\pm 1\%$ or ± 1 bpm, which ever is greater
Resolution	1 bpm
Sensitivity	200 μ V (lead II)
Heart rate averaging	In compliance with the requirements in Clause 201.7.9.2.9.101 b) 3) 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 screen is updated every second.
Response time to heart rate change	Meets the requirements of IEC 60601-2-27: Clause 201.7.9.2.9.101 b) 5). From 80 to 120 bpm: less than 11 s From 80 to 40 bpm: less than 11 s
Time to alarm for tachycardia	Meets the requirements in Clause 201.7.9.2.9.101 b) 6) of IEC 60601-2-27. Waveform 4ah - range: <11 s 4a - range: <11 s 4ad - range: <11 s 4bh - range: <11 s 4b - range: <11 s 4bd - range: <11 s
Arrhythmia Analysis Classifications	Asystole, V-Fib/V-Tach, V-Tach, Vent. Brady, Extreme Tachy, Extreme Brady, PVCs/min, PVC, Couplet, VT>2, Bigeminy, Trigeminy, R ON T, Brady, Tachy, Missed Beat, PNP, PNC, Vent Rhythm, Multif. PVCs, Nonsus. Vtac, Pause, Irr. Rhythm
Tall T-wave rejection capability	When the test is performed based on Clause 201.12.1.101.17 of IEC 60601-2-27, the heart rate meter will reject all 100 ms QRS complexes with less than 1.2 mV of amplitude, and T waves with T-wave interval of 180 ms and those with Q-T interval of 350 ms.
Lead-off detection current	Measuring electrode: ≤ 0.1 μA Drive electrode: ≤ 1 μA
Baseline recovery time	<2.5 s (after defibrillation)

Response to irregular rhythm	In compliance with the requirements in Clause 201.7.9.2.9.101 b) 4) 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
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A.3.2 ECG Specifications (from Defibrillation Electrodes)

Animal connection	paddles or multifunction electrode pads
ECG inputs	pads/paddles
Gain	2.5 mm/mV (×0.25), 5 mm/mV (×0.5), 10 mm/mV (×1), 20 mm/mV (×2), 40mm/mV (×4), Auto. Error less than ± 5%
Sweep speed	6.25mm/s, 12.5 mm/s, 25 mm/s, 50 mm/s. Error no more than ± 5%
Bandwidth (-3dB)	Therapy mode: 1 to 20 Hz
Common mode rejection	Therapy mode: >105 dB
Notch filter	50/60Hz In Therapy mode: notch filter turns on automatically
ECG signal range	±8mV (peak-to-peak value)
Calibration signal	1mV (peak-to-peak value) ±5%
Differential input impedance	≥5 MΩ
Electrode offset potential tolerance	±1V
Defibrillation protection	Enduring 5000V (360 J) charge without data loss or corruption Baseline recovery time: <2.5 s (after defibrillation) Polarization recovery time: <10 s Defibrillation energy absorption: ≤10% (100Ω load)
ESU protection	Cut mode: 300 W Coagulate mode: 100 W Recovery time: ≤10 s
Pace Pulse	
Pace pulse markers	Pace pulses meeting the following conditions are labelled with a PACE marker: Amplitude: ±2 to ± 700 mV Width: 0.1 to 2 ms Rise time: 10 to 100 µs
Pace pulse rejection	The heart rate meter rejects all pulses meeting the following conditions. Amplitude: ±2 to ± 700 mV Width: 0.1 to 2 ms Rise time: 10 to 100 µs
HR	
Measurement range	Feline: 15 to 350 bpm Canine: 15 to 350 bpm
Accuracy	±1% or ±1bpm, which ever is greater
Resolution	1 bpm
Sensitivity	200 µV

Heart rate averaging	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 screen is updated every second.	
Response time to heart rate change	From 80 to 120 bpm:	less than 11 s
	From 80 to 40 bpm:	less than 11 s
Time to alarm for tachycardia	4ah - range:	<11 s
	4a - range:	<11 s
	4ad - range:	<11 s
	4bh - range:	<11 s
	4b - range:	<11 s
	4bd - range:	<11 s
Arrhythmia Analysis Classifications	Asystole, V-Fib/V-Tach, PNP, PNC	
Tall T-wave rejection capability	The heart rate meter will reject all 100 ms QRS complexes with less than 1.2 mV of amplitude, and T waves with T-wave interval of 180 ms and those with Q-T interval of 350 ms.	
Lead-off detection current	≤0.1 μA	
Baseline recovery time	<2.5 s (after defibrillation, in therapy mode)	

A.3.3 Resp Specifications

Technique	Trans-thoracic impedance
Measurement range	0 to 200 rpm
Resolution	1 rpm
Accuracy	121 to 200 rpm: ±2 rpm 0 to 120 rpm: ±1 rpm
Respiration excitation waveform	<300 μA, sinusoid, 62.8 kHz (±10%)
Minimum respiration impedance threshold	0.3Ω with× 5 gain
Bandwidth	0.2 to 2.5 Hz (-3 dB)
Reference impedance range	2200 to 4500Ω, using an ECG cable with 1 kΩ resistor
Apnea alarm time	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s

A.3.4 SpO₂ Specifications

Standard	Meet standards of ISO 80601-2-61
Measurement range	0 to 100%
Resolution	1%
Response time	<20 s (SpO ₂ value sudden changes from 70% to 100%)
Accuracy*	70 to 100%: ±2% (in Canine/Feline mode) 70 to 100%: ±3% (in other mode) 0% to 69%: Not specified
Refreshing rate	≤2 s

