

iM60 VET/iM70 VET

Veterinary Monitor

Version 1.3

# User Manual

CE



# About this Manual

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## Statement

This manual will help you understand the operation and maintenance of the product better. It is reminded that the product shall be used strictly complying with this manual. User's operation failing to comply with this manual may result in malfunction or accident for which EDAN INSTRUMENTS, INC. (hereinafter called EDAN) cannot be held liable.

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## Responsibility of the Manufacturer

EDAN only considers itself responsible for any effect on safety, reliability and performance of the equipment if:

Assembly operations, extensions, re-adjustments, modifications or repairs are carried out by persons authorized by EDAN, and

The electrical installation of the relevant room complies with national standards, and

The instrument is used in accordance with the instructions for use.

## Terms Used in this Manual

This guide is designed to give key concepts on safety precautions.

### **WARNING**

A **WARNING** label advises against certain actions or situations that could result in injury or death to users or patients.

### **CAUTION**

A **CAUTION** label advises against actions or situations that could damage equipment, produce inaccurate data, or invalidate a procedure.

### **NOTE**

A **NOTE** provides useful information regarding a function or a procedure.

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# Chapter 1 Intended Use and Safety Guidance

## 1.1 Intended Use/Indications for Use

The iM60 VET veterinary monitor monitors parameters such as ECG (3-lead, 5-lead selectable), Respiration (RESP), Functional arterial oxygen saturation (SpO<sub>2</sub>), Invasive or noninvasive blood pressure (2 channels IBP NIBP), Temperature (dual-TEMP) and Expired CO<sub>2</sub>. The monitor is equipped with alarms that indicate system faults (such as loose or defective electrodes), physiologic parameters that have exceeded the limits set by the operator, or both.

The iM70 VET veterinary monitor monitors parameters such as ECG (3-lead, 5-lead selectable), Respiration (RESP), Functional arterial oxygen saturation (SpO<sub>2</sub>), Invasive or noninvasive blood pressure (2 channels IBP NIBP), Temperature (dual-TEMP), Expired CO<sub>2</sub> and Anesthetic gas (AG). The monitor is equipped with alarms that indicate system faults (such as loose or defective electrodes), physiologic parameters that have exceeded the limits set by the operator, or both.

## 1.2 Safety Guidance

Federal (U.S.) law restricts this device to sale by or on the order of a physician.

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**WARNING**

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- 1 Before using the device, the equipment, patient cable and electrodes etc. should be checked. Replacement should be taken if there is any evident defect or signs of aging which may impair the safety or performance.
  - 2 Medical technical equipment such as these monitor/monitoring systems must only be used by persons who have received adequate training in the use of such equipment and who are capable of applying it properly.
  - 3 EXPLOSION HAZARD-Do not use the device in a flammable atmosphere where concentrations of flammable anesthetics or other materials may occur.
  - 4 SHOCK HAZARD-To avoid the RISK of electric shock, this equipment must only be connected to a SUPPLY MAINS with protective earth.
  - 5 The equipment can provide protective means to prevent the patient from being burned when used with HF SURGICAL EQUIPMENT. The equipment can protect against the effects of the discharge of a defibrillator. Use only EDAN-approved accessories
  - 6 Extreme care must be exercised when applying medical electrical equipment. Many parts of the human/machine circuit are conductive, such as the patient, connectors, electrodes, transducers. It is very important that these conductive parts do not come into contact with other grounded, conductive parts when connected to the isolated patient input of the device. Such contact would bridge the patient's isolation and cancel the protection provided by the isolated input. In particular, there must be no contact of the neutral electrode and ground.
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**WARNING**

