




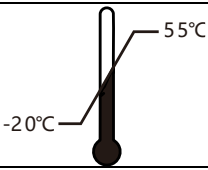
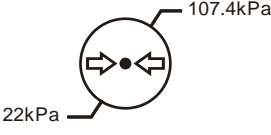
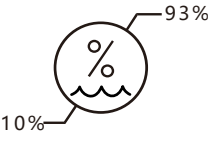













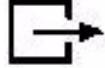


# **Veterinary Monitor User Manual**

**VITALMAX 4000/4100VET**

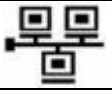
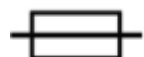






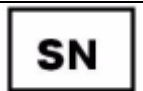


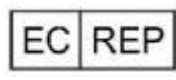



## Explanation of Symbols

The following symbols appear on the monitor and its packaging.

**Table 1 Monitor and Packaging Symbols**

Symbol	Description	Symbol	Description
	Compliance to WEEE standard		Caution, consult accompanying documents
	Keep dry		Temperature limitations
	Atmospheric pressure limitations		Humidity limitations
	Keep upright		Fragile, handle with care
	Recovery		Maximum stacking
	Recyclable		Power On key
	Waveform Freeze key		Record key
	Animal info Key		NIBP key
	AC Power LED		Charging LED
<b>CO<sub>2</sub></b>	CO <sub>2</sub> connector	<b>ECG/RESP</b>	ECG connector (3/5lead)
<b>NIBP</b>	NIBP cuff hose connector	<b>SpO<sub>2</sub></b>	SpO <sub>2</sub> probe connector
<b>TEMP1</b>	TEMP1 connector	<b>IBP1</b>	IBP1 transducer cable connector
<b>TEMP2</b>	TEMP2 connector	<b>IBP2</b>	IBP2 transducer cable connector
	Gas input		Gas output
	CF applied part: including F applied part and defibrillation-proof function.		USB port

**Table 1 Monitor and Packaging Symbols (continue)**

Symbol	Description	Symbol	Description
	Ethernet port		Fuse
	Video output		Protective grounding
	Equipotential grounding		Dangerous Voltage
	Date of manufacture		Manufacturer address
	Serial Number		Configuration number
	Batch code		EU representatives
	Catalogue number		Consult Instructions for Use
	Protective grade		

## Safety Standards

The following table describes the safety standards of the Veterinary monitor.

**Table 2 Safety Standards**

Parameter	Specification
Protection class	Class I, anti-shock, externally and internally powered equipment, per IEC 60601-1
Degree of protection	Type CF defibrillator-proof; per IEC 60601-1 Degree of noxious-liquid proof as IPX1 Anti-shock degree as combination of CF applied part According to the degree of safety of application in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide, the equipment is not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide
Sterilization and disinfection	As recommended by manufacturer
Mode of operation	Continuous

## Safety Conventions

The manual uses the following conventions for Notes, Cautions, and Warnings.

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**Note** — A **Note** calls attention to an important point in the text.

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**Caution** A **Caution** calls attention to a condition or possible situation that could damage or destroy the product or the user's work.

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**Warning** A *Warning* calls attention to a condition or possible situation that could cause injury to the user and/or animal.

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## Safety Requirements

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**Note** — The safety indications in this chapter apply to general monitor use. Safety indications in other chapters apply to specific monitor measurements.

Follow the instructions in this user manual when using the monitor. However, conventional medical practices always supersede this document. Significance of safety requirements set forth here in this manual is not in order of reading sequence.

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**Warning** The monitor is not for home use.

The monitor is only for use on one animal at a time. The monitor is not for diagnostic or therapeutic use.

The monitor is not an apnea monitor. The respiration measurement does not recognize obstructive and mixed apneas — it only indicates when a user-defined time has elapsed since the last detected breath.

Anyone who connects to additional equipment to the signal input port or signal output port configures a medical system and is therefore responsible to ensure that the system complies with the requirements of standard IEC 60601-1. Never permanently install equipment connected to the signal input or output ports. If in doubt, contact supplier.

To avoid mixture, clear all historical data of the last animal before monitoring a new animal. Ensure that the veterinary monitor is in good working condition and is placed in proper position before clinical use.

Never rely exclusively on the alarm system for veterinary monitoring. You must periodically check that monitor alarms are working properly. The most reliable method of veterinary monitoring combines close, personal surveillance along with the correct operation of the monitor.

For pacemaker animals, rate meters may continue to count the pacemaker rate during occurrences of cardiac arrest or come arrhythmia. Do not rely entirely upon rate meter alarms. Keep pacemaker animals under close surveillance. See this manual for disclosure of the pacemaker pulse rejection capability of this instrument.

Never use the monitor during MRIs or CT scans.

Never use cables with exposed conductors. Only use undamaged cables and connectors to avoid personal injury.

Never simultaneously touch the animal and the input or output terminal of the monitor.

The monitor can be used with electrosurgical devices. To avoid burns or death, ensure that the electrosurgical circuitry is properly connected.

Ensure that the animal is not connected to any metal, the surface of any conductors, or grounded parts of any devices when a defibrillator is in use. Never touch the animal, table, or instruments during defibrillation.

Never use the monitor in an environment of anesthetic gases.

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**Disconnect the AC power supply and remove the battery before disassembling the monitor.**

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**Caution** To avoid personal injury, only use accessories and parts produced or recommended by supplier. Otherwise, damage to the monitor can occur.

Position power cords and other cables to prevent tangling, animal contact, or electrical interference.

Always use a three-wire receptacle in order to properly ground the monitor. Use the monitor on battery power only if you suspect any problem with external grounding or wiring.

Only connect the monitor to a power outlet with correct protective grounding. If no grounded power is available, only use the monitor with internal batteries.

The battery will discharge over time when stored inside a monitor with no AC power. Keep the monitor plugged in when storing it and perform a monthly check of battery power.

If multiple devices are connected to an animal, the sum of the leakage currents may cause a dangerous situation. Therefore, qualified service representatives should always perform current leakage tests before setting up the connections. This ensures that leakage is within limits and prevents personal injury and environmental damage. If any question remains, consult the manufacturer for correct usage.

The monitor must conform to the international standard IEC 60601-1-2 and other applicable EMC standards. Interference takes place when electromagnetic energy is extremely high. Ensure that any nearby instruments are also in compliance with EMC standards. Never turn on or use portable communication devices like mobile phones or portable dual-channel radios near a monitor.

Unknown electromagnetic interference could be caused by radio transmitters or nearby televisions. Move veterinary monitors away from these devices or insert shielding materials around the monitor.

Any devices connected to the monitor must comply with the IEC standard for that device. For example, data processing devices must comply with IEC 60950 and medical devices must conform to IEC 60601-1. The whole system must comply with the most recent IEC 60601-1-1 standards.

To ensure monitor safety, all service parts and accessories must comply with IEC 60601 standards. The system configuration of the monitor must comply with IEC 60601-1-1 medical electrical standards.

If animal data is lost, closely monitor the animal or replace the monitor immediately until the monitor restores normal function again.

Monitoring will be stopped while user configurations will be saved automatically when the monitor is powered off.

To reduce the hazard of burns in high-frequency surgical neutral connections, the leads and connectors must be located away from the surgical site. Keep cables away from other devices.

Ensure that qualified service representatives annually calibrate and maintain the monitor.

Periodically check all reusable accessories for damage. Replace and dispose of damaged accessories. When necessary according to your local hospital waste disposal regulations.

ECG electrodes are disposable accessories. Always properly dispose of ECG

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electrodes according to your local hospital waste disposal regulations.

**Clean and sterilize the monitor and accessories according to local requirements. Turn off the monitor and disconnect the power cords before cleaning or sterilization.**

**Keep all monitor packing materials away from children, or dispose of them in accordance with your local environmental regulations.**

**Always properly dispose of the monitor and all accessories at the end of their service life. Dispose of batteries according to your local regulations. Never incinerate batteries or expose them to high temperatures.**

**Ensure that no water condenses into or on the monitor. Condensation can occur from changes in temperature or exposure to humidity.**

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# Chapter 1 Overview

The Veterinary monitor is used for monitoring, recording, and alarming of multiple physiological parameters of horse, dogs, cats, rabbits and else. The monitor stores data in trend and event databases. You can view measurement trend graphs and alarming events to help you identify changes in the animal's physiological condition.

The monitor can monitor ECG, RESP, TEMP, NIBP, SpO<sub>2</sub> and PR. In addition, the monitor has options as CO<sub>2</sub> and IBP.

This document is an integral part of the monitor and provides detailed instructions on how to use and maintain it. Keep the document next to the monitor for reference. In addition, read and keep any documents that come with any accessories, since these contain important information not in this guide.

This guide describes all of the monitor features and options. Your monitor may not have all of them. What you see on the screen, how the menus appear and so forth, depends on the way it has been configured for your hospital.

## 1.1 Indications for Use

The Veterinary monitor is for use by veterinary professionals whenever there is a need for monitoring the physiological parameters of animals.

## 1.2 Intended Use

The Veterinary monitor is intended for monitoring, recording, and alarming of multiple physiological parameters of horse, dogs, cats, rabbits and else in healthcare environments. Additionally, the monitor is for use in transport situations and for connectivity to clinical networks.

## Chapter 2 Basic Operation

This chapter describes how to set up and begin using the Veterinary monitor.

### 2.1 Before You Begin

Before veterinary monitoring, ensure that the monitor is in good condition and used in the proper environment.

#### 2.1.1 Unpacking the Equipment

1. Unpack the equipment and ensure that you have the following:
  - One veterinary monitor
  - Set of veterinary accessories

If anything from the packing list is missing, immediately contact supplier.

2. Keep the packing case for future transport or storage. If it is damaged, immediately contact the courier company.
3. Examine the monitor for cleanliness and general physical condition. Ensure that:
  - The housing is not cracked or broken.
  - Power plugs and cords are in good condition and plug prongs are not bent.
  - The accessory cables are intact.

---

**Caution** If the equipment, accessories, or their packaging show signs of damage, do not use the equipment.

---

#### 2.1.2 Setting up the Monitor

Place and use the monitor in an appropriate location that conforms to the environmental specifications in the section, Environmental Specifications on page B-14. Locate the monitor in an area that:

- Is convenient for observation and operation.
- Is free from movement, dust, corrosive or explosive gases.
- Has a five-centimeter space around to ensure good ventilation and smooth heat dissipation.

You can put the monitor on a flat surface or mount it with the following mounting accessories (if purchased):

- Trolley
- Wall mount

---

**Warning** Never attempt to open the monitor case. Only qualified personnel should service the monitor.

Never block the monitor's air vent during operation.

---

#### 2.1.3 Monitor Power Supply

You can power the monitor with either an AC power source or its internal battery. You can switch back and forth between supplies without powering off the monitor.

When the monitor is connected to an AC power source, you can turn on and operate the veterinary monitor.

When powered on, the monitor is in normal working condition. It can be used to measure vital signs, communicate with the central monitoring system, and charge the battery.

When the monitor is in standby mode, the monitor battery is charging.

When AC power is lost, the battery powered monitor continues to run without interruption on battery power. For more information on battery power, see Chapter 15, maintaining the Battery.


## 2.1.4 Inspecting the Monitor

Before you start using the monitor, ensure that:

1. There is no damage to the monitor or the accessory. Before turning on the power, check the monitor and all the cables, connectors and accessories and ensure that the extension cables are correctly connected to the fittings.
2. AC power is in conformity with standards. Plug one end of the specified power cord into an AC power supply with a protection-grounded wire. Plug the other end into the power connector on the monitor. When the power cord is correctly connected, the AC power LED is green. If the monitor is powered by battery, verify that adequate power remains and the battery power gauge is full.
3. The accessories are correctly connected. For further testing of individual measurement alarms, perform the measurement on yourself (for example, SpO<sub>2</sub>) or use a simulator. Adjust the alarm limits and ensure that you observe the appropriate alarm behavior.
4. All settings like animal type, alarm limits and so on, are correct. Ensure that the monitor is in good working condition and that all functions of the monitor meet the technical requirements mentioned in this guide.
5. When you press the **Power** button on the front panel for 2 seconds, the main screen appears.

## 2.1.5 Checking Your Monitor Software Release

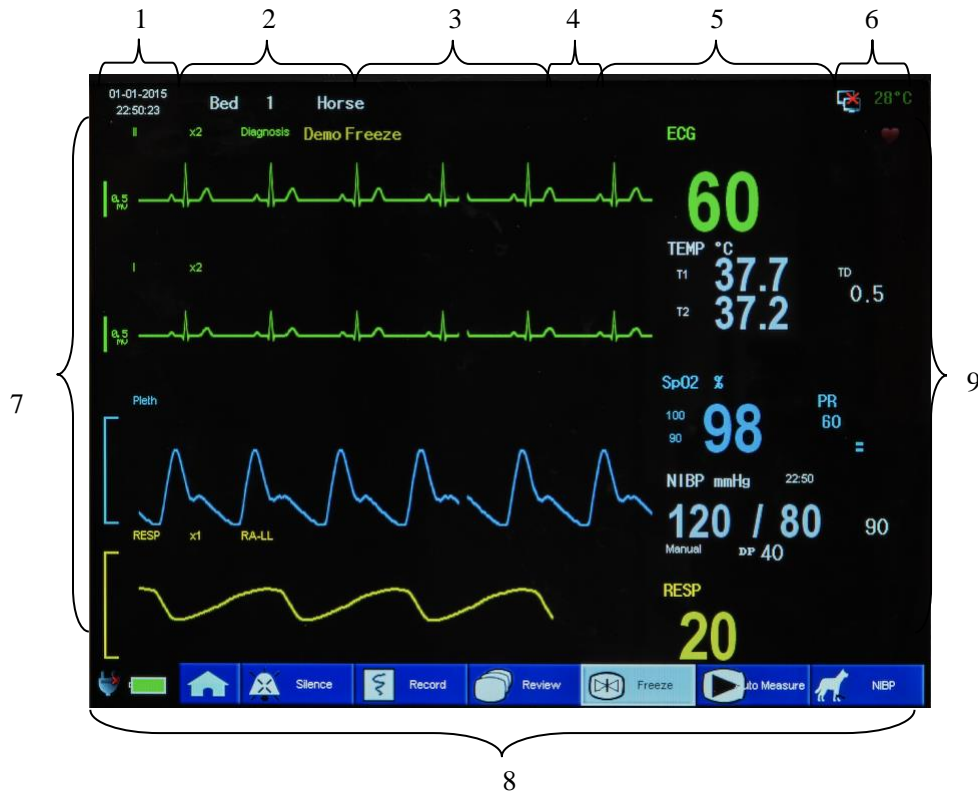
To check the software release of the monitor:

1. Enter **Main** menu ---- Maintenance
2. Choose **About...** and press it. A window displays the software release number with the format: **V1.0.9 (XX.X.X)**
3. Click icon  to return to the previous menu.
4. Repeat until you return to the monitoring screen.  
Or press **Main** return to monitoring screen directly.

## 2.2 Screen Display

The monitor displays parameters, waveforms and relevant information of animal measurements. The main screen display could look different, depending on the configuration of the monitor. You can select a main screen display according to your needs.

The following figure shows a typical screen display.



**Figure 2-4 Display Example**




















The following table describes the screen display.

**Table 2-4 Screen Display Description**

Item Number	Description	Item Number	Description
1	Date and time	6	Monitor internal temperature
2	Animal information	7	Waveforms
3	Technical alarm messages	8	Menu area
4	Alarm Silence remind	9	Numeric panes
5	Physiological alarm messages		

### 2.3.1 Icons on menu area

**Table 2-5 Icons Description**

Meaning	Icon	Description
Silence		Press to pause or restore alarms.
Record		Press to start or stop recordings.
Information review		All waveforms, alarm, NIBP, graphic and tabular trends review
Freeze		Press to freeze or unfreeze waveforms.
Auto Measure		Start Auto NIBP measurement
NIBP		Press to start or stop NIBP Measurement.
Main		Pressing it will enter the main menu for monitor set up.
Record Setup		Record output setup
Alarm Setup		Alarm Limits Setup
Volume		Press to set up volume
Brightness		Press to set up brightness.
Standby		Enter standby mode
Drug Calculation		Drug Calculation Set up
Trend table		Trend table review
Trend Graph		Trend graph review
NIBP Review		NIBP review
Waveform Recall		Review waveform
Animal		Press to display animal information Menu
---		Press down.

## 2.3 Using the Monitor Menus

You can configure the monitor system and measurement settings with the monitor menus. The functions can be accessed by rotate the navigation wheel or touch screen and function key.

## 2.4.1 Submenu

The symbol “>>” on a menu indicates that a menu contains a submenu.

1. To access a submenu by navigation wheel or touch screen.
2. Make your changes, then click icon **X** to return to the previous menu.
3. Repeat until you return to the monitoring screen.  
Or press **Main** back to monitor screen directly.

## 2.4.2 Exiting a menu

You can exit a menu in these ways:

- Use **Main** menu exit and back to the monitoring screen.
- Click icon **X** on the menu, back to previous menu. And repeat until return to monitor screen.

## 2.4 Configuring the Display

You can configure the display to a variety of layouts.

### 2.5.1 Using the Big Number Screen

To display Big Number screen:

1. Enter **Main** menu.
2. Enter **Setup Interface**.
3. Choose display optional and Select Interface. A Listbox appears.
4. Choose **Big Numerics** and press to confirm.

Select the **Big Number** option to enlarge the information on the numeric panes on the screen. This provides a better view of parameters for remote monitoring.

The following figure shows an example of the screen display when **Big Number** is selected:

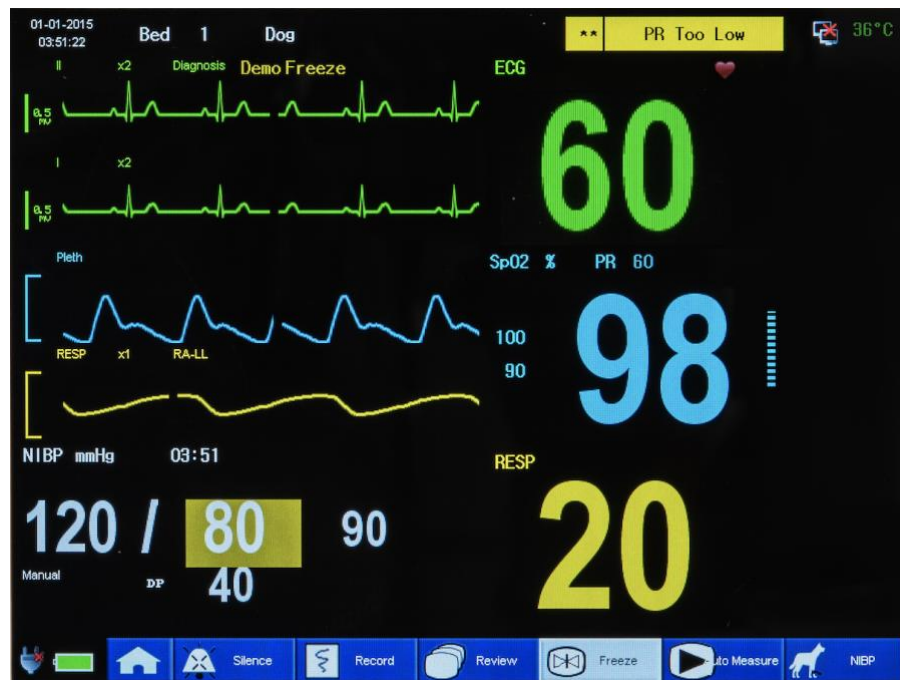


Figure 2-5 Example of Big Number Display

## 2.5.2 Using the Dynamic Trend Screen

To display dynamic trend screen:

1. Enter **Main** menu.
2. Enter **Setup Interface**.
3. Choose display optional and Select Interface. A Listbox appears.
4. Choose **Dynamic Trend** and press to confirm.