A.3.5 PR Specifications

Measurement range	20 to 300 bpm
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Resolution	1 bpm
Accuracy	±3 bpm
Response time	<20 s (PR value sudden changes from 25 to 240 bpm)

A.3.6 NIBP Specifications

Standards	Meet standard of IEC 80601-2-30				
Technique	Oscillometry				
Mode of operation	Manual, Auto and STAT				
Auto mode repetition intervals	1, 2, 2.5, 3, 5, 10, 15, 20, 30, 60, 90, 120, 180, 240 or 480 min				
Static pressure measurement range	0mmHg to 300mmHg				
Static pressure measurement accuracy	±3mmHg				
Measurement range			Weight: >23kg	Weight: 10~23kg	Weight: <10kg
	Systolic	mmHg	25 to 290	25 to 240	25 to 240
	Diastolic	mmHg	10 to 250	10 to 200	10 to 200
	Mean	mmHg	15 to 260	15 to 215	15 to 215
Software overpressure protection	297±3 mmHg				
Measurement accuracy*	Max mean error: ±5 mmHg Max standard deviation: 8 mmHg				
Resolution	1 mmHg				

A.3.7 CO₂ Specifications

Measurement range	0 to 150 mmHg
Accuracy*	Full accuracy mode: 0 to 40 mmHg: ±2 mmHg 41 to 76 mmHg: ±5% of reading 77 to 99 mmHg: ±10% of reading 100 to 150 mmHg: ±(3 mmHg+8% of reading) ISO accuracy mode: Add ±2mmHg to the full accuracy mode
Sart-up time	20 s (typical), 90 s (maximum)
Accuracy drift	Meets the requirement for measurement accuracy within 6 hours.
Resolution	1mmHg
Sample flowrate	Connecting the Oridion sampling line: 50 ml/min
Sample flowrate tolerance	±15% or ±15 ml/min, whichever is greater.
Rise time	Measured with a Oridion sampling line: ≤250 ms @ 50 ml/min (standard sampling line) or ≤280 ms @ 50 ml/min (extended sampling line)
Response time	Measured with a Oridion sampling line: ≤5 s @ 50 ml/min (standard sampling line) or ≤6.5 s @ 50 ml/min (extended sampling line)
awRR measurement range	0 to 150 rpm
awRR accuracy	<60 rpm: ±1 rpm 60 to 150 rpm: ±2 rpm

awRR resolution	1 rpm	
Effect of interference gases on CO ₂ measurements		
Gas	Concentration (%)	Quantitive effect*
N ₂ O	≤60	±1 mmHg
Hal	≤4	
Sev	≤5	
Iso	≤5	
Enf	≤5	
Des	≤15	±2 mmHg
*: means an extra error should be added in case of gas interference when CO ₂ measurements are performed between 0-40mmHg.		
Inaccuracy specifications are affected by the breath rate and I: E change. The EtCO ₂ accuracy is within specification for breath rate ≤ 60rpm and I/E ratio ≤1:1, or breath rate ≤30rpm and I/E ratio ≤ 2:1.		

A.4 Power Supply Specifications

A.4.1 External Power Supply Specifications

AC power	
Line voltage	100 to 240 VAC (±10%)
Current	1.8 to 0.8A
Frequency	50/60Hz (±3Hz)

A.4.2 Battery Specifications

Battery type	Smart lithium ion battery, rechargeable and free of maintenance, one battery can be installed Battery LI24I002H: 14.4V, 5600mAh		
Battery charge time	Charged by the equipment connected to the AC power - Less than 3 hours to 90% and less than 4 hours to 100% with equipment power off. - Less than 5 hours to 90% and less than 6 hours to 100% with equipment power on.		
Battery run time	Operating mode	One new fully charged battery	Testing condition
	Monitoring	≥6 hours	The equipment is configured with a 5-lead ECG, Resp and SpO ₂ , NIBP measurements set at an interval of 15 minutes. The CO ₂ and 4G modules are disabled. The screen brightness is set to the factory default without recording.
	Defibrillation	≥200 discharges	360J discharge with three discharges every minute, the equipment configured with 5-lead ECG, Resp, SpO ₂ , NIBP, CO ₂ and 4G modules are all disabled. The screen brightness is set to the factory default without recording.
	Defibrillation	≥300 discharges	200J discharge with three discharges every minute, the equipment configured with 5-lead ECG, Resp, SpO ₂ , NIBP, CO ₂ and 4G modules are all disabled. The screen brightness is set to the factory default without recording.
Shutdown delay	At least 20 minutes of monitoring and six 360J discharges (after the low battery alarm occurs)		

Note: The specifications above are based on a new battery, and at 20°C±5 °C of ambient temperature.

A.5 Recorder Specifications

Method	High-resolution thermal dot array
Number of waveforms	3 at maximum
Paper speed	6.25 mm/s, 12.5 mm/s, 25 mm/s, 50 mm/s. Error no more than ± 5%
Paper width	50 mm
Grid lines	The operator can choose to print grid lines or not
Auto record	Charge events, shock events, marked events, auto test report, parameter alarms, ARR alarms, if configured on

A.6 Alarm Specifications

Alarm Levels	High, medium, low level alarms, complying with IEC 60601-1-8
Alarm Categories	Physiological alarms, technical alarms; Latched alarms and unlatched alarms.
Alarm lamp	Independent alarm LED
Parameter alarm setting	Alarm properties of all available parameters can be set simultaneously in the Para. Alarm menu
Auto alarm limits	Parameter alarm limits can be automatically adjusted according to currently measured vital signs

A.7 Data Storage

Internal storage	- Standard-capacity internal card: 1 Gbit - High-capacity internal card: 8 Gbit
Marking events	16 types of events, user customized
Events	- Standard-capacity internal card: 500 events. - High-capacity internal card: 1000 events
Waveforms	- Standard-capacity internal card: up to 10 hours for one ECG waveform. - High-capacity internal card: up to 24 hours for one ECG waveform.
Tabular trends	- Standard-capacity internal card: up to 8 hours' trend data with the resolution no less than 1 minute. - High-capacity internal card: up to 72 hours' trend data with the resolution no less than 1 minute.
Selftest reports	Up to 300

A.8 Environmental Specifications

WARNING

- The equipment may not meet the performance specifications if stored or used outside the specified temperature and humidity ranges. If the performance of the equipment is degraded due to aging or environmental conditions, contact your service personnel.
- When the equipment and related products have differing environmental specifications, the effective range for the combined products is that range which is common to the specifications for all products.

NOTE

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

Main Unit			
Item	Temperature	Relative humidity	Barometric
Operating condition	0°C to 45°C (at least 60 minutes of working time when the temperature reduces from room temperature to -20°C)	10% to 95%, non-condensing	-381m to 4575m (57kPa to 106.2kPa)
Storage condition	-30°C to 70°C		
CO ₂ module			
Item	Temperature	Relative humidity	Barometric
Operating condition	5°C to 40°C	10% to 95%, non-condensing	430mmHg to 790 mmHg (57.3kPa to 105.3kPa)
Storage condition	-20°C to 60°C		

Shock
Complies with requirements of 21.102, ISO9919: Peak acceleration: 1000m/s ² (102g) Duration: 6ms Pulse shape: half-sine Number of shocks: 3 shocks per direction per axis (18 total)
Vibration
Complies with requirements of 21.102, ISO9919.
Bump
Complies with the requirements of 6.3.4.2, EN1789. Peak acceleration: 15g Duration: 6ms Number of impacts: 1000 Impact direction: vertical impacts are applied when the equipment under test is placed at normal operating position.
Free fall
Complies with the requirements of 6.3.4.3, EN1789. Drop height: 0.75 m Number of drops: once for each of the six surfaces

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B Mindray Shockable Rhythm Analysis Algorithm

The equipment configured with Mindray shockable rhythm analysis algorithm acquires and analyzes the animal's ECG signals to determine whether or not to give a defibrillation shock. If a shockable rhythm is detected, the algorithm recommends a defibrillation shock. If a nonshockable rhythm is detected, the algorithm recommends no shocks, avoiding unnecessary defibrillation shock to the animal.

Mindray shockable rhythm analysis algorithm has been validated by using the database for evaluation of Mindray algorithm performance.

B.1 Rhythm Recognition and Annotation Methodology

This section describes the recording method, rhythm source, rhythm selection criteria, annotation methods and criteria the database for evaluation of Mindray shockable rhythm analysis algorithm.

B.1.1 Database for Evaluation of Mindray Algorithm Performance

The database for evaluation of Mindray algorithm performance includes international standard database and Mindray clinical database for evaluating the ECG data. The ECG data for evaluation is selected according to AHA recommendations^a with a 10-second wave length.

Database for evaluation of Mindray shockable rhythm analysis algorithm includes:

- MIT-BIH: The Massachusetts Institute of Technology–Beth Israel Hospital Arrhythmia Database (from Holter)
- AHA: The American Heart Association Database for Evaluation of Ventricular Arrhythmia Detectors (from Holter)
- VFDB: MIT-BIH Malignant Ventricular Arrhythmia Database (from Holter)
- CU: The Creighton University Sustained Ventricular Arrhythmia Database [the third edition] (from hospital monitor)
- NST: The Noise Stress Test Database (12 ECG records of 30 minutes each plus 3 records of noise only - supplied with the MIT–BIH database)
- Mindray clinical data (from Mindray monitors, defibrillator monitors and automated external defibrillators)

B.1.2 Rhythm Categories

Each rhythm category for evaluating the ECG data has been confirmed by the clinical experts.

- Shockable rhythms
 - ◆ Coarse ventricular fibrillation (VF): amplitude $\geq 0.2\text{mV}$
 - ◆ Rapid ventricular tachycardia (VT): $\text{HR} \geq 150\text{bpm}$, $\text{QRS duration} \geq 120\text{ms}$
- Nonshockable rhythms
 - ◆ Normal sinus rhythm
 - ◆ Asystole: amplitude $< 0.1\text{mV}$
 - ◆ flutter, supraventricular tachycardias, sinus bradycardia, idioventricular rhythms, heart block, premature ventricular contractions, etc
- Intermediate rhythms
 - ◆ Fine ventricular fibrillation: $0.1\text{mV} < \text{amplitude} < 0.2\text{mV}$
 - ◆ Other VT: ventricular tachycardia that does not meet criteria for VT in the shockable rhythms category

B.2 Mindray Shockable Rhythm Analysis Algorithm Performance

Test results on the performance of the equipment configured with Mindray shockable rhythm analysis algorithm meet IEC 60601-2-4 requirements^b and AHA recommendations^a.