In the dynamic trend view, the monitor displays the most recent trends. The parameter values are plotted vertically along the y-axis of the graphical display. You can set a time range in the Dyn Trend Time menu and that range appears along the horizontal x-axis. The most recent measurements appear on the right side of the graph and the data scrolls to the left, so the oldest data appears on the far left side of the graph.

## 2.5.3 Using Standard Mode

To display Standard interface screen:

1. Enter **Main** menu.
2. Enter **Setup Interface**.
3. Choose display optional and Select Interface. A Listbox appears.
4. Choose **Standard Interface** and press to confirm

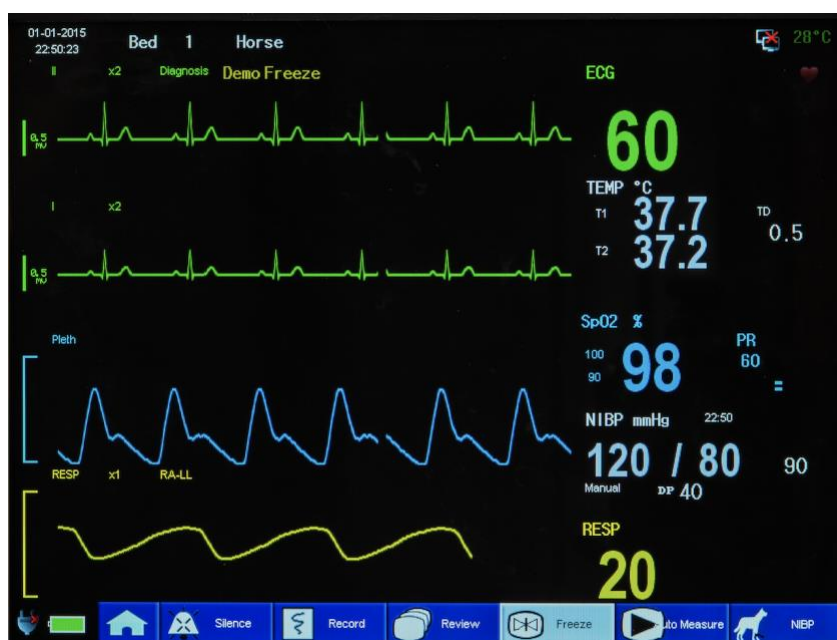


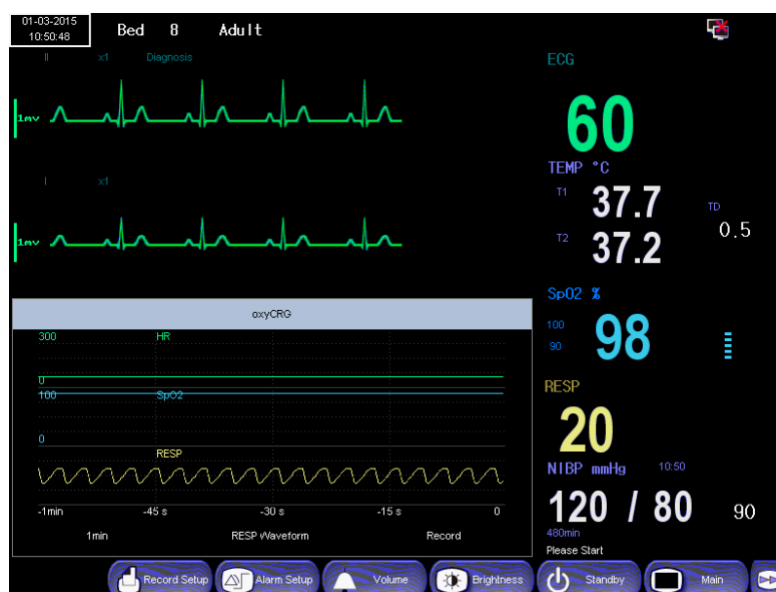
Figure 2-7 Example of Standard interface Screen

## 2.5.4 Displaying the OxyCRG Screen

To display the OxyCGR screen:

1. Enter **Main** menu.
2. Enter **Setup Interface**.
3. Choose display optional and Select Interface. A Listbox appears.
4. Choose **OxyCRG** and press to confirm.
5. An **OxyCRG** screen displays a compressed RESP waveform and beat-to-beat trends for HR and SpO<sub>2</sub>.

The oxycardiography (OxyCRG) can show a segment of waveforms and data collected from ECG, SpO<sub>2</sub> and RESP measurements.



**Figure 2-8 Example of OxyCRG Screen**

To configure the time span of the OxyCRG:

1. Enter **OxyCRG** area, **OxyCRG Setup** window appears.
2. Press **time Select**, a Listbox appears. Options are **1min**, **2min** and **4 min**.
3. Choose an option and press to confirm.
4. Exit the menu.

### 2.5.5 Using Standby Mode

The monitor has two modes: work mode and standby mode. When the monitor is powered on, it starts up in work mode by default. If not monitoring a animal, you can select standby mode to lower battery usage.

In standby mode, the monitor:

- blanks the screen and displays the message **Standby**.
- continues charging the battery connected to AC power.
- saves trend data.
- stops veterinary monitoring.
- stops sending animal data and alarms to the Central Monitoring System.

To enter standby mode:

1. Enter **Standby** menu.
2. Confirm **Yes** to enter Standby mode. The screen displays a **Standby** message.
3. Press any key on the panel or touch the screen or press navigation wheel to exit standby mode and return to the monitoring screen.

---

**Caution** Never enter Standby mode when monitoring a animal. The monitor does not collect animal data until you exit Standby mode.

---

### 2.5.6 Changing the Waveform Speed

You can configure the speed at which physiological waveforms are displayed. The unit of

waveform speed is mm/s. increasing the waveform speed spreads out the waveform scale in the channel for more detailed observation. Reducing the waveform speed compresses the waveform display so that waveform segments display for longer periods of time.

To change the waveform speed:

1. Changing the waveform speed can be done at numeric area. (Only RESP and SpO<sub>2</sub> can be modified at numeric area panes )
2. Enter Numeric area, a **Waveform Setup** appears.
3. Press **Waveform Speed**, a Listbox appears.
4. Choose the needful speed and confirm.
5. Exit the menu.

**Table 2-6 waveform speed description**

Parameter	You can select
ECG	12.5mm/s,25.0mm/s,50.0mm/s
SpO <sub>2</sub>	12.5mm/s,25.0mm/s
IBP	6.25mm/s,12.5mm/s,25.0mm/s
RESP	6.25mm/s,12.5mm/s,25.0mm/s

---


**Note** —When you change the speed of an ECG, IBP, or SpO<sub>2</sub>waveform, you also change the speed for the other waveforms. This is the same for RESP and CO<sub>2</sub> waveforms.

---

### 2.5.7 Changing the Waveform Color

You can configure the color of each waveform. When you change the waveform color, the corresponding numerics also change.

To change the color of a waveform:

1. Press the **Main** menu to display the **Main** menu.
2. Press **System Maintenance**.
3. Press **Color Custom**.
4. Select color option and click icon  to confirm.
5. Exit the menu.

### 2.5.8 Freezing the Waveforms

You can freeze the real-time waveforms to check measurements more closely.

When monitoring.

- Press the Waveform **Freeze** key on the bottom panel to freeze waveforms. Or enter Freeze menu at menu area to freeze waveforms.
- To unfreeze waveforms, press the **Waveform Freeze** key on the bottom panel or press the Freeze menu at menu area.

## 2.5 Changing the Monitor Settings

---

**Warning** Check for the correct animal type and alarm settings before changing the monitor settings.

---

## 2.6.1 Changing the Language

To configure the monitor language:

1. Enter **Main** menu.
2. Enter **System Maintenance**.
3. Type **User Password 2014** and confirm.
4. Select language option at **Choose Language**.
5. Choose Language and confirm by press it.

The following table lists the available languages in the monitor:

**Table 2-7 Monitor Language**

You can select	
CHINESE	SPANISH
ENGLISH	TURKISH
RUSSIAN	PORTUGU

## 2.6.2 System Maintenance Menu

Only service personnel are authorized to configure the monitor for troubleshooting, service or restoring factory settings. The System Maintenance menu for factory password is protected and not available to the user.

## 2.6.3 Changing the Date and Time

---



---

**Warning** Changing the Date and Time deletes all data at the bedside (including stored trends and events).

---




---


The monitor displays the current date and time in the top left corner of the monitoring screen. Once set, the monitor saves the information in its internal clock even when powered off. All animal data, including waveforms, trends and measurements are stored to the preset timestamp.

There are two ways to change date and time

Method 1:

1. Enter **Main** menu.
2. Enter **Setup Interface**.
3. Enter **Time**.
4. Change date and time information.
5. Click icon  to confirm and back to previous menu.
6. Exit the menu.


Method 2:

1. Enter Date and Time area.
2. Change date and time information.
3. Click icon  to confirm and back to previous menu.
4. Exit the menu.

## 2.6 Changing the Brightness

When the monitor is under animal transport or using battery power, you can lower the brightness to save battery power.


To configure the monitor brightness:

1. Enter Brightness menu.
2. Select brightness level option (total 20 levels).
3. Click icon  to confirm and back to monitoring screen.

## 2.7 Managing Animals

Animal information must be properly administered and documented. The monitor displays physiological data and stores it in the trend database as soon as an animal is connected. This lets you monitor an animal not yet admitted. However it is important to properly identify a animal on recordings, reports, and networked devices.

To admit a animal:

1. Enter **Animal** menu. A **Animal Information** window appears.
2. Enter information and click icon  to confirm.
  - **Bed**: enters the animal's bed number. The maximum length is 4 letters.
  - **Sex**: selects **Male** or **Female**.
  - **Type**: select **Horse (large animals)**, **dog (small animals)** or **cat (small newborn animals)**.
  - **Pace**: Pacemaker Detect, select **ON** or **OFF**.
  - **New Animal**: selecting **Yes** clears animal data. Ensure that all necessary reports are printed before selecting **Yes**. Selecting **No** keeps the current measurement data.

When animal information is configured, the relevant information displays at the top left of the monitoring screen.

---

**Note** —Animal information is saved when there is a power loss.

Changing the **Type** in the **Animal Information** window also changes the **Animal Type** in the NIBP menu. Changing the **Type** in the **Animal Information** window might also change the HR and NIBP alarm limits. Changing the **Type** in the **Animal Information** will change all the relative parameters' alarm limits. Always check the alarm limits to ensure that they are appropriate for your animal.

---

## Chapter 3 Alarms

This chapter describes how to configure alarms, including alarm levels and alarm limits. The alarm information in this chapter applies to all measurements. Alarms for specific measurements are described in their respective chapters.

Alarms sound when the monitor senses an irregular condition either in monitor operation or alarm limits.

Alarms include:

- Visual alarms
- Audible alarms

---

**Note** — To correctly identify visual alarms, always observe the monitor within 1 meter of its position.

---

### 3.1 Alarm Types

Alarms consist of physiological alarms and technical alarms. For more information on physiological and technical alarms table.

Physiological alarms are triggered by physiological values exceeding the limits or by an animal's abnormalities.

Technical alarms are triggered by equipment malfunction or improper equipment use. When a technical alarm occurs, there might be problems with readability of animal data; however measurements are not interrupted.

### 3.2 Alarm Levels

Both physiological alarms and technical alarms are classified by priority:

**High:** indicates a potentially life-threatening or other serious situation. These alarms require an immediate response from the clinician.

**Medium:** indicates a physiological condition that requires timely handling. These alarms can be exceeded values or system irregularity. Most medium priority alarms are triggered by values exceeding alarm limits.

**Low:** indicates equipment malfunctions. These alarms require less immediate handling. For example, a low priority alarm might indicate low battery power.

### 3.3 Visual Alarms

The monitor uses the following visual alarm indicators: flashing LEDs, flashing numeric values, and alarm messages.

#### 3.3.1 Flashing LEDs

There is an alarm LED on the front panel of the monitor which divided into two parts. The left is alarm light and the right is messages remind light. The following table describes the alarm LED colors:

**Table 3-1 Alarm LEDs**

Light	Color
High priority alarm	Red, fast flicker

**Table 3-1 Alarm LEDs (continue)**

Light	Color
Medium priority alarm	Yellow, slow flicker
Low priority alarm	Yellow, keep lighting without flicker
Reminder light	Blue, flicker

---

**Note** — If more than one alarm condition is active, the monitor signals the most severe.

---

### 3.3.2 Flashing Numeric Values

When a parameter value exceeds the preset alarm limits, the corresponding numeric flashes.

### 3.3.3 Alarm Messages

When an alarm is triggered, the alarm message appears in the corresponding alarm area. NIBP alarm messages display in the NIBP parameter list.

Higher priority alarm messages pre-empt other priority alarm messages for the same parameter. If multiple alarms of the same priority occur at the same time, the alarm messages rotate every 2 seconds. For more information on alarm messages.

## 3.4 Audible Alarms

When audible alarms are turned on, the audible alarms are repeated at certain intervals. If alarms of more than one priority are triggered, the monitor sounds the most severe. Audible alarms are configurable. You can turn the alarm sound on or off, pause the alarm, or adjust the alarm volume.

The frequency of audible alarm is 200 Hz ~500Hz.

---

**Note** — Changing the alarm sound does not affect visual alarm indicators.

On startup, if the monitor is not connected to a animal, technical alarms are silent (except for the low battery). If the monitor is connected to a animal on startup, technical alarms sound (**Leads Off**, for example)

---

The alarm sound depends on the alarm priority. The following table describes the alarm sound on different alarm priority.

**Table 3-2 Alarm Sound**

Alarm Priority	Alarm Sound
High	Three short beeps followed by two short beeps. This repeats twice, then every 11 seconds. DU-DU-DU-----DU-DU-----DU-DU-DU-----DU-DU
Medium	Three short beeps repeat every 25 seconds, DU-DU-DU
Low	Two short beeps repeat every 25 seconds. DU-

---

---

**Warning** Do not rely exclusively on the audible alarm system for veterinary monitoring. Changing the alarm volume to a low level or turning it off during veterinary monitoring could result in animal danger. The most reliable method of veterinary monitoring combines close personal surveillance with correct operation of monitoring equipment.

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### 3.4.1 Turning On/Off Audible Alarms

When all audible alarms are turned off, the alarm off icon displays in the Alarm Silence remind the screen.


Press “ SILENCE” button to turn on /off all the audible alarms.

To turn on/off individual audible alarms:

Method 1:

1. Enter the **Menu**, then select **Alarm Setup** menu.
2. Choose a parameter setup menu press to enter it. A parameter alarm setup menu appears.
3. Choose turn on/off an individual alarm.
4. Click icon  to confirm and back to previous menu.
5. Exit the menu.

Method 2:

1. Enter individual parameter at numeric panes. The individual parameter setup will appear.
2. Choose turn **ON/OFF** alarm.
3. Click icon  to confirm and back to previous menu.
4. Exit the menu.

---

**Note** —When all audible alarms are off, pressing the **Alarm Silence** menu turns on alarm sounds again. The Alarm Off configuration is not saved when the monitor is turned off. When you turn the monitor on again, audible alarms are on by default.

---

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---

**Warning** When all alarms are turned off, no audible alarm appears for any alarm-triggered event.  
However, visual alarm indicators and messages continue to appear. You cannot turn these off.

---

---

### 3.4.2 Pause Alarms

To pause all audible alarms, press the Alarm Pause menu.

Audible alarms pause for two minutes and resume when the timeout counter reaches 00:00. When all audible alarms are silenced, the monitor displays the Alarm Pause icon Alarm Pause remind area.

Setup Alarm Pause for **1** or **2** minutes.

1. Enter **Main** menu.
2. Enter **Setup interface**.
3. Choose **1 min** or **2 min** at Alarm Silence Time.

To activate all audible alarms before the timeout counter reaches **00:00**, press the **Alarm Pause** menu again.

---


**Note** —Audible alarms reactivate when new alarm-triggered events occur during an alarm pause. These audible alarms sound according to the alarm priority.

---

### 3.4.3 Adjusting the Alarm Volume

You can adjust the alarm volume from one to thirty- two. The minimum volume is one.

To adjust the alarm volume:

1. Enter **Main** menu.
2. Enter **Setup Interface**.
3. Volume options **from 1 to 32 levels** available at Alarm Volume. .
4. Click icon  to confirm and back to previous menu.
5. Exit the menu.

## 3.5 Setting Alarm Limits

You can set alarm limits based on an individual animal's vital signs measurements. These limits determine the conditions that trigger alarms based on the high and low limits set. You set alarm limits in the specific parameter alarm setup menu. See the chapters in this guide for setting specific parameter alarm limits.

---

---

**Warning** Always check that the alarm settings are appropriate for your animal before you start monitoring.

---

---

### 3.5.1 Setting Individual Alarm Limits

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---

**Warning** You can set certain parameter alarm limits (SpO<sub>2</sub>, for example) from 0 to 100. Setting the upper limit to 100 or setting the lower limit to zero is equivalent to no alarm limit. In these instances, the screen does not display an alarm off icon.

---

---

To set an individual alarm limit:

Method 1:

1. Enter **Parameter Menu** at numeric panes.
2. Choose **Alarm Setup**.
3. Choose Alarm Level, **Low**, **High** and **Medium** are options.
4. Set up alarm limit at Alarm High Limit and Alarm Low Limit.
5. Exit the menu.

Method 2:

1. Enter **Alarm Setup** at menu area
2. ECG, SpO<sub>2</sub>, TEMP, NIBP, RESP Alarm Setup are options. Choose one parameter and press to confirm.
3. Setup Alarm **ON/OFF**, Alarm limits and Alarm Level.
4. Exit the menu.

---

**Note** — Both alarm limits remain in the system until they are changed, including when you turn the monitor on and off, or after a power loss.

---

### 3.5.2 Restoring Default Alarm Limits

The monitor has alarm limit settings based on animal type. To restore the default alarm limits:

1. Enter **Main** menu, then **Maintenance** menu.
2. Enter **Default** menu.
3. Choose an option **No** or **Yes**.
  - Yes, keeping current alarm limits.
  - NO, restoring adult default alarm limits.