Test results on IEC 60601-2-4 requirements are shown below.

Rhythm category	Requirement	Test result
Shockable (sensitivity): Coarse VF Rapid VT	>90% >75%	Met Met
Nonshockable (specificity)	>95%	Met
Positive predictive value	Report only	>98%
False positive rate	Report only	<2%

Test results on AHA recommendations are shown below.

Rhythm category	Minimum sample size (cases)	Performance goal	Sample size tested (cases)	Test result
Shockable (sensitivity): Coarse VF Rapid VT	200 50	>90% >75%	205 80	Met Met
Nonshockable (specificity): Normal sinus rhythm Asystole Other nonshockable rhythms	300 100 100 30	>99% >95% >95%	171 180 385	Met Met Met
Intermediate: Fine VF Other VT	25 25	Report only Report only	27 42	66.67% shockable 76.19% nonshockable

^a. Kerber RE, et al, "Automatic External Defibrillators for Public Access Defibrillation: Recommendations for Specifying and Reporting Arrhythmia Analysis Algorithm Performance, Incorporating New Waveforms, and Enhancing Safety: A Statement for Health Professionals from the American Heart Association Task Force on Automatic External Defibrillation", Subcommittee on AED Safety and Efficacy. Circulation, 1997: Vol. 95: 1677-1682.

^b. Clause 201.7.9.3.103 "Essential Performance data of the Rhythm Recognition Detector" and clause 201.107 "Requirements for Rhythm Recognition Detector," International Electrotechnical Association, IEC 60601-2-4, Medical Electrical Equipment – Part 2-4: Particular Requirements for the Basic Safety and Essential Performance of Cardiac Defibrillators: 2010.

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

WARNING

- Use of accessories, transducers and cables other than those specified or provided by the manufacturer of this device could result in increased electromagnetic emissions or decreased electromagnetic immunity of this device and result in improper operation.
- 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 device adjacent to or stacked with other device should be avoided because it could result in improper operation. If such use is necessary, this device and the other device should be observed to verify that they are operating normally.
- Portable RF communications equipment (including peripherals such as antenna cables and external antennas) should be used no closer than 30 cm (12 inches) to any part of the this device, including cables specified by the manufacturer. Otherwise, degradation of the performance of this device could result.
- Other devices may affect this equipment 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.

NOTE

- The equipment needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided below.
- Portable and mobile RF communications equipment may affect this equipment.
- This equipment is intended for use in professional healthcare facility environment, or in home healthcare environment such as restaurants, cafes, shops, stores, markets, schools, churches, libraries, outdoors (streets, sidewalks, parks), domiciles (residences, homes, nursing homes), train stations, bus stations, airports, hotels, hostels, pensions, museums, theatres. If it is used in special environment, such as magnetic resonance imaging environment, the equipment may be disrupted by the operation of nearby equipment.

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

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

HR accuracy, Resp accuracy, SpO₂ accuracy, PR accuracy, NIBP accuracy, CO₂ accuracy, energy accuracy, alarm, data stored, user's interface function.

Guidance and Declaration - Electromagnetic Immunity			
The equipment is suitable for use in the electromagnetic environment specified below. The customer or the user of the equipment should assure that it is used in such an environment.			
Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment - guidance
Electrostatic discharge (ESD) IEC 61000-4-2	±8 kV contact ±15kV air	±8 kV contact ±15kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	±2 kV for power supply lines ±1 kV for input/output lines (length greater than 3 m)	±2 kV for power supply lines ±1 kV for input/output lines (length greater than 3 m)	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1 kV line(s) to line(s) ±2 kV line(s) to earth	±1 kV line(s) to line(s) ±2 kV line(s) to earth	
Voltage dips and Voltage interruptions IEC 61000-4-11	0% U _T for 0,5 cycle 0% U _T for 1 cycle and 70% U _T for 25/30 cycles 0% U _T for 250/300 cycle	0% U _T for 0,5 cycle 0% U _T for 1 cycle and 70% U _T for 25/30 cycles 0% U _T for 250/300 cycle	Mains power quality should be that of a typical commercial or hospital environment. If the user of our product requires continued operation during power mains interruptions, it is recommended that our product be powered from an uninterruptible power supply or a battery.
RATED power frequency magnetic fields IEC 61000-4-8	30 A/m	30 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
U _T is the A.C. mains voltage prior to application of the test level.			