---

**Note** —User can not change default alarm limit.

---

### 3.6 Reviewing Alarm Events

You can review alarm events that occurred during monitoring in the Alarm Event Review window. The monitor can store 60 groups of alarm events in the system, including date; time, parameter values, and the corresponding alarm description.

To review alarm events:

1. Enter **Main** menu, then select **Review** menu.
2. Enter **Alarm Event Review**. The **Alarm Recall Condition** window appears
3. Adjust recall time, choose **Alarm Event Review**
4. Choose **Event type**, the alarm type window appears.
5. Choose individual alarm event from Listbox.
6. Exit the menu.

---

**Note** —When a animal is discharged; the monitor clears the previous animal data and deletes all alarm events from the **Alarm Event Review** window.

---

## Chapter 4 Monitoring ECG

This chapter describes ECG monitoring on the Veterinary monitor.

An electrocardiogram (ECG) monitors the electrical activity of the heart. The Monitor processes these electrical signals and displays an ECG waveform on the screen with its numeric on the numeric pane. The monitor can:

- Display up to 7 ECG waveforms
- Compute and display heart rate (HR) values
- Monitor ST segment deviation for each lead displayed
- Detect and filter pacemaker-generated signals
- Perform HR variation analysis

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**Warning** ARR, ST monitoring are not suitable for small newborn animals.

---



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### 4.1 Placing the Electrodes

Good electrode-to-skin contact is important for a good ECG signal because the skin is a poor conductor of electricity. To obtain valid signals, the animal skin must be cleaned before applying any electrodes.

---

**Note** — Thorough skin cleaning plays an important role in minimizing electrostatic interference. Before using high frequency devices, properly clean the skin and attach electrodes correctly to the animal site. This reduces the hazard of turns in case of a defective neutral electrode at the high frequency device.

---

To prepare the skin:

1. Select sites with intact skin and no impairment of any kind.
2. Clip or shave hair from sites as necessary.
3. Wash sites thoroughly with soap and water, leaving no residue. Do not use ether or pure alcohol because these substances dry the skin and increase resistance.
4. Dry skin thoroughly.
5. Use ECG skin preparation (abrasive) paper to remove dead skin cells and to improve the conductivity of the electrode site.

The labels and colors of the ECG electrodes differ according to the standards. The electrode placement illustrations in this guide use the AAMI and IEC labels and colors. The following table describes the AAMI and IEC labels and lead colors.

**Table 4-1 Lead Description**

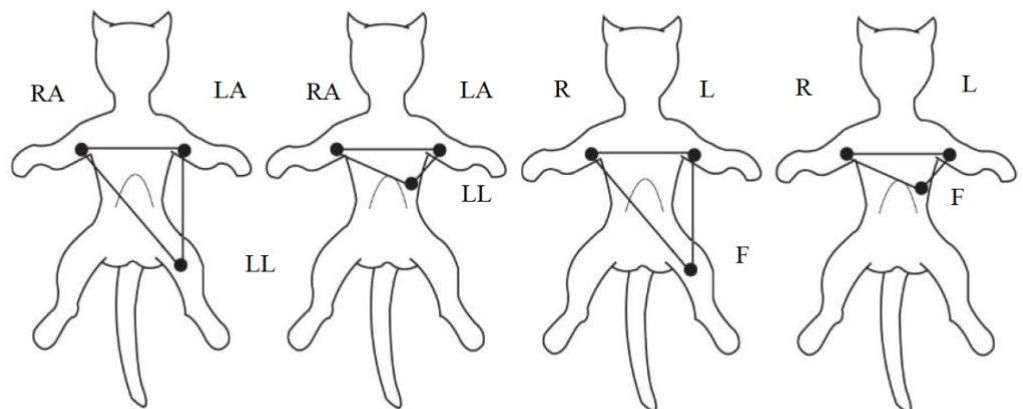
AAMI		IEC	
Lead	Color	Lead	Color
RA	White	R	Red
LA	Black	L	Yellow

**Table 4-1 Lead Description (continue)**

AAMI		IEC	
Lead	Color	Lead	Color
LL	Red	F	Green
RL	Green	N	Black
V	Brown	C	White
V1	Brown/Red	C1	White/Red
V2	Brown/Yellow	C2	White/Yellow
V3	Brown/Green	C3	White/Green
V4	Brown/Blue	C4	White/Brown
V5	Brown/Orange	C5	White/Black
V6	Brown/Violet	C6	White/Violet

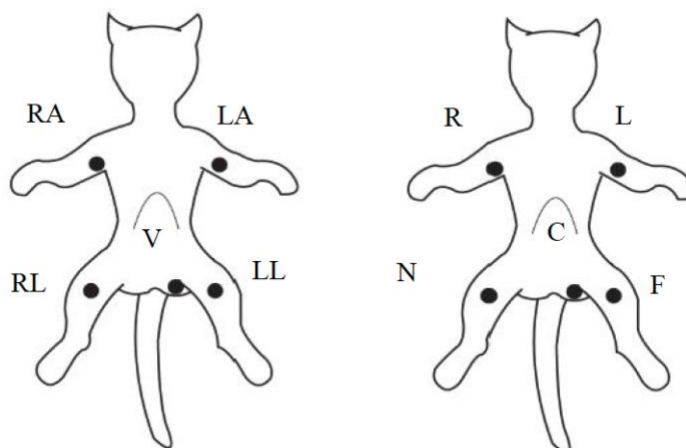
When placing electrodes, choose a flat, non-muscular site where the signal will not be affected by movement or bones. Correct lead placement is always important for accurate diagnosis, especially in the precordial leads, which are close to the heart. QRS morphology can be greatly altered if an electrode is moved away from its correct location.

The following figure shows the 3-lead ECG electrode locations:



**Figure 4-1 Three-Lead Locations**

The following figure shows the 5-lead ECG electrode locations:



**Figure 4-2 Five-Lead Locations**

### 4.1.1 Changing a Lead Set

A pair of electrodes forms a lead. Each lead provides a different view of the same cardiac activity. You can select a proper lead mode and an ECG lead. The selected lead mode and ECG lead displays on top of the ECG waveform.

To change the ECG lead set:

1. Enter **ECG Setup menu** at numeric panes.
2. Choose **Lead Type**, 3 Leads and 5 Leads are options.
3. Exit the menu.

---

**Note** — When **Three Lead** is selected, only one ECG waveform channel displays on the screen.

---

To select an ECG lead:

1. Enter **ECG Setup menu** at numeric panes.
2. Choose ECG 1 or ECG 2. A lead set option (see Table 4-2) appears.
3. Choose one lead and confirm.
4. Exit the menu.

**Table 4-2 ECG Lead**

When Lead Mode is	The options are
<b>3- Lead</b>	<b>I, II, III</b>
<b>5- Lead</b>	<b>I, II, III, aVR, aVL, aVF, V</b>

**I, II** and **III** are bipolar extremity leads. **aVR, aVL** and **aVF** are voltage-added extremity leads. **V** is the chest lead.

### 4.1.2 Lead Recommendations for Surgical Animals

The lead location depends on the type of surgical operation. For example, for chest surgery, the electrodes should be attached to the side or the back of the chest.

When high frequency electrosurgical equipment is used, animal leads and wires should be away from the surgical operation site and other devices. This reduces the burning risk due to a poor connection of the neutral electrode.

**Warning** Electrosurgical equipment must be properly grounded to avoid a current inflow hazard. This can cause interference on the ECG signal.

### 4.1.3 Connecting ECG Cables

To connect ECG cables:

1. Attach the clips or snaps to the electrodes before placing them. If you are not using pre-gelled electrodes, apply electrode gel to the electrodes before placement.
2. Place the electrodes on the animal according to the selected lead placement.
3. Attach the electrode cable to the animal cable.
4. Plug the animal cable into the ECG connector on the monitor.

**Warning** To protect the monitor from damage during defibrillation, to obtain accurate ECG information, and to protect against noise and other interference, use only ECG electrodes and cables approved by supplier.

During surgery, use the appropriate electrode ECG safety cable, or lead cable for measuring ECG in the operating room. These cables have extra circuitry to protect the animal from burns during cautery, and they decrease electrical interference. This also reduces the hazard of burns in case of a defective neutral electrode at the HF device. These cables cannot be used for measuring respiration.

## 4.2 The ECG Display

When ECG is being monitored, the monitor displays the ECG waveforms and its numeric values. The monitor can display up to 7 ECG waveforms at the same time on the screen.

### 4.2.1 ECG Waveform and Numeric Pane

The following figure shows a typical ECG waveform (ECG1, for example) and numeric pane:



Figure 4-3 Typical ECG Waveform and numeric pane

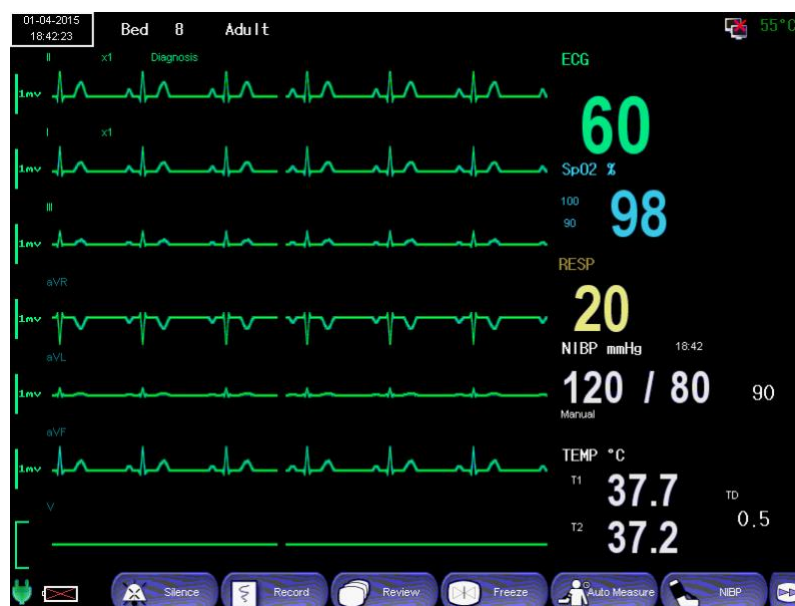
- 1 = 1 mV calibration bar
- 2 = ECG lead
- 3 = ECG gain
- 4 = ECG mode
- 5 = ECG1 waveform
- 6 = ECG numeric pane label
- 7 = ECG value
- 8 = ST numeric pane label (ST1/ST2)

- 9 = ST value (ST1/ST2)
- 10 = Heartbeat indicator
- 11 = Time interval (once per second)
- 12 = PVCs numeric pane label
- 13 = PVCs value

## 4.2.2 Displaying Seven ECG Waveforms

Depending on options, the monitor can display seven ECG waveforms at the same time and the heart rate value in ECG numeric pane.

The following figures show an example of a 7-ECG waveform display.



**Figure 4-4 Example of a 7-ECG Waveform Display**

To display or exit the 7-ECG display:

1. Enter ECG numeric pane **ECG Setup** window appears..
2. Enter **Other Setup**, **ECG Other Setup** windows appears.
3. Press **ECG Display**, a Listbox appear.
4. Choose **Multi-Lead Display**.
5. Exit the menu.

## 4.3 Configuring the ECG Display

### 4.3.1 Changing the ECG Waveform Size

If the ECG waveform is too small or clipped, use the ECG Gain menu to adjust the size of the waveform. Changing the ECG gain only affects the visual appearance of the ECG wave on the screen. It does not affect the ECG signal analyzed by the monitor.

You can configure the ECG gain for all ECG channels in the same manner. For example, to change the gain for ECG1:

1. Enter **ECG1** waveform area, **ECG1 Waveform Setup** window appears.
2. Selecting different gains displays the ECG waveform in different scales. In addition, a 1 mV calibration bar displays on the left of the **ECG1** channel. The following table describes the ECG scale:

**Table 4-3 ECG Scale**

<b>When the ECG Gain is</b>	<b>The scale height</b>
<b>X0.25</b>	is 2.5 mm.
<b>X0.5</b>	is 5 mm.
<b>x1</b>	is 10 mm.
<b>x2</b>	is 20 mm.
<b>Auto</b>	Varies in step with the ECG gain.

3. Exit the menu.

---

**Caution** A low ECG gain can result in incorrect HR measurements or asystole. When an ECG waveform is too low, change to the ECG lead with the strongest signal to prevent a Leads Off alarm.

---

### 4.3.2 Changing the ECG Waveform Speed

The waveform speed determines the speed at which the waveform is drawn across the screen. Changing waveform speed steps as following:

1. Enter **ECG1** or **ECG2** waveform area, **ECG1 Waveform Setup** or **ECG2 Waveform Setup** window appears.
2. Selecting different waveform speed.
3. The ECG waveform speed options are: **50.0 mm/s**, **25.0 mm/s** and **12.5 mm/s**
4. Exit the menu.

---

**Note** — Changes to the waveform speed of one ECG waveform apply to all of the displayed ECG waveforms.

---

### 4.3.3 Changing the ECG Waveform Color

For more information on changing ECG waveform color, see Changing the Waveform Color on page 22.

## 4.4 Changing the Heart Rate Volume

You can adjust the heart rate volume by two methods.

Method 1:

1. Enter **ECG Setup** menu at numeric panes.
2. Press **Other Setup**, an **ECG Setup** window appears.
3. Press **Beat Volume**, an option window appears.
4. The options of Heart Rate Volumes is from 1 to 32 levels
5. Exit the menu.

Method 2:

1. Enter **Volume** Menu.
2. Choose **Beat Volume**.
3. The options of Heart Rate Volumes is from 1 to 32 levels
4. Exit the menu.

## 4.5 Changing the ECG Mode

The monitor has three ECG modes for different monitoring environments: **Monitor**, **Operation** and **Diagnostic**. The current ECG mode displays on top of the ECG1 channel.

To change the ECG mode:

1. Enter **ECG Setup** menu at numeric panes.
2. Press **filter**, a **Listbox** appears. Options are Diagnosis, Monitor,.
  - In **Monitor** mode, false alarms are filtered.
  - In **Operation** mode, the monitor reduces false readings and interference. Use this only in locations (operating rooms, for example) where there is significant external interference that might cause ECG waveform distortion. This mode is not affected by calibration.
  - In **Diagnostic** mode, the original (unfiltered) ECG waveform displays.
3. Exit the menu.

## 4.6 Changing HR Alarm Settings

For more information on HR alarm settings, including turning on/off the HR alarm, see Setting Individual Alarm Limits on page 26.

---

**Note** —When all audible alarms are off, pressing the **Alarm Silence** key once turns on alarm sounds again. The Alarm Off configuration is not saved when the monitor is turned off. When you turn the monitor on again, audible alarms are on by default.

---

## 4.7 Monitoring Arrhythmia

Arrhythmia (short for ARR) is optional function. Contact your local supplier representative to open this function. ARR analysis analyzes the ECG waveforms and heart rate and provides a report on their changes.

### 4.7.1 Turning Arrhythmia Analysis On and Off

To turn ARR analysis on or off:

1. Enter **ECG Setup** menu at numeric panes.
2. Press **ARR Analysis**, ARR Analysis window appears.
3. Choose ARR Analysis **ON** or **OFF**.
4. Exit the menu.

### 4.7.2 Choosing an ECG Lead for Arrhythmia Monitoring

It is important to select a suitable lead for arrhythmia monitoring. Guidelines for non-paced animals are:

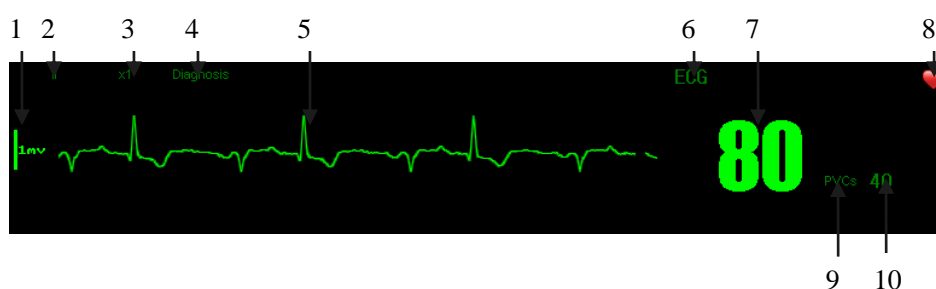
- QRS should be tall and narrow (recommended amplitude > 0.5 mV).
- R-wave should be above or below the baseline (not bi-phasic).
- T-wave should be smaller than 1/3 R-wave height.
- P-wave should be smaller than 1/5 R-wave height.

For paced animals, in addition to the above, the pace pulse should be:

- Not wider than the normal QRS.
- The QRS complexes should be at least twice the height of pace pulses.
- Large enough to be detected, with no re-polarization.

### 4.7.3 The Arrhythmia Display

The following figure shows an example of the ARR waveform and the numeric pane:



**Figure 4-5 ARR Waveform and Numeric Pane**

- 1 = 1 mV calibration bar
- 2 = ECG lead of ARR occurrence
- 3 = ECG gain of ARR occurrence
- 4 = ECG mode of ARR occurrence
- 5 = ARR waveform
- 6 = ECG numeric pane label
- 7 = ECG value
- 8 = Heartbeat indicator
- 9 = PVCs numeric pane label
- 10 = PVCs value (number of occurrence per minute)

The ARR type displays on the physiological alarm area. The ARR type can be:

**Asystole, VFib/VTach, VTach, Extreme Brady, Extreme Tachy, Non Sustain VTach, Vent Rhythm, Run PVCS, Pair PVCS, R on T PVC, Vent Bigeminy, Vent Trigeminy, PVC Rate High, Multiform PVC, Pacer not Capture, Pacer not Pace, Pause, Missed Beat, SVT, AFib, Irregular HR.**

---

**Note** —When no heartbeat is detected, an **Asystole** alarm message appears on the monitor. The system only collects ARR signals from the ECG1 channel.

---

## 4.8 Changing Arrhythmia Alarm Settings

When an ARR occurs, the ARR: occurred alarm message displays on top of the screen. To turn on PVC audible alarms, see Turning On/Off Audible Alarms on page 25. To turn off PVC audible alarms, see when all audible alarms are off, pressing the Alarm Silence key twice turns on alarm sounds again. The Alarm Off configuration is not saved when the monitor is turned off. When you turn the monitor on again, audible alarms are on by default on page 25.

## 4.9 Safety Information

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**Warning** Use only ECG cables or leads specified by supplier. Other ECG cables and leads can cause improper performance and/or provide inadequate protection during defibrillation.

Using electrodes of dissimilar metal materials can cause over polarization or accelerated polarization.

Ensure that the ECG connectors or electrodes never come into contact with other conductive parts, or with ground. In particular, ensure that all of the ECG electrodes are attached to the animal.

**For pacemaker animals, the monitor can continue to count pacemaker rate during cardiac arrest or some arrhythmias. Do not rely entirely upon the monitor's alarm. Keep pacemaker animals under close surveillance.**

**The monitor and defibrillator must be in good working order prior to cardioversion.**

**When a defibrillator is used, ensure that the electrodes and animal cables are not in contact with metal or other conductive surface or device grounds.**

**Do not use non-defibrillation cables to perform defibrillation on a animal. During RESP monitoring, do not use cables from an anti-electrosurgical unit.**

**Never entangle the electrosurgical (ES) cables with ECG cables. When using ES equipment, place the ECG electrodes halfway between the ES grounding plate and the ES knife to avoid burning.**

**When using electrosurgical equipment, never place ECG electrodes near the grounding plate of the ES devices, as this can cause interference on the ECG signal.**

**Properly ground electrosurgical equipment to reduce hazards from current inflow which might cause interference to the ECG signals. When using ES equipment, place the animal lead wires and cables far way from the operating room table and other devices.**

---

**Note** —ECG cables can be damaged when connected to an animal during defibrillation. Check cables that have been connected to a animal during defibrillation for functionality before using them again.

Monitoring with the pace detection feature enabled does not normally affect the monitoring of non- pacemaker animals. However, in some instances, if the animal does not have a pacemaker, it can be desirable to turn the detection function off so that artifacts in the waveform are not mistaken for a pacemaker signal.

When the ECG circuitry is overloaded or any part of the amplifier saturated, the top or the bottom of the ECG waveform appears dashed or becomes a straight, broken-line.

Use only recommended or qualified Ag/Ag/Cl electrodes.

Line isolation monitor transients may resemble actual cardiac waveforms and thus inhibit heart rate alarms. Such transients may be minimized by proper electrode and cable placement, as specified in this manual and electrode directions for use.

When the monitor is connected to a paced animal or other electric generators, or when the animal has an arrhythmia problem, incorrect HR measurements could occur. In this case, ECG signals might still appear after the animal is dead. Keep the paced animal under close observation in order to make correct diagnoses.

---

## Chapter 5 Monitoring Respiration

Respiration can be measured using one of the following methods:

- ECG. The monitor measures the thoracic impedance between two ECG electrodes on the animal's chest. Changes in the impedance due to thoracic movement produce the Resp waveform on the monitor screen. The monitor counts the waveform cycles to calculate the respiration rate (RR).
- CO<sub>2</sub>. You can measure an animal's airway respiration rate (awRR). The awRR value is calculated by directly measuring air movement in and out of the animal's airway.

### 5.1 Lead Placement for Monitoring Respiration

Correct animal skin preparation techniques for electrode placement are important for Resp. measurements. See Placing the Electrodes on page 28.

Cardiac Overlay: Cardiac activity that affects the Resp waveform is called cardiac overlay. Correct electrode placement can help to reduce cardiac overlay: avoid the liver area and the ventricles of the heart in the line between the respiratory electrodes. This is particularly important for neonates.

Lateral Chest Expansion: Some animals, especially neonates, expand their chests laterally. In this case it is best to place the two respiratory electrodes in the right midaxillary and left lateral chest areas at the animal's maximum point of breathing movement to optimize the respiratory wave.

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

#### 5.1.1 Selecting a Respiration Lead

Select a respiration lead according to your needs. Respiration is detected from impedance changes between the selected ECG electrodes.

To select a respiration lead:

1. Enter **RESP Setup** menu.
2. Press **RESP Lead**, a listbox window appears. .  
The **RESP Lead** options are: **RA-LA, RA-LL**.
3. Exit the menu.

### 5.2 The Respiration Display

The respiration measurement is displayed on the monitor as a continuous wave and a numeric respiration rate. The following figure shows an example of the respiration waveform and numeric pane

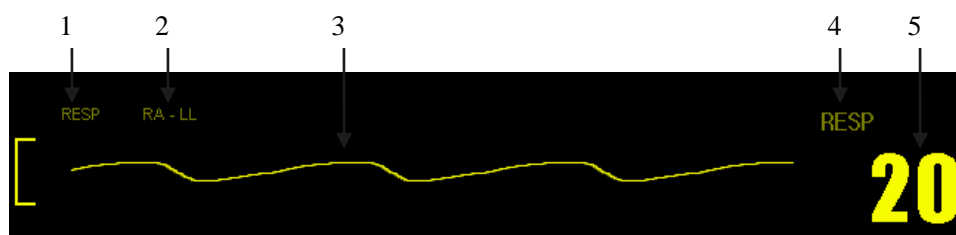


Figure 5-1 Resp Waveform and Numeric Pane

1 = Resp waveform label

- 2 = Resp lead
- 3 = Resp waveform
- 4 = Resp numeric pane label (respiration rate unit)
- 5 = Resp rate

---

**Note** — If the detected respiration rate is close to the heart rate, the alarm message **Beat Interference** displays.

---

## 5.3 Changing the Respiration Display

You can configure the monitor respiration display by changing the respiration settings.

### 5.3.1 Changing the Respiration Waveform Size

You can configure the respiration waveform size by selecting a respiration gain to increase/decrease the waveform height.

To change the RESP gain:

1. Enter **REST Setup** menu at numeric panes.
2. Choose **RESP Gain**, a listbox appears. Options are **0.25, 0.5, 1, 2, 4**
3. Exit the menu.

### 5.3.2 Changing the Respiration Waveform Speed

The waveform speed that you configure determines the speed that the waveform scans on the screen. For more information on changing the speed of the waveform, see Changing the Waveform Speed on page 19.

The options for waveform speeds are: **25.0 mm/s, 12.5 mm/s** and **6.25 mm/s**.

### 5.3.3 Changing the Color of the Respiration Waveform

For more information on changing the respiration waveform color, see Changing the Waveform Color on page 20.

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**Warning** The respiration measurement does not recognize obstructive and mixed apneas. It only indicates an alarm when a user-defined time has elapsed since the last detected breath.

The safety and effectiveness of the respiration measurement method in the detection of apnea, particularly the apnea of prematurity and apnea of infancy, has not been established.

If operating under conditions according to EMC Standard EN 60601-1-2 (Radiated Immunity 3V/m), field strengths above 1V/m might cause erroneous measurements at various frequencies. Therefore, avoid using electrically radiating equipment in close proximity to the respiration measurement unit.

To monitor respiration, use only non-OR ECG (non-shielded) accessories listed in Accessories on page 76 ,you cannot measure respiration if you are using an OR ECG cable set. This is because of the higher internal impedance of the OR cable set, required for use if electro-surgery is being performed.

Implanted pacemakers which can adapt to the Minute Volume may occasionally react on the Impedance measurement used by veterinary monitors for the determination of the Resp value and execute pacing with the maximum programmed rate. Switching off the Resp measurement can prevent this.

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## 5.4 Changing the Respiration Alarm Settings

To turn on/off the RESP audible alarm and for more information on changing the respiration alarm settings, see Setting Individual Alarm Limits on page 26.

## 5.5 Changing the Apnea Alarm Settings

The apnea alarm is a high priority alarm used to detect apneas. The respiration measurement does not recognize obstructive and mixed apneas it only indicates an alarm when a user-defined time has elapsed since the last detected breath.

To turn apnea alarms on or off:

1. Enter **RESP Setup** menu at numeric panes. .
2. Press **Apnea Alarm**, a listbox appears.
3. Press **No**, close Apnea Alarm. Press **10s, 15s, 20s, 25s, 30s, 35s, and 40s** to confirm Apnea alarm on. Apnea Alarm Time is the time that has elapsed since the last detected breath. It ranges from 10 seconds to 40 seconds at 5-second intervals.
4. Exit the menu.

## 5.6 Safety Information

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**Warning** Do not use ECG cables with ESD resistance for monitoring RESP.

**The monitor measures respiration by using ECG cables and electrodes. Do not use an operating room (OR) ECG cable set to monitor respiration. Respiration can only be monitored with an ICU ECG cable set. This is because of the higher internal impedance of the OR cable set.**

**Radiated electromagnetic signals from sources external to the animal and monitor might cause inaccurate respiration readings. Keep animals under close surveillance when monitoring respiration.**

**Excessive animal movement could result in incorrect respiration measurements. Pay close attention to animals who move excessively.**

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**Note** —When ECG electrodes are applied to an animal's arms, respiration impedance monitoring is not available.

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## Chapter 6 Monitoring SpO<sub>2</sub>

Pulse oximetry uses a motion-tolerant signal processing algorithm. It provides these measurements:

- Oxygen saturation of arterial blood (SpO<sub>2</sub>) percentage of oxygenated hemoglobin in relation to the sum of oxyhemoglobin and deoxyhemoglobin.
- Pleth waveform – A visual indication of an animal's pulse.
- Pulse rate – rate of arterial pulsations.

### 6.1 Selecting an SpO<sub>2</sub> Sensor

Read the Instructions for Use supplied with your sensor before using it. See SpO<sub>2</sub> accessories on page 76 for recommended SpO<sub>2</sub> sensors.

### 6.2 Applying the Sensor

Follow the SpO<sub>2</sub> sensor's Instructions for Use, adhering to all warnings and cautions.

To correctly apply the sensor:

- Remove colored nail polish from the application site.
- Ensure that the sensor is applied to smooth skin sites with sufficient arterial blood flow and that no excessive animal movement and/or vibration occur.
- Apply the sensor at the same level as the animal's heart.
- Ensure that the sensor is not on extremities with an arterial catheter or intra vascular venous infusion line.
- Ensure that the sensor is the appropriate size. The sensor should not be so loose as to fall off, nor should it be too tight.
- Ensure that the light emitter and the photo-detector are directly opposite each other. All light from the emitter must pass through the animal's tissue.

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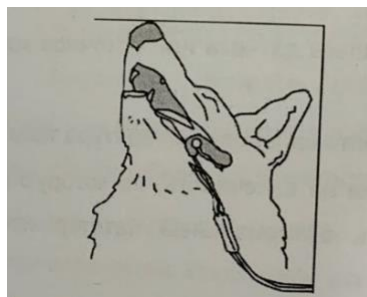
**Warning** At elevated ambient temperatures be careful with measurement sites that are not well perfused because this can cause severe burns after prolonged application. All listed sensors operate without risk of exceeding 41 °C(105.8 °F) on the skin if the initial skin temperature does not exceed 35°C (95 °F).

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### 6.3 Connecting SpO<sub>2</sub> Cables

Connect one end of the sensor cable (or use an extension cable) to the SpO<sub>2</sub> connector on the monitor and attach the other end to the proper position of animal site.



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**Warning** Position the sensor cable and connector away from power cables, to avoid electrical interference.

For small newborn animals, make sure that all sensor connectors and adapter cable connectors are outside the incubator. The humid atmosphere inside can cause inaccurate measurements.

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## 6.4 Measuring SpO<sub>2</sub>

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**Note** — Clean the sensor surface with 70% ethanol before and after use. Never immerse the sensor in liquid.

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To start monitoring SpO<sub>2</sub>:

1. Select a sensor of the correct type and size and attach it to the animal site.
2. Connect the SpO<sub>2</sub> cables and ensure a good connection.
3. Configure the appropriate SpO<sub>2</sub> alarm limits. See Setting Individual Alarm Limits on page 26.

The monitor displays the SpO<sub>2</sub> waveform and the SpO<sub>2</sub> value when it detects the animal SpO<sub>2</sub>. During measurement, the following factors can influence SpO<sub>2</sub> readings:

- Nail polish, especially blue or purple.
  - Excessive animal smoking which causes temporary high CO levels and results in higher readings.
  - Injected dyes like methylene blue or intra vascular dyshemoglobins (methemoglobin and carboxyhemoglobin).
  - Strong ambient lighting and animal motion.
  - Misplacing the sensor.
  - Poor perfusion.
- 
- 

**Warning** Inspect the application site every two to three hours to ensure skin quality and correct optical alignment. If the skin quality changes, move the sensor to another site. Change the sensor position at least every four hours.

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## 6.5 Assessing Suspicious SpO<sub>2</sub> Readings

Inaccurate readings may be caused by animal motion or weak signals, especially for neonatal animals. Observe the following guidelines when monitoring neonatal animals:

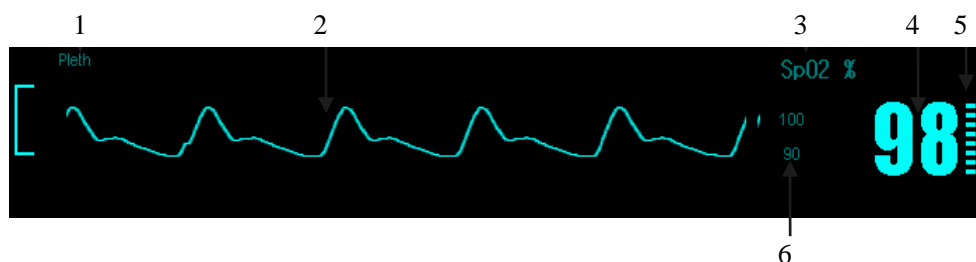
- There should be a six-second uninterrupted, non-artifact SpO<sub>2</sub> waveform.
- A stable SpO<sub>2</sub> value should remain for at least six seconds.

When the pulse rate is very low, or serious arrhythmia occurs, the SpO<sub>2</sub>/Pleth pulse rate may differ from the heart rate calculated from the ECG. However, this does not indicate an inaccurate SpO<sub>2</sub> value.

If you suspect the measured SpO<sub>2</sub> value, use the pleth wave and perfusion indicator to assess the signal quality.

## 6.6 The SpO<sub>2</sub> Display

The following figure shows an example of the Pleth wave and the SpO<sub>2</sub> numeric pane.



**Figure 6-1 Pleth Wave and SpO<sub>2</sub> Numeric Pane**

- 1 = SpO<sub>2</sub> waveform label
- 2 = Pleth wave
- 3 = SpO<sub>2</sub> numeric label (SpO<sub>2</sub> unit)
- 4 = SpO<sub>2</sub> value
- 5 = SpO<sub>2</sub> perfusion indicator bar
- 6 = SpO<sub>2</sub> Alarm upper and lower limit

Figure 6-1 shows a normal SpO<sub>2</sub> waveform. When the SpO<sub>2</sub> signal is inadequate, the waveform becomes abnormal.

## 6.7 Changing the SpO<sub>2</sub> Display

You can change the SpO<sub>2</sub> display screen according to your needs.

### 6.7.1 Changing the SpO<sub>2</sub> Waveform Speed

The waveform speed that you configure determines the speed of the waveform scanning on the screen. For more information on changing the speed of the waveform, see Changing the Waveform Speed on page 19.

The options for waveform speed are: **25.0 mm/s**, **12.5 mm/s**

### 6.7.2 Changing the Color of the SpO<sub>2</sub> Waveform

For more information on changing the SpO<sub>2</sub> waveform color, see Changing the Waveform Color on page 20.

## 6.8 Configuring the SpO<sub>2</sub> Pulse Rate Display

To turn on or off the SpO<sub>2</sub> pulse rate display:

1. Enter **Main Menu**.
2. Enter **Maintenance**.
3. Enter password and confirm. **User Maintenance** window appears.
4. Choose **PR on**.

## 6.9 Changing the SpO<sub>2</sub> Alarm Settings

To turn on the SpO<sub>2</sub> audible alarm, see Turning On/Off Audible Alarms on page 25. For more information on SpO<sub>2</sub> alarm limits, see Setting Individual Alarm Limits on page 26.

## 6.10 Changing the PR Alarm Settings

To configure the PR alarm limits:

Method 1:

1. Enter **SpO<sub>2</sub> Setup** menu at numeric panes.
2. Set up **PR** limits at **PR High Limit** and **PR Low Limit**.
3. Exit the menu.

Method 2:

1. Enter **Alarm Setup** menu at menu area.
2. Enter **SpO<sub>2</sub> Alarm Setup**.
3. Set up **PR** limits at **PR High Limit** and **PR Low Limit**.
4. Exit the menu.

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## 6.11 Safety Information

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**Warning** Continuous monitoring might make skin red, blistered, or cause compression necrosis. This is especially true for neonates or animals with perfusion disorder or unhealthy skin. Periodically inspect the sensor application site and change the application site at least every four hours.

Never use disposable sensors on animals who have allergic reactions to the adhesive. Avoid placing the sensor on extremities with an arterial catheter, or intravascular venous infusion line.

If a sensor is too loose, it might compromise the optical alignment or fall off. If it is too tight, for example because the application site is too large or becomes too large due to edema, excessive pressure may be applied. This can result in venous congestion distal from the application site, leading to interstitial edema, hypoxemia and tissue malfunction.

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**Caution** The sensor consists of sensitive electronic components which may be damaged if misused. Keep sharp-edged objects away from the cable.

Improper cleaning of the sensor could compromise the SpO<sub>2</sub> sensor life span. Use only the specified sensors and cables or animal injury may result.

Do not use a SpO<sub>2</sub> sensor if it shows signs of damage or deterioration or its packing is damaged.

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## Chapter 7 Monitoring NIBP

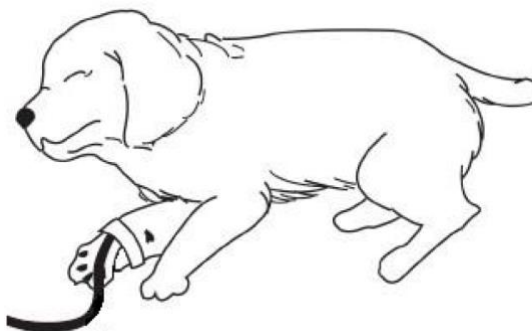
The monitor uses the oscillometric method for measuring NIBP. The principle of the Oscillometric method of measuring blood pressure is stopping the arterial blood stream with the pressure of the inflation cuff. As the cuff pressure decreases, the air pressure oscillation wave caused by the blood stream can be measured in the cuff. The Systolic (SYS), Diastolic (DIA) and Mean Arterial Pressure (MAP) are recognized by amplitude changes of the oscillometric wave under different cuff pressures.

### 7.1 Connecting the NIBP Cuff and Hose

To monitor NIBP:

1. Select an NIBP cuff of proper size (marked on the cuff). Ensure that the cuff is completely deflated.
2. If possible, wrap the cuff around the animal's legs at heart level with the palm upwards. The index line should fall between the two range lines and the arterial marking should be over the animal's brachial artery with the cuff correctly on the brachial artery.
3. Place the cuff 2 cm-5 cm above the elbow and make sure that the cuff is in the correct position.
4. Place the hose along the left or the right side of the animal's arm to avoid tangling.

The following figure show correct cuff placement.



**Figure 7-1 NIBP Cuff Placement**

5. Attach the cuff hose to the NIBP connector on the monitor. The hose clicks into place when seated correctly. Make sure that there is no blockage between the monitor and the hose.
6. Press the **NIBP** key on the right panel of the monitor or press the NIBP menu at menu area to start or stop the NIBP measurement at any time.