Guidance and Declaration - Electromagnetic Immunity			
The equipment is suitable for use in the electromagnetic environment specified below. The customer or the user of the equipment should assure that it is used in such an environment.			
Immunity test	IEC 60601 Test level	Compliance level	Electromagnetic environment - guidance
Conducted RF IEC 61000-4-6	3 Vrms 150k to 80 MHz	3 Vrms (V1)	Portable and mobile RF communications equipment should be used no closer to any part of the device, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance: $d = \left[\frac{3.5}{V1} \right] \sqrt{P} \quad 150\text{k to } 80 \text{ MHz}$ $d = \left[\frac{3.5}{E1} \right] \sqrt{P} \quad 80 \text{ MHz to } 800 \text{ MHz}$ $d = \left[\frac{7}{E1} \right] \sqrt{P} \quad 800 \text{ MHz to } 2.7 \text{ GHz}$ where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m)^b. Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey^c, should be less than the compliance level in each frequency range^d Interference may occur in the vicinity of equipment marked with the following symbol:
	6 Vrms in ISM bands and amateur radio bands ^a between 0.15 MHz and 80 MHz	6 Vrms (V2)	
Radiated RF EM fields IEC 61000-4-3	3V/m 80 MHz to 2.7 GHz	3 V/m (E1)	
	10V/m 80 MHz to 2.7 GHz (IEC60601-2-4)	10 V/m	
	20V/m 80 MHz to 2.7GHz	20 V/m	
Proximity fields from RF wireless communications equipment IEC 61000-4-3	27 V/m 380 to 390 MHz	27 V/m	
	28 V/m 430 to 470 MHz, 800 to 960 MHz, 1700 to 1990 MHz, 2400 to 2570 MHz	28 V/m	
	9 V/m 704 to 787 MHz, 5100 to 5800 MHz	9 V/m	
Note 1: At 80 MHz and 800 MHz, the higher frequency range applies. Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			
^a The ISM (industrial, scientific, and medical) bands between 150 kHz and 80 MHz are 6.765 MHz to 6.795 MHz; 13.553 MHz to 13.567 MHz; 26.957 MHz to 27.283 MHz; and 40.66 MHz to 40.70 MHz. The amateur radio bands between 0,15 MHz and 80 MHz are 1,8 MHz to 2,0 MHz, 3,5 MHz to 4,0 MHz, 5,3 MHz to 5,4 MHz, 7 MHz to 7,3 MHz, 10,1 MHz to 10,15 MHz, 14 MHz to 14,2 MHz, 18,07 MHz to 18,17 MHz, 21,0 MHz to 21,4 MHz, 24,89 MHz to 24,99 MHz, 28,0 MHz to 29,7 MHz and 50,0 MHz to 54,0 MHz. ^b Compliance level in the ISM frequency bands between 150 kHz to 80 MHz and in the frequency range 80 MHz to 2.7 GHz are intended to decrease the likelihood that portable/ mobile communication equipment could cause interference if it is inadvertently brought into animal areas. For this reason, an additional factor of 10/3 is used in calculating the recommended separation distance for transmitters in these frequency ranges. ^c Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the device is used exceeds the applicable RF compliance level above, the device should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the device. ^d Over the frequency ranges 150 kHz to 80 MHz, field strengths should be less than 3V/m.			

Recommended Separation Distances between Portable and Mobile RF, Communications Equipment and This Equipment			
The equipment is intended for use in an electromagnetic environment in which radiated RF disturbance are controlled. The customer or the user of the equipment can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the equipment as recommended below, according to the maximum output power of the communication equipment.			
Rated Maximum Output power of Transmitter Watts (W)	Separation Distance According to Frequency of Transmitter (m)		
	150 kHz to 80 MHz $d = \left[\frac{3.5}{V1} \right] \sqrt{P}$	80 MHz to 800 MHz $d = \left[\frac{3.5}{E1} \right] \sqrt{P}$	800 MHz to 2.7 GHz $d = \left[\frac{7}{E1} \right] \sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.20	1.20	2.30
10	3.80	3.80	7.30
100	12.00	12.00	23.00
For transmitters at a maximum output power not listed above, the recommended separation distanced in meters (m) can be determined using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer. Note 1: At 80 MHz and 800 MHz, the higher frequency range applies. Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			

D Alarm Messages

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

In this chapter:

- The “I” column indicates how indications of technological alarms are cleared after the Alarm Pause button  or [Alarm Reset] soft key is pressed: “A” means all alarm indications are cleared; “B” indicates alarm light and alarm tones are cleared and the alarm messages change to prompt messages; and “C” indicates only alarm tone is disabled, but alarm light and alarm message remain presented.
- The “L” column indicates the alarm level: “H” refers to high, “M” refers to medium, and “L” refers to low. “*” means the alarm level is user-adjustable.
- XX represents a measurement or parameter label, such as ECG, NIBP, HR, PVCs, RR, SpO₂, PR, etc.

In the “Cause and solution” column, corresponding solutions are given instructing you to troubleshoot problems. If the problem persists, contact your service personnel.

D.1 Physiological Alarm Messages

Measurement	Alarm Message	L	Cause and solution
XX	XX Too High	M*	XX value has risen above the high alarm limit or fallen below the low alarm limit. Check the animal's condition and check if the animal category and alarm limit settings are correct.
	XX Too Low	M*	
ECG	Asystole	H	Arrhythmia has occurred to the animal. Check the animal's condition and the ECG connections.
	V-Fib/V-Tach	H	
	V-Tach	H	
	Vent. Brady	H	
	Extreme Tachy	H	
	Extreme Brady	H	
	Brady	M*	
	Tachy	M*	
	PVCs/min	M*	
	R ON T	M*	
	PVC	M*	
	VT>2	M*	
	Couplet	M*	
	Bigeminy	M*	
	Trigeminy	M*	
	Missed Beat	M*	
	Vent Rhythm	M*	
	Multif. PVCs	M*	
	Nonsus. Vtac	M*	
	Pause	M*	

Measurement	Alarm Message	L	Cause and solution
ECG	Irr. Rhythm	M*	Arrhythmia has occurred to the animal. Check the animal's condition and the ECG connections.
Resp	Resp Apnea	H	The respiration signal was so weak that the equipment cannot perform respiration analysis. Check the animals condition and the Resp connections.
	Resp Artifact	H	The respiration circuit is disturbed. Check for any possible sources of signal noise.
SpO2	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	L	The pulse signal was so weak that the equipment cannot perform pulse analysis. Check the animal's condition, SpO ₂ sensor and measurement site.
CO2	CO2 Apnea	H	The animal stops breathing, or the respiration signal was so weak that the equipment cannot perform respiration analysis. Check the animal's condition, CO ₂ accessories and airway connections.