---

**Warning**

**Do not wrap the cuff too tightly around the legs. It may cause discoloration, and ischemia of the extremities. Inspect the application site regularly to ensure skin quality and inspect the extremity of the cuffed legs for normal color, warmth and sensitivity. If the skin quality changes, or if the extremity circulation is being affected, move the cuff to another site or stop the blood pressure measurements immediately. Check more frequently when making automatic or stat measurements.**

**If the cuff is too small or too tight, the result will be higher than the normal value, and vice versa. Select a proper cuff for different animals and correctly place the cuff to collect reliable results.**

**For small newborn animals, use only the NIBP cuff recommended by the**

**manufacturer to avoid overloaded inflation pressure.**

**Do not re-use disposable NIBP cuffs.**

For more information on NIBP cuffs, see NIBP Accessories on page 76.

## 7.2 Measurement Limitations

NIBP measurements are impossible with heart rate extremes of less than 40 bpm or greater than 300 bpm, or if the animal is on a heart-lung machine.

The measurement may be inaccurate or impossible:

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

## 7.3 The NIBP Display

The following figure shows an example of the NIBP numeric pane.



**Figure 7-2 NIBP Numeric Pane**

- 1 = NIBP Numeric Pane label
- 2 = NIBP unit
- 3 = Time of last NIBP measurement
- 4 = Work mode (Manual mode in this example)
- 5 = Systolic pressure value
- 6 = Diastolic pressure value
- 7 = Mean arterial pressure value

## 7.4 Selecting the NIBP Measurement Modes

There are three NIBP measurement modes:

### Manual

Selecting **Manual** lets you manually take NIBP readings. When you press the **NIBP** key on the front panel the monitor starts/stops NIBP measurement. When a NIBP measurement is started, the monitor inflates the cuff to a certain pressure and then deflates it to get an NIBP value.

### Auto

Selecting **Auto** specifies that the monitor take NIBP measurements at regular intervals. The monitor inflates the cuff at the start of each measurement cycle and collects NIBP values. In **Auto** mode, if the animal blood pressure is high, the monitor adjusts the

maximum inflation pressure by re-inflating the cuff. The NIBP measurement automatically stops if NIBP values cannot be correctly collected in the **Auto** mode.

**Note** —Every parameter changes (including the beginning of every auto measurement settings) of the monitor, in auto measurement mode, for the first measurement, the system will indicate “Please start”, it means press the “NIBP” button on the front pane to start the measurement, then it enters into auto measurement cycle.

#### **Stat**

Selecting **Stat** specifies that the monitor continuously measure animal NIBP for 5 minutes. Use **Stat** for continuous NIBP monitoring of supervised animals in special cases. The monitor displays **Stat** in the NIBP numeric pane and starts to count down after starting the first NIBP measurement. 04:59 will appear also.

When **Stat** mode times out or **Auto** mode pauses due to a measurement error or technical malfunction, the monitor switches to **Manual** mode.

To change the NIBP measurement mode:

1. Enter **NIBP Setup** menu at numeric panes.
2. Press **Interval Time**, a listbox appears.
3. Choose option of **Manual, or Auto** and press to confirm.
4. Choose option of **Stat** and press to confirm
5. Exit the menu.

---

**Note** —When monitoring, the initial inflation pressure is adjusted (except in **Manual** mode) according to the previous measurement value. The initial inflation pressure specifies the maximum amount that the cuff will inflate for the first NIBP measurement.

In **Auto** mode, the interval time displays in the NIBP numeric pane. The monitor starts to count down after an NIBP measurement completes. When the measurement is paused, it reverts to the preset time display until the next measurement

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## 7.5 Selecting the NIBP Interval Time

An interval is measured from the end of one NIBP measurement to the start of the next measurement and is shown in the NIBP numeric pane. For example, 1min is displayed as 1min in the numeric pane. You can configure the NIBP interval time only in Auto mode.

To change the NIBP interval time:

1. Enter **NIBP Setup** menu at numeric panes.
2. Press **Interval Time**, a Listbox appears.
3. The options are: **1min, 2min, 3min, 4min, 5min, 10min, 15min, 30min, 60min, 90min, 120min, 180min, 240min** and **480min**.
4. Press to confirm an interval time.
5. Exit the menu.

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**Warning** Under Auto or Stat mode, prolonged measurements may increase friction between the cuff and animal skin which may cause purpura, ischemia, and neuropathy. 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, place the cuff on another site or stop NIBP monitoring.

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## 7.6 Changing the NIBP Unit

You can configure the NIBP unit to mmHg or kPa. The unit displays in the NIBP numeric pane.

To change the NIBP unit:

1. Enter **NIBP Setup** menu at numeric panes.
2. Press **Unit**, a Listbox appears.
3. Choose **mmHg** or **kPa** and press to confirm.
4. Exit the menu.

---

**Note** — When you change the NIBP unit, this change displays wherever pressure parameters are displayed on the monitor.

---

## 7.7 Viewing NIBP Measurement Data

After a complete NIBP measurement, the NIBP measurement value displays in the NIBP numeric pane.

When no menu is on the monitoring screen, choose NIBP Review menu or Review menu to view the data in the NIBP list. The monitor displays up to 400 groups of measurement data in time sequence, with the latest reading at the top.

## 7.8 Changing the NIBP Alarm Settings

To turn on the NIBP audible alarm, see Turning On/Off Audible Alarms on page 25. To turn off the NIBP audible alarm, see when all audible alarms are off, pressing the Alarm Silence menu once turns on alarm sounds again. The Alarm Off configuration is not saved when the monitor is turned off. When you turn the monitor on again, audible alarms are on by default on page 25.

For more information on NIBP alarm limit settings see Setting Individual Alarm Limits on page 26.

### 7.8.1 Changing the NIBP Alarm Record Settings.

To change the NIBP Alarm Record Settings:

1. Enter **NIBP Setup Menu** at numeric pane.
2. Press **Alarm ON/OFF**, a Listbox appears.
3. ON or OFF are options, choose and confirm.
4. Exit the menu.

## 7.9 Calibrating NIBP and Compensating Pressure

NIBP calibration and pressure compensation is not user-configurable. A qualified service professional should perform NIBP calibration and pressure compensation every twelve months or when you suspect that the NIBP reading is not correct.

## 7.10 Safety Information

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**Warning** Continual NIBP measurements can cause injury to the animal being monitored. Weigh the advantages of frequent measurement and/or use of Stat mode against the risk of injury.

**In some cases, rapid, prolonged cycling of an NIBP cuff has been associated with any or all of the following: ischemia, purpura, or neuropathy. Apply the cuff according to the directions and check the cuff site and cuffed extremity regularly when blood pressure is measured at frequent intervals or over extended periods of time.**

**Check the animal's leg to assure that circulation is not constricted, i.e. no discoloration or ischemia of the extremities. Check the legs at regular intervals based on the circumstances of the specific situation.**

**Never place the cuff on an area where circulation is compromised or has the**

**potential to be compromised. Never measure NIBP on animals with sickle-cell disease or any condition where skin damage has occurred or is expected.**

**Never use the NIBP cuff on a leg 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.**

**Never apply the blood pressure cuff to the same extremity as the one to which an SpO<sub>2</sub> sensor is attached because the cuff inflation disrupts SpO<sub>2</sub> monitoring and leads to nuisance alarms.**

**Select an appropriate cuff and ensure that the correct animal type is selected before monitoring. Wrong cuff sizes can overload inflation pressure on small or small newborn animals.**

**Use clinical judgment before using NIBP monitoring on animals with serious blood clot disease due to the risk of hematoma in the limb with the cuff.**

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## Chapter 8 Monitoring Temperature

This chapter describes how to monitor body temperature. The monitor measures temperature through the sensor temperature and electrical impedance. The monitor can measure two temperatures simultaneously, TEMP1 and TEMP2. The monitor displays the temperature values and the difference between these two temperatures in the numeric panes.

### 8.1 Selecting and Connecting Temperature Probe

There is one type of temperature probe: esophageal/rectal probe.

1. Connect the temperature cable to the TEMP1 connector/TEMP2 connector.
2. Place the other end on the proper position of animal site.

The numeric panes of the monitor displays the temperature value collected.

For more information on the temperature probes, see Temperature Accessories on page 76.

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**Warning** Never reuse disposable temperature probes to avoid cross-infection. Never exchange and use temperature probes of different types.

Clean the probe before and after each use.

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### 8.2 Influencing Factors

The following factors can affect temperature measurements:

- Improper position of the temperature probe.
- Poor heat balance, heat dissipation.
- Animal temperature fluctuation.

### 8.3 Monitoring Temperature

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**Warning** Before taking temperature measurements, ensure that the temperature probe is not in contact with a heat source; cool the probe for at least 5 minutes before starting a temperature measurement.

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To measure the temperature:

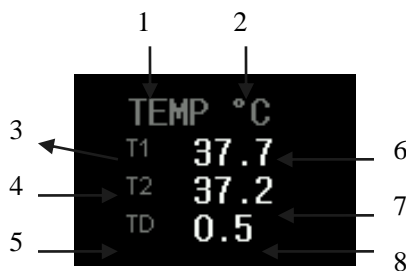
1. Select the correct probe and connect the probe to the monitor. See Selecting and Connecting Temperature Probes on page 49.
2. Apply the probe to the correct location on the animal.
3. Set the temperature unit and appropriate alarm limits.
4. Start temperature monitoring.

The temperature parameter value stabilizes and displays in the temperature numeric panes.

### 8.4 The Temperature Display

The monitor displays two temperature values in the numeric pane. The following figure

shows an example of a temperature numeric pane.




**Figure 8-1 Temperature Numeric Pane**

- 1 = TEMP Numeric Pane label
- 2 = TEMP value
- 3 = T1 label
- 4 = T2 label
- 5 = TD label
- 6 = T1 value
- 7 = T2 value
- 8 = TD value

## 8.5 Configuring the Temperature Display

You can turn on or off the temperature display on the numeric pane.

To configure the temperature display:

1. Enter **TEMP Setup** at numeric pane.
2. Turn off the **TEMP Setup** by click icon  or press **Main** menu.

## 8.6 Changing the Temperature Unit

You can configure the temperature unit to °C or °F. The unit displays in the temperature numeric pane.

To change the temperature unit:

1. Enter **TEMP Setup** at numeric pane.
2. Press **TEMP Unit**, a Listbox appears.
3. Choose an option °C or °F, press it to confirm.
4. Exit the menu.

---

**Note** —Changing the TEMP unit also changes any other temperature parameters displayed on the monitor.

---

## 8.7 Changing the Temperature Alarm Settings

To turn on the temperature audible alarm, see Turning On/Off Audible Alarms on page 25. For more information on temperature alarm limits, see Setting Individual Alarm Limits on page 26.

## 8.8 Safety Information

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**Warning** The disposable probes are sterile and should be handled accordingly. See the probe

**package for a Use by date.**

**Use only the specified probes for your monitor.**

**When the probe is disconnected or loose, the monitor stops measuring the temperature with no audible alarm. To ensure animal safety, check the probe connection and position periodically.**

**Do not use a probe if you see any signs of damage.**

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## Chapter 9 Monitoring CO<sub>2</sub>

Measure carbon dioxide (CO<sub>2</sub>) to monitor an animal's respiratory and ventilation status. The CO<sub>2</sub> measurement produces:

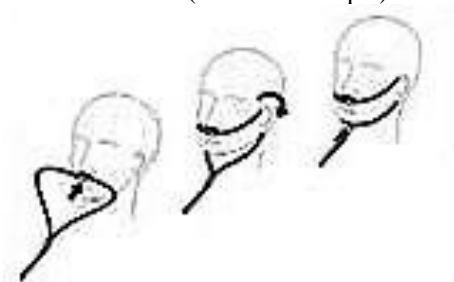
- A CO<sub>2</sub> waveform.
- An end tidal CO<sub>2</sub> (etCO<sub>2</sub>) value: the CO<sub>2</sub> value measured at the end of the expiration phase.
- An inspired minimum CO<sub>2</sub> (inCO<sub>2</sub>) value: the smallest value measured during inspiration.
- An airway respiration rate (awRR): the number of breaths per minute, calculated from the CO<sub>2</sub> waveform.

The CO<sub>2</sub> measurement principle is infrared transmission, where the intensity of infrared light passing the respiratory gas is measured with a photo detector. As some of the infrared light is absorbed by the CO<sub>2</sub> molecules, the amount of light passing the gas probe depends on the concentration of the measured CO<sub>2</sub>.

### 9.1 Connecting the CO<sub>2</sub> Accessories

For intubated animals requiring an airway adapter: install the airway adapter at the proximal end of the circuit between the elbow and the ventilator Y-section.

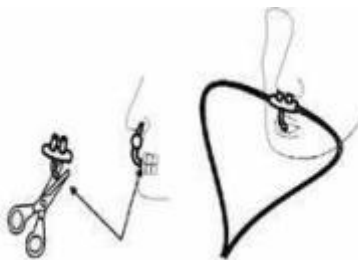
For non-intubated animals: place the nasal cannula onto the animal. Figure 9-1 shows the connection of the nasal cannula (human as sample).



**Figure 9-1 Nasal Cannula Connection**

For animals prone to mouth breathing, use an oral-nasal cannula. Trim the oral sampling tip if necessary to fit the animal. It should extend down past the teeth and be positioned in the oral cavity. Remove the cannula from the animal if you need to trim the tip.

For nasal or oral-nasal cannulas with oxygen delivery, place the cannula on the animal as shown in Figure 9-2, then attach the oxygen supply tubing to the oxygen delivery system and set the prescribed oxygen flow.



**Figure 9-2 Oral-Nasal Cannula Connection**

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**Note** — Always connect the airway adapter to the sensor before inserting the airway adapter into the breathing circuit. In reverse, always remove the airway adapter from the breathing circuit before removing the sensor. Always disconnect the cannula, the airway adapter, or the sampling tube from the sensor when not in use.

---

## 9.2 Influencing Factors

The following factors influence the CO<sub>2</sub> measurement:

- Atmospheric pressure variation
- N<sub>2</sub>O, O<sub>2</sub> and water vapor
- Calibration deviation
- Fluid contamination
- Reusing disposable cannulas
- Improperly placed cannulas

## 9.3 Measuring Carbon Dioxide

To start a CO<sub>2</sub> measurement:

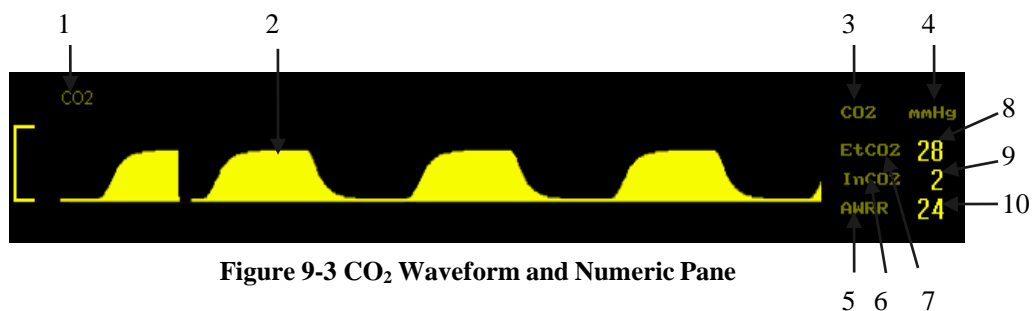
1. Attach the transducer connector to the CO<sub>2</sub> connector.
2. Wait 2 minutes, allowing the transducer to reach its operating temperature.
3. Connect the cannula, airway adapter, or gas sampling tube to the transducer as necessary.
4. Calibrate the transducer, if necessary and start monitoring CO<sub>2</sub> after the calibration completes.
5. Set the correct animal type for CO<sub>2</sub>.
6. Enter **CO<sub>2</sub> Setup** at numeric area.
7. Set the correct CO<sub>2</sub>, INS, AWRR alarm limits.
8. Press **Other Setup, CO<sub>2</sub> Settings** window appears.
9. Choose **Work Mode**, a Listbox appears. Option for Measurement or Standby.
10. Enter **Measurement Mode**.
11. Start CO<sub>2</sub> monitoring, when the monitor collects the CO<sub>2</sub> signals of the animal, the Et CO<sub>2</sub>, In CO<sub>2</sub> and AWRR value display on the monitoring screen.

## 9.4 Removing Exhaust Gases from the System

When using the Microstream CO<sub>2</sub> measurement on animals who are receiving or have recently received anesthetics, connect the outlet to a scavenging system or to the outlet connector, to avoid exposing medical staff to anesthetic gases.

## 9.5 The CO<sub>2</sub> Display

The following figure shows an example of the CO<sub>2</sub> waveform and numeric pane.



- 1 = CO<sub>2</sub> waveform label  
 2 = CO<sub>2</sub> waveform

- 3 = CO<sub>2</sub> Numeric Pane label
- 4 = CO<sub>2</sub> unit
- 5 = EtCO<sub>2</sub> label
- 6 = InCO<sub>2</sub> label
- 7 = AWRR label
- 6 = EtCO<sub>2</sub> value
- 7 = InCO<sub>2</sub> value
- 8 = AWRR value

## 9.6 Changing the CO<sub>2</sub> Display

You can change the CO<sub>2</sub> display screen according to your needs.

### 9.6.1 Changing the CO<sub>2</sub> Waveform Speed

The waveform speed that you configure determines the speed of waveform scanning on the screen. For more information on changing the speed of the waveform, see Changing the Waveform Speed on page 19.

The options for waveform speed are: **12.5 mm/s** and **6.25 mm/s**.

### 9.6.2 Changing the CO<sub>2</sub> Waveform Display Mode

To configure the CO<sub>2</sub> waveform display mode:

1. Enter CO<sub>2</sub> waveform area.
2. Choose **Draw Mode**, a Listbox appears.
3. Choose **MONO** or **Color**.
4. Exit the menu.

### 9.6.3 Changing the Color of the CO<sub>2</sub> Waveform

For more information on the changing CO<sub>2</sub> waveform color, see Changing the Waveform Color on page 20.

### 9.6.4 Changing the CO<sub>2</sub> Work Mode

There are two work modes: **Standby Mode** and **Work Mode**. During **Standby Mode**, the CO<sub>2</sub> module operates with low power consumption. Set the CO<sub>2</sub> work mode to **Standby Mode** when the monitor is not measuring CO<sub>2</sub> to lengthen the module's lifespan.

To change the CO<sub>2</sub> work mode:

1. Enter **CO<sub>2</sub> Setup** menu at numeric pane.
2. Press **Other Setup**, enter **CO<sub>2</sub> Settings**.
3. Work modes have options as **Standby Mode** and **Work Mode**.
4. Exit the menu.

### 9.6.5 Changing the CO<sub>2</sub> Unit

You can configure the CO<sub>2</sub> unit to mmHg or kPa. The unit displays in the CO<sub>2</sub> numeric pane.

To change the CO<sub>2</sub> unit:

1. Enter **CO<sub>2</sub> Setup** menu at numeric pane.
2. Choose **Unit**.
3. Options are **mmHg**, **kPa** and **%**.
4. Exit the menu

---

**Note** — When you change the CO<sub>2</sub> unit, this also changes any other pressure units displayed on the monitor.

----- large animals like horse, bear, pig, tiger and else by using sidestream EtCO<sub>2</sub> module;  
for small animals like dogs, cats, rabbits and else by using mainsream ETCO<sub>2</sub> module.

---

### 9.6.6 Changing the CO<sub>2</sub> Alarm Settings

CO<sub>2</sub> alarms include the etCO<sub>2</sub> alarms, the in CO<sub>2</sub> alarms and respiration rate alarms.

To turn on/off the CO<sub>2</sub> audible alarms, see Turning On/Off Audible Alarms on page 25.

For more information on CO<sub>2</sub> alarm limits, see Setting Individual Alarm Limits on page 26.

## 9.7 Safety Information

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**Warning** Use only approved accessories to ensure accurate CO<sub>2</sub> measurements.

Replace the FilterLine periodically as necessary.

Never use Microstream measurements in the presence of flammable anesthetics mixed with air and/or Oxygen or Nitrous Oxide.

Never measure CO<sub>2</sub> in the presence of pharmaceuticals in aerosols. EtCO<sub>2</sub> measurement accuracy may decrease temporarily while performing electro-surgery or defibrillation. This does not affect animal or equipment safety.

Leakages in the breathing system or sampling system may cause the displayed etCO<sub>2</sub> values to be too low. Always connect all components securely and check for leaks according to standard clinical procedures.

Displacement of the nasal or combined nasal oral cannulas can cause lower than actual etCO<sub>2</sub> readings. CO<sub>2</sub> values for non-intubated animals using Microstream accessories always tend to be lower than for intubated animals. If values appear extremely low, check whether the animal is breathing through the mouth or whether one nostril is blocked.

Never reuse disposable accessories.

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## Chapter 10 Monitoring Invasive Blood Pressure

Invasive blood pressure (IBP), or direct blood pressure measurement, provides accurate blood pressure values of the cardio-artery area. IBP monitoring can track transient variations of arterial blood pressure; however a catheter must be inserted through the skin into the blood vessel where skin damage can occur. IBP measurements are typically used only on seriously ill animals or animals in surgery.

The IBP measurement can generate:

- IBP waveforms
- Systolic pressure value (SYS)
- Diastolic pressure value (DIA)
- Mean arterial pressure value (MAP)

### 10.1 Using the IBP

This monitor can measure two invasive blood pressures at one time, IBP1, IBP2.

### 10.2 Selecting a Pressure Transducer

There are different types of disposable and reusable IBP transducers. Use IBP transducers compliant with the ANSI/AAMI BP23-1986 standard and an accuracy of 5 uV/V/mmHg.

For more information on IBP transducers, see IBP Accessories on page 73.

### 10.3 Before Measuring Invasive Blood Pressure

Before starting an IBP measurement, set the correct pressure measurement and corresponding pressure label.

#### 10.3.1 Connecting and Flushing the IBP Tubing

To connect and flush the tubing:

1. Plug the pressure cable into the IBP1/IBP2 connector.
2. Use saline to flush the tubing system to exhaust all air from the tubing. Ensure that the transducer and stopcocks are free of air bubbles.
3. Connect the pressure line to the animal catheter.
4. If you are using an infusion pressure cuff with the pressure line, attach the pressure cuff to the fluid to be infused. Inflate it according to your standard hospital procedure, and then start the infusion.
5. Position the transducer so that it is level with the heart, approximately at the level of the midaxillary line.

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**Warning** If measuring intracranial pressure with a sitting animal, level the transducer with the top of the animal's ear. Incorrect leveling may give incorrect values.

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#### 10.3.2 Selecting a Pressure for Monitoring

According to the position of the tubing, select the pressure label to identify the pressure type. The label is a unique identifier for each type of pressure. It displays on the top left side of the IBP waveform area.

To select a pressure:

1. Enter **IBP Setup** at numeric pane.

2. Choose Channel 1 or Channel 2 at **IBP Setup** Menu.
3. Choose the needful pressure label; refer to table 10-1.
4. Exit the menu.

**Table 10-1 IBP Pressure Labels**

Label	Description	Label	Description
<b>ART</b>	Arterial blood pressure	<b>PA</b>	Pulmonary artery pressure
<b>CVP</b>	Central venous pressure	<b>RAP</b>	Right atrial pressure
<b>LAP</b>	Right atrial pressure	<b>ICP</b>	Intracranial pressure

## 10.4 Zeroing the Pressure Transducer

To avoid inaccurate pressure readings, the monitor requires a valid zero. Zero the transducer in accordance with your hospital policy. You must perform a zero:

- When you use a new transducer or tubing.
- Every time you reconnect the transducer cable to the monitor.
- If you think the monitor's pressure readings are incorrect.

To zero the transducer:

1. Turn off the stopcock to the animal.
2. Vent the transducer to atmospheric pressure, to compensate for the static and atmospheric pressure exerted on the transducer.
3. Position the transducer so that it is level with the heart, approximately at the level of the midaxillary line.
4. Enter **IBP Setup** at numeric panes.
5. Choose **Channel 1 Zeroing** or **Channel 2 Zeroing**.
6. Close the stopcock to atmospheric pressure and open the stopcock to the animal, IBP calibration is complete.

## 10.5 Measuring Invasive Blood Pressure

To measure IBP:

1. Correctly prepare for the pressure measurement. See Before Measuring Invasive Blood Pressure on page 52.
2. Zero the transducer. See Zeroing the Pressure Transducer on page 53.
3. Turn on IBP alarms and set the correct IBP alarm limits. See Changing the IBP Alarm Settings on page 55.
4. Start measuring.

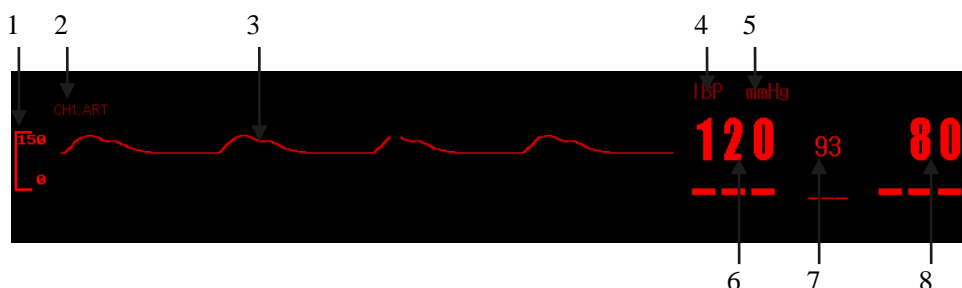
---

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

---

## 10.6 The Invasive Blood Pressure Display

The following figure shows an example of the IBP1 waveform; however, the waveforms for IBP1 and IBP2 are the same. On the IBP channel, there are two grid lines that display as dotted lines along the top and bottom of the waveform. A scale displays on the left side.



**Figure 10-1 IBP Waveform and Numeric Pane**

- 1 = calibration bar
- 2 = CH1 pressure type
- 3 = IBP1 waveform
- 4 = IBP Numeric Pane label
- 5 = IBP unit
- 6 = Systolic pressure (CH1 in this example)
- 7 = Mean arterial pressure (CH1 in this example)
- 8 = Diastolic pressure (CH1 in this example)

## 10.7 Changing the Invasive Blood Pressure Waveform Display

You can configure the monitor IBP display by changing the IBP settings.

### 10.7.1 Changing the Invasive Blood Pressure Waveform Size

You can configure the IBP waveform size by selecting an IBP gain to increase/decrease the waveform height. The difference between the two numbers on the left side of the baselines is equal to the selected IBP waveform gain. You may configure the IBP gain by Manual or Auto.

If Auto is selected, the monitor will choose one of the gain options as the IBP waveform gain according to the measured pressure.

To change the IBP gain:

1. Enter **IBP Setup** Menu at numeric panes.
2. Choose **Channel Gain** or **Channel2 Gain**. The IBP gain options are: 40mmHg, 60mmHg, 80mmHg, 120mmHg, 180mmHg, 240mmHg, 330mmHg, 450mmHg and AUTO.
3. Exit the menu.

### 10.7.2 Changing the Invasive Blood Pressure Waveform Speed

The waveform speed you configure determines the speed of the waveform scanning on the screen. For more information on changing the speed of waveform, see Changing the Waveform Speed on page 16.

The options for the waveform speed are: **25.0 mm/s**, **12.5 mm/s** and **6.25 mm/s**.

### 10.7.3 Changing the Invasive Pressure Waveform Color

For more information on changing IBP color, see Changing the Waveform Color on page 16.

## 10.8 Changing the Invasive Blood Pressure Unit

You can configure the IBP unit to mmHg or kPa. The unit displays in the IBP numeric pane.

To change the IBP unit:

1. Enter **IBP Setup** menu at numeric area.

2. Choose **Unit**.
3. IBP unit have **mmHg** and **kPa**.
4. Exit the menu.

---

**Note** — When you change the IBP unit, the change displays wherever pressure parameters are.

---

## 10.9 Changing the IBP Alarm Settings

IBP alarms include alarms for SYS, DIA and MAP. IBP default alarm limits are different according to the IBP pressure type. When CVP or ICP is selected as the pressure type, only MAP alarms are available for alarm settings.

To turn on the SYS, DIA and MAP audible alarm, see Turning On/Off Audible Alarms on page 21. For more information on IBP alarm limit settings see Setting Individual Alarm Limits on page 22.

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**Warning** Set correct alarm limits for the selected pressure type. Alarm limits change if you change pressure types.

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## 10.10 Safety Information

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**Warning** Only use IBP cables, transducers and domes recommended by the manufacturer or that are in conformity with medical device safety requirements.

**Connect the IBP cable to the IBP connector and ensure that the IBP components do not come into contact with other conductive parts or with ground.**

**Check the IBP cable for damage. If any damage is found, change the cable or replace the transducer connector.**

**Only use disposable transducers and domes once. Discard them properly as medical waste. Perform regular or continuous flushing during IBP measurements to prevent clotting or blocking.**

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## Chapter 11 Review

### 11.1 Trend Table display

The **Trend Table** window displays animal data in a list format.

To Trend Table:

1. Enter **Trend Table Menu** at menu area.  
Or Enter **Main** menu and select **Review Menu**, press **Trend Table** comes to menu.
2. Choose **RES**, a Listbox appears. Options of **1min, 5min, 10min, 30min** and **60min**.
3. Press **▲** or **▼** to watch earlier or later data, Press **◀** or **▶** to observe trend data with different parameters
4. Exit the menu.

### 11.2 Trend Graph display

The Trend Display menu displays animal data in graphic form. It may display the most recent data in the past 168 hours.

The latest 1 hour trend graph can be displayed at a data resolution of 1 second or 5 seconds.

The latest 168 hours trend graph can be displayed at a data resolution of 1 minute, 5 minutes or 10 minutes.

To Trend Graph:

1. Enter **Trend Graph Menu** at menu area.  
Or Enter **Main** menu and select **Review Menu**, press **Trend Graph** comes to menu.  
Press parameter at left area. **HR, PVCs, ST1, ST2, SpO<sub>2</sub>, PR, NIBP SYS / MAP / DIA IBP1, IBP2, RR, TI, T2** are options.
2. Choose RES, a Listbox appears. Options of **1s, 5s, 1min, 5min, 10min**.
3. Press **◀** or **▶** can do page turning to check the Trend graph earlier or later; press **◀** or **▶** can check the Trend datum in some points of moment.
4. Press record to print current graph.
5. Exit the menu.

---

**Note** —The Trend Graph display window only show the channel of the selected parameters, totally 3 channels can be displayed on this window, the selected parameters can't be repeated.

---

In the window, the parameter value of the trend and its corresponding alarm limits display on the left of the window. The buttons at the bottom change the time scale and the trend segments.

Parameter values are plotted vertically along the y-axis of the display. A time range appears along the horizontal x-axis. The most recent measurements appear on the right side of the graph and the data scrolls to the left so that the oldest data appears on the far left.

### 11.3 NIBP Review

By NIBP Recall, each measured NIBP result and the corresponding time can be displayed. The veterinary monitor can display the most recent 400 NIBP measurement data in the NIBP retrospection. The recall screen may display 10 sets of measurement data.

To NIBP Review:

1. Enter **NIBP Review** Menu at menu area.  
Or Enter **Main** menu and select **Review Menu**, press **NIBP Review** comes to menu.
2. Press  $\blacktriangle$  or  $\blacktriangledown$ , to the earlier or later measurement data
3. Press record to print NIBP review list.
4. Exit the menu.

## 11.4 Waveform Recall

The Waveform Recall display 2h waveform.

1. Enter **Waveform Recall Menu** at menu area.  
Or Enter **Main** menu and select **Review Menu**, press **Waveform Recall** comes to menu.  
Press parameter at left area. **I, II, III, aVR, aVL, aVF, V, SPO<sub>2</sub>, RESP** are optional.
2. Press  $\blacktriangleleft$  or  $\blacktriangleright$ , to check the waveform which happens in every minute earlier or later, Press  $\blacktriangleleft$  or  $\blacktriangleright$ , to check the waveform which happens in every second earlier or later.
3. Choose Waveform Speed, **6.25mm/s, 12.5mm/s** and **25.0mm/s** are options.
4. Choose Waveform Number, **1, 2, 3** and **4** are options.
5. Exit the menu.

## 11.5 Alarm Recall (Physiological alarm)

You can review alarm events that occurred during monitoring in the Alarm Event Review window. The monitor can store 60 groups of alarm events in the system, including date; time, parameter values, and the corresponding alarm description.

To review alarm events:

1. Enter **Main** menu, select **Review** menu.
2. Enter **Alarm Event Review**. The **Alarm Recall Condition** window appears.
3. Adjust recall time, choose **Alarm Event Review**.
4. Choose **Event type**, the alarm type window appears.
5. Choose individual alarm event at **Event Type**. Options are **All, ECG, SpO<sub>2</sub>, NIBP, RESP, TEMP, HR\_H>180, HR\_L<60, SpO<sub>2</sub><90%, RR\_H>40, RR\_L<10, TEMP\_H>40°C** and **TEMP\_L<34°C**.
6. Press  $\blacktriangle$  or  $\blacktriangledown$  to watch earlier or later alarm event. Press  $\blacktriangleleft$  or  $\blacktriangleright$  to observe trend data with different parameters.
7. Exit the menu.

Alarm events and time are shown on the left of the physiological alarm window. The details of the alarming events which selected will be displayed on the right include alarming types, time and waveforms.

---

**Note** —the system will automatically keep the alarm event records when its power cut off. But if the power cut is caused by the un-normal ways such as lightning stroke or artificially damaged, the system can't ensure to keep records.

---

## 11.6 Technical Alarm Event Recall

The steps of checking the technical alarm event recall:

1. Press the area of alarm to enter **Device Alarm Event Review** (Technical alarm) menu.
2. Press  $\blacktriangle$  or  $\blacktriangledown$  to turn page for checking the technical alarm events earlier or later.
3. Exit the menu.

## Chapter 12 Drug Calculation

The monitor provides a Drug Calculation window to let you calculate a drug concentration, infusion rate, titration rate, and dosage calculation. You can also generate a titration chart for infusion speed and time.

### 12.1 Calculating the Drug Concentration

Enter the following information before calculation:

- **Drug Name:** You can select 15 drug names: **Drug A, Drug B, Drug C, Drug D** and **Drug E, Aminophylline, Dobutarnine, Doparnine, Epinephrine, Heparin, Isuprel, Lidocaine, Nipride, Nitroglycerin** and **Pitocin**. **Drug A, B, C, D** and **E** are defined by the doctor as any drugs other than those specified in the menu.
- **Weight:** required. **kg** is the unit. Enter a number no greater than 250 kg.
- **Total Dose:** required. Unit: **mg**
- **SOL Volume:** required. Volume of the diluted liquid in **ml** unit.

---

**Note** — After choosing the drug name, system will offer a group of default numbers which only for reference. The actual using dosage must be confirmed according to the anesthetist's introductions.

---

- **Drug concentration:** After you enter the required information, the monitor automatically calculates the drug concentration and shows the value in red. Drug concentration = drug total volume/ SOL volume. Unit is ug(mcg)/ml.
- **Dosage** is the drug volume injected per unit time. The dosage is related to the **Dosage Unit** selected. When the **Dosage Unit** is changed, the **Dosage** value changes accordingly. You can select the following units: **Dose/min, Dose/h, Dose/kg/min** or **Dose/kg/h**.

### 12.2 Calculating the Infusion Rate, Titration Rate and Medication Time

You cannot calculate the infusion rate, titration rate and medication time until the drug concentration is generated.

- **Volume per drop** means the drops of per milliliter in different infusion containers. Volume per drop can be 15GTT/ml(using the glass infusion container, 15 drops per milliliter) or 20GTT/ml(when using disposable infusion container, 20drops per milliliter).
- **Infusion Rate** is the SOL volume injected per unit time. It uses milliliter per hour (**ml/h**) as the unit. Infusion rate = drug dosage/ drug concentration.
- **Medication Time** is the time to complete the infusion of the total dose. It uses hour (**h**) as the unit. Medication time = drug volume/ dosage.

To calculate the infusion rate and the medication time.

1. Enter **Drug Calculation menu** at menu area.
2. Enter the Drug name, Weight, Total Dose and SOL Volume, the monitor generates and displays the infusion rate and the medication time.

You can only perform the titration rate calculation after the infusion rate is generated.

- **Titration Rate:**The unit of titration rate is **GTT/min**. Titration rate = infusion rate x volume per drop.

To calculate the titration rate:

1. Enter **Drug Calculation menu** at menu area.

2. Choose Volume per drop from **15** GTT/ml or **20** GTT/ml, then confirm.
3. The monitor generates and displays the titration rate.

---

**Note** — If the Drug name, Weight, Total Dose, SOL Volume and **Drop Volume** is changed, the monitor re-calculates the **Infusion Rate and Medication Time, Titration Rate not change.**

When the **Animal Type** is **Neo**. The **Titration Rate** and **Drop Volume** are not valid.

---

## 12.3 Using the Titration Chart

You can view the injected drug dosage for different infusion rates. You can only use the **Titration Chart** after the drug concentration; infusion rate, titration rate, and medication time are calculated.

To use the titration chart:

1. Enter **Drug Calculation menu** at menu area.
2. Enter **Titration Chart**.
3. Press **Basic**, a Listbox appear.
4. Dosage, Infusion Rate and Titration Rate available, press to confirm.
5. Press **Step**, **Spinbox** appears. Option (from 1 to 10) and press to confirm.
6. Press Dosage Tyep, a Listbox appears. Option of Dose/min, Dose/h, Dose/kg/min and Dose/kg/h available, press to confirm.
7. Choose **▲ or ▼** to check the information of titration data.
8. Exit the menu.

## Chapter 13 Cleaning and Care

This chapter gives general guidelines on the cleaning and care of your monitor and accessories. Use only the approved cleaning methods and agents listed in this chapter. The warranty does not cover damage caused by using unapproved substances. Cleaning methods described in this chapter have been tested by supplier. Other methods and cleaning agents may contaminate or damage the monitor. In addition, qualified professionals should perform periodic calibration and maintenance of the monitor.