D.2 Technical Alarm Messages

Measurement	Alarm Message	L	I	Cause and solution
XX	XX SelfTest Err	H	C	An error occurred to the XX module, or there is a problem with the communications between the module and the main unit. Restart the equipment.
	XX Init Err	H	C	
	XX Comm Err	L	C	
	XX Comm Stop	H	C	
	XX Overrange	L	C	The measured XX value is not within the specified range for XX measurement. Contact your service personnel.
ECG	ECG Lead Off	L*	B	The ECG electrode has become detached from the animal or the lead wire has become disconnected from the trunk cable. Check the connection of the electrodes and leadwires.
	ECG YY Lead Off (YY represents the leadwires V, LL, LA, and RA, as per AHA standard, or C, F, L and R as per IEC standard.)	L*	B	
	Pads/Paddles Off	L*	B	The pads/paddles have been detached from the animal or the therapy cable is loose. Check that the electrode pads/paddles and therapy cable are properly connected.
	ECG Noise	L	A	The ECG signal is noisy. Check for any possible sources of signal noise form the area around the cable and electrode, and check the animal for excessive motion.
	ECG Signal Invalid	L	A	ECG amplitude is so low that ECG signal is undetectable. Check for any possible source of interference from the area around the cable and electrode; check the animal's condition.

Measurement	Alarm Message	L	I	Cause and solution
SpO ₂	SpO ₂ 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 the sensor is not damaged. Reconnect the sensor or use a new sensor.
	SpO ₂ Sensor Fault	L	C	
	SpO ₂ No Sensor	L	B	
	SpO ₂ Non-Pulsatile	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.
	SpO ₂ Low Perf	L	B	
NIBP	NIBP Loose Cuff	L	A	The NIBP cuff is not properly connected, or there is a leak in the airway.
	NIBP Air Leak	L	A	
	NIBP Pneumatic Leak	L	A	Check the NIBP cuff and pump for leakages.
	NIBP Air Press. Err	L	A	An error occurred to the air pressure. Verify that the equipment 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 problem persists, change the cuff.
	NIBP Sig. Saturated	L	A	The NIBP signal is saturated due to excess motion or other sources.
	NIBP Overrange	L	A	The animal's NIBP value may be beyond the specified measurement range.
	NIBP Excessive Motion	L	A	Check the animal's condition and reduce the animal motion.
	NIBP Equip Err	H	A	An error occurred during NIBP measurement and therefore the equipment cannot perform analysis correctly. Check the animal's condition and NIBP connections, or replace the cuff.
	NIBP Time Out	L	A	
	NIBP Measure Failed	L	A	
	NIBP Reset For Err	L	A	An illegal reset occurred during NIBP measurement. Check if the airway is occluded.
CO ₂	CO ₂ Sensor High Temp	L	C	Check, stop using or replace the sensor.
	CO ₂ No Watertrap	L	B	Check the watertrap connections.
	CO ₂ Zero Failed	L	A	Check the CO ₂ connections. After the sensor's temperature becomes stabilized, perform a zero calibration again.
	CO ₂ Module Error	L	C	There is a problem with the CO ₂ module, or a problem with the communications between the main unit and the CO ₂ module. Restart the equipment.
	CO ₂ Occlusion	L	C	The airway was occluded. Check the airway and remove the occlusion.

Measurement	Alarm Message	L	I	Cause and solution
Main control system	Memory Error	L	C	There is a problem with the data card. Format the CF card. If the problem persists, contact your service personnel.
	Power Board Comm Err	H	C	An error occurred to the power board, or there is a problem with the communications between the power board and the main unit. Restart the equipment.
	Therapy Module Comm Err	S	C	An error occurred to the therapy module, or there is a problem with the communications between the therapy module and the main unit. Restart the equipment. If the problem persists, contact your service personnel.
	Main Control Selftest Err	H	C	The main control voltage is abnormal. Replace the main control board.
	RT Clock Need Reset	L	C	Reset system time.
	RT Clock Err	H	C	An error occurred to the RTC chip, or the button cell is depleted. Replace corresponding part.
	Last Manual Test Failed	L	C	Check the equipment connection and perform the manual test to clear the faults.
	Last Auto Test Failed	L	C	
	Last Energy Test Failed	L	C	
Power board	Power Board Selftest Err	H	C	An error occurred to the system power supply. Restart the equipment.
	Power Board Volt Err	L	C	
	Low Battery	S	C	Change battery or connect the equipment to the AC power source to charge the batteries.
	No Battery	L	C	Battery is not installed. Install the battery.
	Battery Depleted! System will shut down immediately. Connect to AC mains or replace battery.	S	C	Connect the equipment to AC mains.
	Battery Err	H	C	There is a problem with the batteries. Check the batteries for damage; verify that correct batteries are used. Replace the batteries if necessary.
	Battery Aged	L	C	Replace the battery.
	Battery failed charging	M	C	Battery failure or power board hardware failure. Replace the battery. If the problem persists, contact your service personnel.
Therapy module	Therapy Equip Selftest Err	S	C	An error occurred during therapy module self test. Restart the equipment or replace the therapy module low voltage board.
	Defib Malfunction	S	C	The defibrillation function fails or the defibrillation function fails. Restart the equipment and test defibrillation function. If the problem persists, contact your service personnel.
	Disarming Failed	H	C	There is a problem with the therapy module disarming circuit. Replace the therapy module low voltage board and high voltage board.
Monitoring module	Monitor Module Selftest Err	H	C	An error occurred during MPM module power-on self test. Replace the MPM module.
	Monitor Module Reset Err	H	C	MPM module reset abnormally. In this case, the MPM module restores to default configuration. You can ignore this problem.
	Monitor Module Voltage Err	L	C	The voltage of MPM module is abnormal. Replace the MPM module.