### 13.1 General Guidelines

Keep the monitor, cables and accessories free of dust and dirt. After cleaning and disinfecting, check the equipment carefully. Do not use if you see signs of deterioration or damage. If you need to return any equipment to supplier, decontaminate it first.

Follow these general precautions:

- Always dilute cleaning agents according to the instructions in this chapter or use lowest possible concentration.
- Never allow liquid to enter the case.
- Never immerse any part of the equipment in liquid or allow any liquid to enter electrical contacts.
- Never use abrasive material (such as steel wool or silver polish).
- Never use bleach or strong solvents such as acetone or acetone-based compounds.
- Never autoclave, steam sterilize, or ultrasonically clean the monitor or cables.
- Never use alcohol on the animal cables. Alcohol can cause the plastic to become brittle and fail prematurely.

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**Caution** If you spill liquid on the exterior of the monitor, use a clean cloth to dry the monitor. If you believe the liquid may have gotten inside the monitor, power off the monitor and contact your service representative.

Use the accessories according to instructions accompanied. The manufacturer information might be more current.

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To clean the monitor:

1. Turn off the veterinary monitor and unplug the power cord.
2. Clean the monitor at room temperature. Use a soft cloth and any of the following cleaning agents:
  - Isopropyl alcohol (70% solution in water)
  - Mild soap and water
  - Sodium hypochlorite (chlorine bleach), 3% solution in water
3. Dry the cleaned parts with a cloth.

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**Note** — Do not permit any liquid to enter the monitor and avoid pouring liquids on the monitor while cleaning. Do not allow water or cleaning solution to enter the measurement connectors.

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### 13.2 Cleaning the Accessories

When possible, clean the accessories according to the manufacturer's instructions. Use the general guidelines in this chapter if you do not have specific product cleaning instructions.

### 13.2.1 Cleaning the Cables

Dampen a soft cloth with one of the following cleaning agents:

- Alcohol-free hand soap
- Sodium hypochlorite (chlorine bleach), 3% solution in water

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**Note** — This solution might discolor the cable.

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Wring any excess moisture from the cloth and gently clean the cables.

### 13.2.2 Cleaning the SpO<sub>2</sub> Sensor

To clean the SpO<sub>2</sub> sensor:

1. Wipe all sensor surfaces, including finger pads and cable, with a clean cloth dampened with any of the following validated cleaning solution:
  - mild detergent
  - salt solution (1%)
2. Wipe the sensor with a water-dampened cloth to remove all cleaner residue. Then dry all sensor and cable surfaces with a clean, dry cloth. Set the sensor aside allowing it to dry completely.

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**Note** — If you notice any signs of deterioration or damage to the sensor or cable, immediately dispose of them following proper procedures defined by your medical facility.

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### 13.2.3 Cleaning the NIBP Cuff

To clean the NIBP cuff:

1. Remove the rubber bladder from the cuff.
2. Clean the cuff in detergent (mild soap wash).
3. Air dries the cuff.
4. Check the cuff and tube. If you see any signs of deterioration or damage, do not use it.
5. Put the rubber bladder back into the cuff.

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**Note** — Never dry-clean the cuff.

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### 13.2.4 Cleaning the Temperature Probe

To clean the temperature probe:

1. Hold the probe with one hand and clean the probe from the top with a wet lint-free cloth.
2. Use a dry cloth to clean the surface of the temperature probe.
3. Check the temperature probe and do not use if you see signs of deterioration or damage.

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**Caution** Never heat the probe over 100°C (212°F). Only heat to 80°C (176°F) - 100°C (212°F) for a short time.

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## 13.3 Disinfecting the Monitor

To avoid long-term damage to the equipment, do not disinfect unless directed by the hospital.

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**Warning** Never mix disinfecting solutions (such as bleach and ammonia) as hazardous gases may result.

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Clean the equipment before disinfecting. Wipe the monitor after disinfection. You can use the following disinfectants:

- Ethanol (up to 70%), 1- and 2- Propanol (up to 70%)
- Glutaraldehyde (up to 3.6%)

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**Note** —Disinfect the accessories according to the manufacturer’s instructions. Use the general guidelines in this chapter if you do not have specific product cleaning instructions.

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### **13.4 Sterilizing the Monitor**

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

## Chapter 14 Maintaining the Battery

You can power the monitor with either an AC power source or its optional Lithium ion battery.

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**Warning** Only use batteries specified by supplier. Other batteries can cause monitor damage or personal injury.

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### 14.1 Charging LED

A battery symbol on the front panel indicates the charging LED.

- Flashing green: the monitor is connected to an AC power and charging the battery.
- Steady green: the monitor is fully charged.
- Off: the monitor is not connected to an AC power.

When the battery begins charging, the charging LED flashes. The battery needs 8 hours before it is fully charged. After the charging is complete, the charging LED is steady on.

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**Note** — Always leave the monitor plugged into an AC power source when not in use. This ensures that the battery is charged. Check the battery status at least once a month.

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### 14.2 Battery Indicators

When the monitor is powered by the internal battery, a battery power gauge displays on the top right corner of the screen and shows the remaining battery capacity. More lines inside the indicator mean a larger capacity remains.

The battery capacity depends on the method and frequency of use. A new, fully charged battery can support a continuously working monitor for at least 2 hours. However, NIBP measurements and printing might use more battery power.

When the gauge has 2 lines, the gauge flashes and the monitor sounds an alarm, indicating a low battery. The monitor shuts off in 5 minutes if you do not plug it into an AC power source.

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**Note** — When the battery does not have enough power to support normal monitor use, the monitor shuts off and will not function until you plug it into an AC power source.

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### 14.3 Recharging the Battery

Before putting the monitor into service, fully charge the battery. You can charge a battery in a monitor used to monitor animals.

To charge the battery:

1. Insert the battery into the monitor.
2. Connect the monitor to an AC power source. The charging LED flashes, indicating the charging status.
3. Charge the battery at least 8 hours. The charging LED is steady on and the battery power gauge is full. Continue charging the battery for at least 2 more hours.

## 14.4 Optimizing the Battery

The battery life depends on the time and frequency of usage. Correctly maintain and use the battery to extend the battery life span. The battery optimization function is password-protected. If the battery does not work according to specifications, replace the battery or contact your service representative.

## 14.5 Disposing of a Battery

When a battery displays signs of damage or when it no longer charges, replace it. Dispose of the used battery in accordance with local laws and regulations.

## 14.6 Safety Information

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**Warning** Never open a battery or incinerate it. The battery could ignite, explode, leak or heat up, causing personal injury if not disposed of properly.

Never heat the battery above 40°C.

Keep the battery out of the reach of children and in its original package until you are ready to use it. Under extreme conditions, the battery could leak, causing corrosive liquids to enter eyes and burn skin. If this occurs, flush with water and seek immediate medical attention.

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## Chapter 15 Maintenance and Troubleshooting

**Warning** Failure to implement a satisfactory maintenance schedule for this equipment may cause undue equipment failure and potential health hazards..

If you meet a problem with any of the equipment, pls contact professional service personnel.

### 15.1 Inspecting the Equipment and Accessories

Perform a visual inspection before every use.

1. Examine the unit exterior for general physical condition. Make sure that the monitor is clean and the housings and connectors are not cracked or broken.
2. Inspect all accessories (cables, transducers, sensors and so on). If any show signs of damage, do not use.
3. Examine all system cables, the power plug and cord for damage. Make sure that the prongs of the plug do not move in the casing. If damaged, replace it with an appropriate one.
4. Inspect the animal cables, leads and their strain reliefs for general condition. Make sure there are no breaks in the insulation. Make sure that the connectors are properly engaged at each end to prevent rotation or other strain.

### 15.2 Maintenance Tasks and Test Schedules

The following tasks are for qualified service professionals only. Ensure that these tasks are carried out as indicated by the monitor's maintenance schedule, or as specified by local laws. Clean and disinfect equipment to decontaminate it before testing or maintaining it.

**Table 15-1 Maintenance Tasks and Test Schedules**

Maintenance Task and Test Schedule	Frequency
Safety checks	At least once every two years, or as needed, after any repairs where the power supply is removed or replaced, or if the monitor has been dropped.
Performance assurance for all measurements not listed below	At least once every two years or if you suspect that the measurement values are incorrect.
NIBP calibration	At least once every two years, or as specified by local laws.
Battery	See Chapter 12, Maintaining the Battery.

### 15.3 Troubleshooting

If you suspect a problem with an individual measurement, read the related section in this guide and double check the measurement settings.

Use the following tables to troubleshoot problems with the monitor and accessories.

**Table 15-2 ECG Problems**

<b>Problem</b>	<b>Solution</b>
HR or ARR measurements inaccurate	<ul style="list-style-type: none"> <li>• Check the animal's ECG signal</li> <li>• Check/adjust the lead position</li> <li>• Check/reclean skin</li> <li>• Check/replace ECG electrode</li> <li>• Check ECG wave amplitude</li> </ul>
The lead wires are connected but there is no ECG waveform and the screen displays <b>Leads Off</b> or <b>No Signal</b> .	<ul style="list-style-type: none"> <li>• Ensure that the electrode is in good contact with the animal.</li> <li>• Check all the extension parts of the ECG lead wires. The circuit between the plugs and pins of the 5 ECG extension cables are open. Replace the lead wire if the circuit is open.</li> <li>• Check the ECG electrode and replace the electrode after long-term use.</li> </ul>
The monitor does not show the ECG baseline waveform consistently on the screen and the waveform moves out of the display area at times.	<ul style="list-style-type: none"> <li>• Ensure that the environment is dry and that the monitor is not wet. If there is dampness in the environment or monitor, run the monitor continuously for 24 hours to dry it out.</li> <li>• Check the quality of the electrode and whether the animal site where the electrode attached is clean. Replace the electrode or clean the contact site.</li> </ul>

**Table 15-3 SpO<sub>2</sub> Problems**

<b>Problem</b>	<b>Solution</b>
There is no SpO <sub>2</sub> waveform or values.	<ul style="list-style-type: none"> <li>• Check the position of the sensor on the animal.</li> <li>• Check whether the red light of the finger probe is flashing. If there is no red light flashing, there might be poor contact. Check the extension cable and the connector.</li> <li>• Check whether the animal's arm is under pressure. Never make blood pressure and SpO<sub>2</sub> measurements on the same arm.</li> <li>• Check whether the environmental temperature is too low. Do not expose the animal's arm to cold air since this can affect readings.</li> </ul>
The SpO <sub>2</sub> values turn on and off during SpO <sub>2</sub> monitoring.	In long term monitoring or operation, animal movement may result in SpO <sub>2</sub> interruptions. Keep the animal stabilized. Animal hand motion resulting in SpO <sub>2</sub> interruptions is normal.

**Table 15-4 NIBP Problems**

<b>Problem</b>	<b>Solution</b>
<b>Measurement Timeout</b> displays in the NIBP channel.	<p>There is a malfunction during measurement and the monitor cannot process the measurement data.</p> <ul style="list-style-type: none"> <li>• Check the animal's status and connection.</li> <li>• Replace the cuff and restart the measurement.</li> </ul>
<b>Cuff Loose</b> displays in the NIBP numeric pane.	<p>Ensure the proper cuff size is being used.</p> <ul style="list-style-type: none"> <li>• Check the cuff position.</li> <li>• Check the extension tube for breakage and if the tube is damaged, replace it.</li> </ul>

**Table 15-4 NIBP Problems (continue)**

<b>Problem</b>	<b>Solution</b>
<b>Pressure Range Exceeded</b> displays in the NIBP numeric pane.	A blood pressure reading has exceeded the pressure range. The monitor cannot take any more NIBP readings until the alarm is acknowledged.
<b>Measurement Error</b> displays in the NIBP numeric pane.	This error can be caused by: system self-testing, excessive animal and/or limb movement, or air leakage. Consult your service representative.

**Table 15-5 TEMP Problems**

<b>Problem</b>	<b>Solution</b>
There is no temperature displayed.	The TEMP sensor might be off the animal or the monitor. <ul style="list-style-type: none"> <li>• Check the sensor connection.</li> <li>• If you cannot solve the problem, replace the sensor.</li> <li>• If the problem continues, consult your service representative.</li> </ul>

If you suspect an intermittent, system-wide problem, call your service personnel.

## 15.4 Disposing of the Monitor

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**Warning** To avoid contaminating or infecting personnel, the environment or other equipment, make sure you disinfect and decontaminate the monitor appropriately before disposing of it in accordance with your country's laws for equipment containing electrical and electronic parts. For disposal of accessories, where not otherwise specified, follow local regulations regarding disposal of hospital waste.

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Do not dispose of waste electrical and electronic equipment as unsorted municipal waste. Collect it separately, so that it can be safely and properly reused, treated, recycled, or recovered.

## A Accessories

This appendix describes the accessories that are compatible with the Veterinary monitor.

**Table A-1 Accessories list**

Accessories	Specification
ECG cable	Integrated 5-leads Cable, snap/clip type, with vet metal clip
Electrodes	5 pcs for large animal, 5 pcs for small newborn animal
extension cable of NIBP	NIBP Extension cable
NIBP cuff	NIBP Cuff, size 1 ~ 5
SpO <sub>2</sub> probe	Ear clip SPO2 sensor
TEMP probes	Rectal type for small newborn animal, and large animal

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**Warning** Reusing single-use accessories can result in poor accessory performance or infections. Never use an accessory if there is damage to the packaging or the accessory.

Only use accessories recommended by the manufacturer. Using other kinds of accessories might cause damage or personal injury.

The accessories specified above have passed toxicity and biocompatibility tests.

Always check the package for production and expiration dates, and validity and storage periods before using an accessory on an animal.

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## B Specifications

This appendix describes the specifications of the Veterinary monitor.

### B.1 ECG/ST/Arrhythmia Specifications

The following table describes the ECG/ST/arrhythmia specifications.

**Table B-1 ECG Specifications**

Parameter	Specifications
CMRR (common mode rejection ratio)	>90 dB
HR measurement and alarm range	Adult/Pedi: 15bpm - 300bpm Neonate: 15bpm - 350bpm
HR accuracy	1bpm or 1%, whichever is greater
ECG channel	Up to 7channels
ST range	-2.0 mV - +2.0 mV
ST accuracy	0.02 mV or 10%, whichever is greater
Pacemaker pulse rejection capability	Meets AAMI EC 13
ECG leads	5-lead
Alarm indication	Visual and audible indicators
QRS indicator	Audible tone and heart symbol flashes
ECG speed	12.5 mm/s, 25.0mm/s, 50.0 mm/s
ECG gain	×0.25,×0.5,×1,×2,×4, Auto
Bandwidth	Monitor mode: 0.5 Hz - 40 Hz $\begin{matrix} (+0.4dB) \\ (-3.0dB) \end{matrix}$ Operation mode: 1.0 Hz - 25 Hz $\begin{matrix} (+0.4dB) \\ (-3.0dB) \end{matrix}$ Diagnostic mode: 0.05 Hz - 100 Hz $\begin{matrix} (+0.4dB) \\ (-3.0dB) \end{matrix}$
Tall T-wave rejection capability	Exceeds ANSI/AAMI EC 13 minimum recommended 1.2 mV T-wave amplitude
Heart rate alarm response time	<12s
Defibrillator protected	Tested with5kV
Recovery time following defibrillation	< 5s
Signal delay	0.5s
Auxiliary current (leads off detection)	Active electrode:< 100nA Reference electrode: < 900 nA

**Table B-1 ECG Specifications (continue)**

Parameter	Specifications
Heart ratemeter accuracy and response to irregular rhythm	Ventricular bigeminy: 80 bpm±2bpm Slow alternating ventricular bigeminy: 60 bpm ±2bpm Rapid alternating ventricular bigeminy: 120 bpm ±2bpm Bidirectional systoles: 90 bpm±2bpm
Response time of heart rate meter to change in heart rate	HR change from 80 bpm to 120 bpm: ≤ 8 s maximum HR change from 80 bpm to 40 bpm: ≤ 10 s maximum
Time to alarm for tachycardia	Vent tachycardia (1 mVpp, 206 bpm): Gain 0.5, range 6.5 to 8.4s, average 7.2s Gain 1.0, range 6.1 to 6.9s, average 6.5s Gain 2.0, range 5.9 to 6.7s, average 6.3s Vent tachycardia (2 mVpp, 195 bpm): Gain 0.5, range 5.4 to 6.2s, average 5.8s Gain 1.0, range 5.7 to 6.5s, average 6.1s Gain 2.0, range 5.3 to 6.1s, average 5.7s
ECG analog output	0.67 Hz - 40 Hz
Time to alarm for high heart rate	≤10s
Time to alarm for low heart rate	≤10s

## B.2 Respiration Specifications

The following table describes the respiration specifications.

**Table B-2 Respiration Specifications**

Parameter	Specification
Work mode	Thoracic impedance
Respiration rate measurement and alarm range	Adult: 0 rpm - 120 rpm Pediatric: 0 rpm - 150 rpm Neonate: 0 rpm - 150 rpm
Apnea alarm duration	10 s - 40 s
Respiration accuracy	2 rpm or ±2%, whichever is greater
Respiration speed	6.25 mm/s, 12.5 mm/s, 25.0 mm/s
Respiration gain	×0.5,×1,×2
Alarm delay	<10s

## B.3 SpO<sub>2</sub> Specifications

The update rate for the SpO<sub>2</sub> value and pulse rate is typically 1 second. Data averaging and other signal processing on the displayed and transmitted data values of SpO<sub>2</sub> and pulse rate is not more than 20 seconds. Depending on the magnitude of difference between the alarm limit and the displayed value, the alarm signal generation delay may be from 1 second to 20 seconds.

Because pulse oximeter measurements are statistically distributed, only approximately two-thirds of pulse oximeter equipment measurements can be expected to fall within the □Arms value measured by a CO-oximeter.

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**Note** — It is not necessary to have a SpO<sub>2</sub> calibration when the monitor is in use.

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The following table describes the SpO<sub>2</sub> specifications.

**Table B-3 SpO<sub>2</sub> Specifications**

Parameter	Specification
SpO <sub>2</sub> measurement range	0% - 100%
SpO <sub>2</sub> pulse rate range	20 bpm -254 bpm
SpO <sub>2</sub> pulse rate accuracy	2 bpm in the range of 70%-100%, Other scope is not defined
SpO <sub>2</sub> speed	12.5 mm/s, 25.0 mm/s
SpO <sub>2</sub> pulse rate sound	PR tone
Wavelength range <sup>1</sup>	500 nm - 1000 nm for all specified sensors
Maximum optical output power	150 mW for all specified sensors
Pulse rate display	Numeric

1. Information about wavelength ranges can be useful for clinicians performing photo dynamic therapy.
2. Sensor accuracy was obtained by performing controlled hypoxia studies on healthy, non-smoking adult volunteers (according to EN ISO 9919). The SpO<sub>2</sub> readings have been compared to CO-oximeter measurements on arterial blood samples. To represent the general population, data from at least 10 subjects (male and female) with a wide range of skin color was taken to validate SpO<sub>2</sub> accuracy. Accuracy data for Masimo sensors is included in the sensor package insert.