Measurement	Alarm Message	L	I	Cause and solution
Recorder	Recorder Init Err	L	A	Restart the equipment.
	Recordhead Overheated	L	A	The recorder has been working for a prolonged time. Clear the recording tasks and resume the recording till the recorder's print head cools down.
	Recorder Overcurrent	L	A	Re-load the recorder paper.
Others	Load Config Err	L	A	Check if the configuration is correct, or restore the factory configuration.

NOTE

- In the "L" column "S" refers to special technological alarm. The special technological alarms cannot be paused or silenced, and the alarm volume is unchangeable. These alarms stops only when the alarm condition is eliminated.

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E Electrical Safety Inspection

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

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

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

E.1 Power Cord Plug

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

E.2 Device Enclosure and Accessories

E.2.1 Visual Inspection

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

E.2.2 Contextual Inspection

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

E.3 Device Labeling

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

- Main unit label
- Integrated warning labels

E.4 Protective Earth Resistance

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

LIMITS

For all countries, $R = 0.2 \Omega$ Maximum

E.5 Earth Leakage Test

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

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

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

LIMITS

For 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

E.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

- ◆ 100µA in Normal Condition
- ◆ 500µA in Single Fault Condition

E.7 Mains on Applied Part Leakage

The Mains on Applied Part test applies a test voltage, which is 110% of the mains voltage, through a limiting resistance, to selected applied part terminals. Current measurements are then taken between the selected applied part and earth. Measurements are taken with the test voltage (110% of mains) to applied parts in the normal and reverse polarity conditions

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

- Normal Polarity
- Reversed Polarity

LIMITS

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

E.8 Animal Auxiliary Current

Animal Auxiliary currents are measured between any selected Applied Part connector and the remaining Applied Part connectors. 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,

- ◆ 10µA in Normal Condition
- ◆ 50µA in Single Fault Condition

For BF  applied parts,

- ◆ 100µA in Normal Condition
- ◆ 500µA in Single Fault Condition

NOTE

-
- **Make sure the safety analyzer is authorized comply with requirement of IEC 60601-1.**
 - **Follow the instructions of the analyzer manufacturer.**
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F Defibrillator Shift Checklist

Equipment Name: _____ Serial Number: _____ Department: _____

Item	Pass/ Fail	Corrective Actions/Remarks
1. Equipment Appearance ◆ Clean, no foreign substance, no crack		
2. Cables/Connectors ◆ Cables not frayed, connectors and pins not broken or loose ◆ Connectors engage securely		
3. Inspection after turned on ◆ Battery installed, battery capacity indicated with at least four power bars. ◆ Check the historical test results by pressing the Test Report () button on the front panel.		
4. Necessary Accessories (Electrode pads, electrodes, paddles or recorder paper) ◆ Present and sufficient ◆ Inspected to be used normally		
5. Auto Test ◆ Status indicator illuminated in green		
6. Shock Test ■ If the external paddles are used: 1. Connect the equipment with AC power supply, and the AC power indicator is illuminated. 2. Connect the paddles cable to the equipment, and place the external paddles in the paddle tray. 3. Press the Charge button on the external paddles, and charge the equipment to 50J. 4. Press the Shock button on the external paddles. 5. The system prompts that the shock is delivered normally.		
■ If the electrode pads are used: 1. Connect the equipment with AC power supply, and the AC power indicator is illuminated. 2. Connect the pads cable to the equipment. 3. Perform the manual test with the test load connected. 4. The system prompts that the Energy Delivery test is passed.		
7. Monthly Check on Expiration Date ◆ The electrode pads are not expired.		
Checked by: _____ Date: _____		

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G Symbols and Abbreviations

G.1 Units

μA	microampere
μV	microvolt
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
J	Joule
k	kilo
kg	kilogram
kPa	kilopascal
L	litre
lb	pound
m	meter
mAh	Milliampere hour
Mb	mega byte
mcg	microgram
mEq	milli-equivalents
mg	milligram
min	minute
ml	milliliter

mm	millimeter
mmHg	millimeters of mercury
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

–	negative, minus
%	percent
/	per; divide; or
+	plus
=	equal to
<	less than
>	greater than
≤	less than or equal to
≥	greater than or equal to
±	plus or minus
×	multiply
©	copyright

G.3 Abbreviations and Acronyms

AaDO ₂	alveolar-arterial oxygen gradient
AAMI	Association for Advancement of Medical Instrumentation
AC	alternating current
ACI	acceleration index
AG	anaesthesia gas
AHA	American Heart Association
ANSI	American National Standard Institute
Ao	aortic pressure