## B.4 Temperature Specifications

The following table describes the temperature specifications.

**Table B-4 Temperature Specifications**

Parameter	Specification
Temperature range	0°C - 50°C (32°F - 122 °F)
Unit	°C or °F
Temperature accuracy	±0.1°C
Resolution	0.1°C
Updating time	Approximately 1 second
Alarm delay	<10s

## B.5 Non-invasive Blood Pressure Specifications

The following table describes the NIBP specifications.

**Table B-5 NIBP Specifications**

Parameter	Specification
Measuring method	Oscillometric method
Measuring parameter	SYS, DIA, MAP,
Unit	mmHg or kPa
Work mode	Manual, Auto, Stat
Cycle time	1-5,10, 15, 30, 60, 90, 120, 180, 240, 480 minutes
SYS range	Large animal: 40 mmHg -270mmHg (5.3 kPa - 36.0kPa) Small animal: 40 mmHg - 200mmHg (5.3kPa - 26.7kPa) Newborn animal: 40 mmHg - 135mmHg (5.3kPa - 18.0kPa)
DIA range	Large animal: 10mmHg - 210mmHg (1.3kPa - 28.0kPa) Small animal: 10 mmHg - 150mmHg (1.3 kPa - 20.0kPa) Newborn animal: 10mmHg -100mmHg (1.3kPa -13.3kPa)
MAP range	Large animal: 20 mmHg -230mmHg (2.7 kPa - 30.7kPa) Small animal: 20 mmHg -165mmHg (2.7 kPa - 22.0kPa) Newborn animal: 20mmHg -110mmHg (2.7kPa - 14.7kPa)
NIBP accuracy	±0.80kPa (±6mmHg)
Cuff pressure range	Large animal / Small animal: 0 mmHg - 300 mmHg (0 kPa - 40.0 kPa) Newborn animal: 0 mmHg - 150 mmHg (0 kPa - 20.0 kPa)
Initial inflation pressure	Large animal: 160 mmHg (21.3kPa) Small animal: 140 mmHg (18.6 kPa) Newborn animal: 100 mmHg (13.3 kPa)
Deflation pressure	30 mmHg above the last measured systolic value
Alarm delay	<10s

## B.6 Carbon Dioxide Specifications

The following table describes the CO<sub>2</sub> specifications.

**Table B-6 CO<sub>2</sub> Specifications**

Parameter	Specification
Work mode	Work, Standby
CO <sub>2</sub> range	0 mmHg - 99 mmHg (0 kPa - 13.2 kPa)
Unit	mmHg or kPa
CO <sub>2</sub> accuracy	0 mmHg- 40 mmHg (0 kPa- 5.33 kPa): ±2 mmHg(±0.3 kPa) 41 mmHg- 76 mmHg (5.47 kPa- 10.1 kPa): ±5 mmHg(±0.7 kPa) 77 mmHg- 99 mmHg (10.3 kPa- 13.2 kPa): ±10 mmHg(±1.3 kPa)
Sample flow rate	Maximum: 50 ml/m + 15 ml/m Minimum: 50 ml/m - 7.5 ml/m
Waveform speed	6.25 mm/s, 12.5 mm/s
Alarm delay	<10s

## B.7 Invasive Blood Pressure Specifications

The following table describes the IBP specifications.

**Table B-7 IBP Specifications**

Parameter	Specification
IBP range	ART 0 - 300 mmHg PA -6 - 120 mmHg CVP -10 - 40 mmHg RAP -10 - 40 mmHg LAP -10 - 40 mmHg ICP -10 - 40 mmHg
IBP accuracy	1 mmHg or 2%, whichever is greater
Unit	mmHg or kPa
Sampling rate	62.5 times per second
Waveform speed	6.25 mm/s, 12.5 mm/s, 25.0 mm/s
Transducer sensitivity (Intellivue: Input sensitivity)	5 uV/V/mmHg
Resolution	1 mmHg (0.13 kPa)
Transducer type	Disposable
Updating time	Approximately 1 second
Alarm delay	<10s

## B.8 Power Specifications

The following table describes the power specifications.

**Table B-8 Power Specifications**

AC Power Parameter	Specification
Mains power input	100V-240V~, 50 Hz/60 Hz,
Power input	50VA
Fuse	F2AL 250V
Battery Power Parameter	Specification
Capacity	Lithium ion 7.4 V/2200 mAh
Charging time	4 hours (to 90% battery capacity)
Typical operating time	3.5 hours (with ECG, SpO <sub>2</sub> measurement and NIBP measured every 15 minutes)
Charge mode	Automatic (with charge protection feature) when the monitor is connected to an AC power source.
Discharge protection	When the monitor is powered by battery, the monitor powers off if the battery power is almost depleted.

## B.9 Display Specifications

The following table describes the display specifications.

**Table B-9 Display Specifications**

Parameter	Description
Type	Color TFT LCD
display Size	12.1 /8 inch

## B.10 Physical Specifications

The following table describes the physical specifications.

**Table B-10 Physical Specifications**

Parameter	Description
Net weight	4.5 KGs
Gross weight	5.6 KGs
Size	300x170x305mm

## B.11 Environmental Specifications

The following table describes the environmental specifications.

**Table B-11 Environmental Specifications**

Parameter	Specification
Temperature	Operating: 0 °C - 40 °C Storage: -20 °C +55 °C for the device
Relative humidity	Operating: 15% - 80% (noncondensing) Storage: 10% - 93% (noncondensing)
Barometric pressure	Operating: 59 kPa ~ 107.4 kPa Storage: 22 kPa ~ 107.4 kPa

## B.12 Interface Specifications

The following table describes the interface specifications.

**Table B-10 Interface Specification**

Parameter	Specification
Isolation	1.5 kV
Delay time	<0.5 s
Data output	Via Ethernet port
Defib sync	0 to 5V pulse

Software upgrade	Net port
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## C Alarm

### C.1 The physiological alarm information

Table C-1 Physiological alarm information

Source	Alarm information	Level	Reason and Solution
XX	XX Too High	HIGH or MED	XX value has exceeded the high alarm limit or below the low alarm limit. Check the animal physiological status, animal type and alarm limit setup.
	XX Too Low	HIGH or MED	
ECG	ECG Lost	MED	The ECG signal is too weak. The system cannot analyze the data. Check the animal, electrodes, cables and leads.
	Arrhythmia	MED	Arrhythmia
	Arrhythmia Other Abnormity	MED	Irregular rhythm
	HR No Detection	HIGH	No heart rate signal detected.
	Asystole	HIGH or MED	No QRS in continuous 4 seconds.
	VFIB/VTAC	HIGH or MED	A fibrillatory wave for 4 consecutive seconds. Consecutive PVBs greater than numbers of PVBs limit. ( $\geq 5$ ). The R-R interval less than 600ms.
	R on T	HIGH or MED	HR <100, R-R interval less than 1/3 the average interval. There is a compensatory pause; the length is 1.25X average R-R interval. (Only for the next R wave interrupt the T wave of the preceding beat)
	VT > 2	HIGH or MED	Number of PVCs is greater than 3 but less than 5.
	Couplet	HIGH or MED	Paired PVCs detected in normal heartbeats.
	PVC	HIGH or MED	Not belong to above mentioned PVB type.
	Bigeminy	HIGH or MED	Bigeminy
	Trigeminy	HIGH or MED	Trigeminy
	Tachy	HIGH or MED	Consecutive 5 QRS complex, average R-R interval less than 0.5s.
	Brady	HIGH or MED	Consecutive 5 QRS complex, average R-R interval greater than 1.5s.
	PNC	HIGH or MED	No QRS complex detected for 1.75 times milliseconds in the average R-R interval following a pace pulse (For paced animals only).
PNP	HIGH or MED	No pace pulse and QRS complex detected interval for 1.75 times milliseconds in the average R-R (For paced animals only).	
RESP	RESP Apnea	HIGH	The RESP signal is too weak. The system cannot analyze the data. Check the animal, electrodes, cables and leads.

**Table C-1 Physiological alarm information (continue)**

Source	Alarm information	Level	Reason and Solution
RESP (continue)	Resp Cardiac Overlay	HIGH	The animal RR can not measure since heartbeat interrupts RESP. Check the animal, electrodes, cables and leads.
SpO <sub>2</sub>	No Pulse	HIGH	The PR signal is too weak. The system cannot analyze the data. Check the animal, SpO <sub>2</sub> sensor and measure site.

eNote — XX is representative of ECG, RESP, SpO<sub>2</sub>, PR

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## C.2 The Technical alarm information

**Table C-2 Technical alarm information**

Source	Alarm information	Level	Reason and Solution
ECG	Leads Off	LOW	Electrodes are disconnected to the animal, or leads and main cable disconnected, check the electrodes and leads connection.
	ECG V Lead Off	LOW	
	ECG LL Lead Off	LOW	
	ECG LA Lead Off	LOW	
	ECG RA Lead Off	LOW	
	ECG Init Err	MED	There is an ECG module error, or module or communication between the module and main board has failed, restart.
	ECG Comm Stop	MED	
	ECG Comm Err	MED	
	HR Alarm Limit Error	LOW	ECG parameter alarm limit is accidental modified, please contact your service representative.
	PVC	LOW	
	ST Alarm Limit Error	LOW	
	RR Alarm Limit Error	LOW	
	ECG Noise	LOW	There is signal interference, check the leads and main cables, check the electrodes and leads connection.
	HR Exceed	LOW	ECG parameter value is over range, please contact your service representative.
	PVCs Exceed	LOW	
ST Exceed	LOW		
ST1 Exceed	LOW		
ST2 Exceed	LOW		

**Table C-2 Technical alarm information (comtinue)**

Source	Alarm information	Level	Reason and Solution
ECG	ST3 Exceed	LOW	ECG parameter value is over range; please

(continue)	ST4 Exceed	LOW	contact your service representative.
	ST5 Exceed	LOW	
	ST6 Exceed	LOW	
	ST7 Exceed	LOW	
	ST8 Exceed	LOW	
SpO <sub>2</sub>	SpO <sub>2</sub> Probe Off	LOW	The SpO <sub>2</sub> sensor disconnected from the animal or monitor or module. Check the sensor connection.
	SpO <sub>2</sub> No Sensor	LOW	
	Sensor Malfunction	LOW	
	SpO <sub>2</sub> Init Error	MED	There is a SpO <sub>2</sub> module error, or module or communication between the module and main board has failed, restart.
	SpO <sub>2</sub> Communication Stop	MED	
	SpO <sub>2</sub> Communication Error	MED	
	SpO <sub>2</sub> Alarm Limit	LOW	SpO <sub>2</sub> parameter value is over range, please contact your service representative
	SpO <sub>2</sub> Exceed	LOW	
	PR Alarm Limit Error	LOW	
	PR Exceed	LOW	
	PI Alarm Limit Error	LOW	
	PI Exceed	LOW	
NIBP	SYS Alarm Limit Error	LOW	NIBP parameter alarm limit is accidental modified; please contact your service representative.
	MAP Alarm Limit Error	LOW	
	DIA Alarm Limit Error	LOW	
	SYS Exceed	LOW	NIBP parameter value is over range, please contact your service representative
	MAP Exceed	LOW	
	DIA Exceed	LOW	
	NIBP Communication Stop	MED	There is a NIBP module error, or module or communication between the module and main board has failed, restart.
	NIBP Initialization Error	MED	
	NIBP Self test Error	MED	
	NIBP Communication Error	MED	The blood pressure cuff is not connected or placed correctly or there is air leakage.
	Cuff Loose	LOW	
	Air Leak	LOW	
Air Pressure Error	LOW	Ambient atmospheric pressure is abnormal, confirm whether the environment is fit for monitor specification, if any special cause impact	

**Table C-2 Technical alarm information (continue)**

Source	Alarm information	Level	Reason and Solution
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NIBP (continue)	Low Signal	LOW	The animal PR is too weak or cuff loose, check the animal and replace the cuff site. If it fails replace the cuff.
	Range Exceeded	LOW	Probably the animal blood pressure is over range.
	Excessive Motion	LOW	Check the animal, stop movement on animal arm.
	Overpressure	LOW	Probably the air circuit is blocked, check if and try again.
	Signal Satuated	LOW	Excessive signal amplitude caused by movement or other reasons.
	NIBP Time Out	LOW	There is an error in the NIBP measurement. The system can not analyze. Check the animal, connection or replace the cuff.
	Measurement Error	LOW	
	Cuff Type Err	LOW	The blood pressure cuff is different from animal type, check the animal type and replace.
	NIBP Illegally Reset	LOW	There is a malfunction during NIBP measurement, Check whether air circuit blocked and remeasure.
TEMP	T1 Sensor Off	LOW	The TEMP sensor is disconnected from the animal or module, check the sensor connection.
	T2 Sensor Off	LOW	
	Temp Board Failure	MED	There is a TEMP module error, or module or communication between the module and main board has failed, restart.
	Temp Initialization Error	MED	
	Temp Communication Error	MED	
	Temp Communication Stop	MED	
	T1 Alarm Limit Error	LOW	TEMP parameter alarm limit is accidental modified, please contact your service representative.
	T2 Alarm Limit Error	LOW	
	TD Alarm Limit Error	LOW	
	T1 Exceed	LOW	TEMP parameter value is over range, please contact your service representative
	T2 Exceed	LOW	
	TD Exceed	LOW	
IBP	IBP1 Sensor Off	LOW	The IBP sensor is disconnected from the animal or module, check the sensor connection.
	IBP2 Sensor Off	LOW	
	IBP Initialiazation Error	MED	There is an IBP module error, or communication between the module and main board has failed, restart.
	IBP Communication Error	MED	
	IBP Communication Stop	MED	
	IBP1 Alarm Limit Error	LOW	IBP parameter alarm limit is accidental modified; please contact your service representative.
	IBP2 Alarm Limit Error	LOW	
	IBP1 SYS Exceed	LOW	IBP parameter value is over range; please contact your service representative.

**Table C-2 Technical alarm information (continue)**

Source	Alarm information	Level	Reason and Solution
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IBP (continue)	IBP1 DIA Exceed	LOW	IBP parameter value is over range; please contact your service representative.
	IBP1 MEAN Exceed	LOW	
	IBP2 SYS Exceed	LOW	
	IBP2 DIA Exceed	LOW	
	IBP2 MEAN Exceed	LOW	
	IBP1 Need Zero-Cal	LOW	The IBP1, IBP2 zero.
	IBP2 Need Zero-Cal	LOW	
CO <sub>2</sub>	CO <sub>2</sub> Sensor Off	LOW	The CO <sub>2</sub> sensor is disconnected from the animal or module, check the sensor connection.
	CO <sub>2</sub> Initialization Error	MED	There is a CO <sub>2</sub> module error, or communication between the module and main board has failed, restart.
	CO <sub>2</sub> Communication Error	MED	
	CO <sub>2</sub> Communication Stop	MED	
	CO <sub>2</sub> Alarm Limit Error	LOW	CO <sub>2</sub> parameter alarm limit is accidental modified, please contact your service representative.
	InCO <sub>2</sub> Alarm Limit Error	LOW	
	AwRR Alarm Limit Error	LOW	
	CO <sub>2</sub> out of Range	LOW	CO <sub>2</sub> parameter value is over range, please contact your service representative.
	INCO <sub>2</sub> out of Range	LOW	
	AWRR out of Range	LOW	
	CO <sub>2</sub> Sensor Overheated	LOW	Check, stop using or replace the sensor.
	CO <sub>2</sub> Faulty Sensor	LOW	
	CO <sub>2</sub> Zero Required	LOW	Confirm air circuit connect correct and sensor temperature stable, re-zero.
	CO <sub>2</sub> Check Sampling Line	LOW	Airway adaptor and sampling line does not work, check, clean or replace the adaptor.

## D Glossary

This appendix defines some terminology and abbreviations.

### D.1 Terminology Definitions

**Table D Terminology Definitions**

<b>Term</b>	<b>Definition</b>
a/AO <sub>2</sub>	Alveolar-arterial oxygen
AaDO <sub>2</sub>	Alveolar-arterial oxygen difference
AG	Anesthetic gas
AO	Aortic pressure
ARR	Arrhythmia
ART	Arterial pressure
aVL	Left arm augmented lead
aVR	Right arm augmented lead
BSA	Body surface area
BT	Blood temperature
C.O.	Cardiac output
C(a-v)O <sub>2</sub>	Arteriovenous oxygen content
CaO <sub>2</sub>	Arterial oxygen content
CcO <sub>2</sub>	Content of capillary oxygen
CI	Cardia index
CO <sub>2</sub>	Carbon dioxide
CvO <sub>2</sub> ca	Arteriovenous oxygen content difference
CVP	Central venous pressure
DES	Desflurane
DIA	Diastolic
DO <sub>2</sub>	Oxygen delivery
ECG	Electrocardiograph
ENF	Enflurane
EtCO <sub>2</sub>	End-tidal carbon dioxide
EtN <sub>2</sub> O	End-tidal nitrous oxide
EtO <sub>2</sub>	End-tidal oxygen

**Table D Terminology Definitions (continue)**

Term	Definition
FA	Femoral artery pressure
GP	Gas parameter
HAL	Halothane
HR	Heart rate
IBP	Invasive blood pressure
ICP	Intracranial pressure
InCO <sub>2</sub>	Inspired carbon dioxide
In N <sub>2</sub> O	Inspired nitrous oxide
InO <sub>2</sub>	Inspired oxygen
IP	Invasive blood pressure
ISO	Isoflurane
LA	Left arm
LCW	Left cardiac work
LCWI	Left cardiac work index
LL	Left leg
LVSW	Left ventricular stroke work
LVSWI	Left ventricular stroke work index
MAP	Mean arterial pressure
MV	Minute volume
N <sub>2</sub> O	Nitrous oxide
NIBP	Non-invasive blood pressure
O <sub>2</sub>	Oxygen
O <sub>2</sub> ER	Oxygen extraction ratio
Pa/FiO <sub>2</sub>	Fraction of inspired oxygen
PAO <sub>2</sub>	Oxygen pressure
PR	Pulse rate
PVR	Pulmonary vascular resistance
PVR	Pulmonary vascular resistance
PVRI	Pulmonary vascular resistance index
Q <sub>s</sub> /Q <sub>t</sub>	Shunt fraction
RA	Right arm
RCW	Right cardiac work

**Table D Terminology Definitions (continue)**

Term	Definition
RCWI	Right cardiac work index
RESP	Respiration
RL	Right leg
RR	Respiration rate
RVSW	Right ventricular stroke work
RVSWI	Right ventricular stroke work index
SEV	Sevoflurane
SI	Stroke index
SpO <sub>2</sub>	Arterial oxygen saturation from pulse oximetry
SV	Stroke volume
SVI	Stroke volume index
SVR	Systemic vascular resistance
SVRI	Systemic vascular resistance index
SYS	Systolic pressure
TEMP	Temperature
VA	Alveolar volume
Vd	Dead space
Vd/TV	Dead space/tidal volume ratio
VO <sub>2</sub>	Oxygen consumption