Art	arterial
aVF	left foot augmented lead
aVL	left arm augmented lead
aVR	right arm augmented lead
awRR	airway respiratory rate
BAP	brachial arterial pressure
BIS	bispectral index
BP	blood pressure
BPSK	binary phase shift keying
BSA	body surface area
BT	blood temperature
BTPS	body temperature and pressure, saturated
C.I.	cardiac index
C.O.	cardiac output
CaO ₂	arterial oxygen content
CCO	continuous cardiac output
CCU	cardiac (coronary) care unit
CE	Conformité Européenne
CIS	clinical information system
CISPR	International Special Committee on Radio Interference
CMOS	complementary metal oxide semiconductor
CMS	central monitoring system
CO ₂	carbon dioxide
COHb	carboxyhemoglobin
CP	cardiopulmonary
CVP	central venous pressure
DC	direct current
Defib	defibrillation
Des	desflurane
Dia	diastolic
DPI	dot per inch
DVI	digital video interface
ECG	electrocardiograph
EDV	end-diastolic volume
EEC	European Economic Community
EEG	electroencephalogram
EMC	electromagnetic compatibility
EMG	electromyograph

EMI	electromagnetic interference
Enf	enflurane
ESU	electrosurgical unit
Et	end-tidal
EtCO ₂	end-tidal carbon dioxide
EtN ₂ O	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
Fi	fraction of inspired
FiCO ₂	fraction of inspired carbon oxygen
FiN ₂ O	fraction of inspired nitrous oxide
FiO ₂	fraction of inspired oxygen
FPGA	field programmable gate array
FV	flow-volume
Hal	halothane
Hb	hemoglobin
Hb-CO	carbon mono-xide hemoglobin
HbO ₂	oxyhemoglobin
HIS	hospital information system
HR	heart rate
I:E	inspiratory-expiratory ratio
IBP	invasive brood pressure
ICG	impedance cardiography
ICP	intracranial pressure
ICT/B	intracranial catheter tip pressure transducer
ICU	intensive care unit
ID	identification
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
IP	internet protocol
Iso	isoflurane
IT	injectate temperature
LA	left arm
LAP	left atrial pressure
Lat	lateral

LCD	liquid crystal display
LCW	left cardiac work
LCWI	left cardiac work index
LED	light emitting diode
LL	left leg
LVDS	low voltage differential signal
LVET	left ventricular ejection time
LVSW	left ventricular stroke work
LVSWI	left ventricular stroke work index
MAC	minimal alveolar concentration
MAP	mean arterial pressure
MetHb	methemoglobin
MRI	magnetic resonance imaging
MVe	expiratory minute volume
MVi	inspiratory minute volume
N/A	not applied
Neo	neonate
NIBP	noninvasive blood pressure
NIP	negative inspiratory pressure
O ₂	oxygen
O ₂ CI	oxygen consumption index
O ₂ R	oxygen extraction ratio
OR	operating room
oxyCRG	oxygen cardio-respirogram
PA	pulmonary artery
Paw	airway pressure
PAWP	pulmonary artery wedge pressure
PD	photodetector
PEEP	positive end expiratory pressure
PEF	peak expiratory flow
PEP	pre-ejection period
PIF	peak inspiratory flow
PIP	peak inspiratory pressure
Pleth	plethysmogram
Pmean	mean pressure
PNC	pacer not captured
PNP	pacer not paced
Pplat	plateau pressure

PR	pulse rate
PVC	premature ventricular complex
PVR	pulmonary vascular resistance
PVRI	pulmonary vascular resistance index
R	right
RA	right arm
RAM	random access memory
RAP	right atrial pressure
Raw	airway resistance
Rec	record, recording
Resp	respiration
RHb	reduced hemoglobin
RL	right leg
RM	respiratory mechanics
RR	respiration rate
RSBI	rapid shallow breathing index
SaO ₂	arterial oxygen saturation
SEF	spectral edge frequency
Sev	sevoflurane
SFM	self-maintenance
SI	stroke index
SMR	satellite module rack
SpO ₂	arterial oxygen saturation from pulse oximetry
SQI	signal quality index
SR	suppression ratio
STR	systolic time ratio
SV	stroke volume
SVR	systemic vascular resistance
SVRI	systemic vascular resistance index
Sync	synchronization
Sys	systolic pressure
Taxil	axillary temperature
TD	temperature difference
Temp	temperature
TFC	thoracic fluid content
TFI	thoracic fluid index
TFT	thin-film technology
Toral	oral temperature

Trect	rectal temperature
TVe	expiratory tidal volume
TVi	inspiratory tidal volume
UAP	umbilical arterial pressure
UPS	uninterruptible power supply
USB	universal serial bus
UVP	umbilical venous pressure
VAC	volts alternating current
VEPT	volume of electrically participating tissue
VI	velocity index
WOB	work of breathing

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H

Device Tracking

In order to provide high quality product and perform better service, we are going to track our product. Please contact us with the device tracking information when you have received your defibrillator/monitor:

Please fill the information in the next page, cut the table and fax it to +86 755 86541668. You can also email your information to service@mindrayanimal.com.

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Device Tracking Information

User Information

Customer Name			
Department name			
Address			
City	State	Zip/Post Code	Country
Contact Person			
Tel No.		Fax No.	
Email Address			
Device Information			
Product name	Serial number	Model	Installation Date