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- 7 Do not come into contact with the patient, table, or the monitor during defibrillation.
  - 8 The simultaneous use of cardiac pacemaker and other patient-connected equipment may cause safety hazard.
  - 9 Magnetic and electrical fields are capable of interfering with the proper performance of the device. For this reason make sure that all external devices operated in the vicinity of the monitor comply with the relevant EMC requirements. X-ray equipment or MRI devices are a possible source of interference as they may emit higher levels of electromagnetic radiation.
  - 10 Route all cables away from patient's throat to avoid possible strangulation.
  - 11 Do not rely exclusively on the auditory alarm system for veterinary monitoring. Adjustment of alarm volume to a low level or off during veterinary monitoring may result in a hazard to the patient. Remember that the most reliable method of veterinary monitoring combines close personal surveillance with correct operation of monitoring equipment.
  - 12 Accessory equipment connected to the analog and digital interfaces must be certified according to the respective IEC/EN standards (e.g. IEC/EN 60950 for data processing equipment and IEC/EN 60601-1 for medical equipment). Furthermore all configurations shall comply with the valid version of the standard IEC/EN 60601-1. Therefore anybody, who connects additional equipment to the signal input or output connector to configure a medical system, must make sure that it complies with the requirements of the valid version of the system standard IEC/EN 60601-1. If in doubt, consult our technical service department or your local distributor.
  - 13 Only patient cable and other accessories supplied by EDAN can be used. The performance and electric shock protection cannot be guaranteed, and the patient may be injured otherwise. Prior to use, check if the casing of a disposable or sterilized accessory is intact. Do not use it if its casing is damaged.
  - 14 During monitoring, if the power supply is off and there is no battery for standby, the monitor will be off. The settings configured by the user can be stored, and settings not configured by user keep no change. That is, the last settings used will be recovered when the power is restored.
  - 15 The device and accessories are to be disposed of according to local regulations after their useful lives. Alternatively, they can be returned to the dealer or the manufacturer for recycling or proper disposal. Batteries are hazardous waste. Do NOT dispose them together with house-hold garbage. At the end of their life hand the batteries over to the applicable collection points for the recycling of waste batteries. For more detailed information about recycling of this product or battery, please contact your local Civic Office, or the shop where you purchased the product.
  - 16 The packaging is to be disposed of according to local or hospital's regulations; otherwise, it may cause environmental contamination. Place the packaging at the place which is inaccessible to children and pets.
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**WARNING**

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- 17 When interfacing with other equipment, a test for leakage current must be performed by qualified biomedical engineering personnel before using with patients.
  - 18 Devices connecting with monitor should be equipotential.
  - 19 After defibrillation, the ECG display recovers within 10 seconds if the correct electrodes are used and applied based on the manufacturers' instructions.
  - 20 This equipment is not intended for home usage.
  - 21 Do not service or maintain the monitor or any accessory which is in use with the patient.
  - 22 The appliance coupler or mains plug is used as isolation means from supply mains. Position the monitor in a location where the operator can easily access the disconnection device.
  - 23 Assembly of the monitor and modifications during actual service life shall be evaluated based on the requirements of IEC60601-1.
  - 24 The monitors are not intended for use in an MRI environment.
  - 25 Without use of data store function, all data measured (including trend data, review data, alarm events and so on) are cleared either when the monitor is turned off or when the monitor is powered down in the process of monitoring.
  - 26 Additional multiple socket-outlets or extension cords can't be connected to the system.
  - 27 Only items that have been specified as part of the system or specified as being compatible with the system can be connected to the system.
  - 28 Connecting any accessory (such as external printer) or other device (such as the computer) to this monitor makes a medical system. In that case, additional safety measures should be taken during installation of the system, and the system shall provide:
    - a) Within the patient environment, a level of safety comparable to that provided by medical electrical equipment complying with IEC/EN 60601-1, and
    - b) Outside the patient environment, the level of safety appropriate for non-medical electrical equipment complying with other IEC or ISO safety standards.
  - 29 All the accessories connected to system must be installed outside the patient vicinity, if they do not meet the requirement of IEC/EN 60601-1.
  - 30 The medical electrical equipment needs to be installed and put into service according to the EMC Information provided in this user manual.
  - 31 Portable and mobile RF communications equipment can affect medical electrical equipment; refer to the recommended separation distances provided in this user manual.
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**WARNING**

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- 32 Using accessories other than those specified may result in increased electromagnetic emission or decreased electromagnetic immunity of the monitoring equipment.
  - 33 If leakage or foul odor is detected, ensure that there's no fire around.
  - 34 Only recommended batteries can be used for the monitor.
  - 35 The monitor should not be used adjacent to or stacked with other equipment. If adjacent or stacked use is necessary, you must check that normal operation is possible in the necessary configuration before you start monitoring patients.
  - 36 Do not touch accessible parts of medical or non-medical electrical equipment in the patient environment and the patient simultaneously, such as USB connector, VGA connector or other signal input/output connectors.
  - 37 SHOCK HAZARD - Don't connect electrical equipment, which has not been supplied as a part of the system, to the multiple portable socket-outlet supplying the system.
  - 38 SHOCK HAZARD - Don't connect electrical equipment, which has been supplied as a part of the system, directly to the wall outlet when the non-medical equipment is intended to be supplied by a multiple portable socket-outlet with an isolation transformer.
  - 39 The monitors are MR Unsafe. The monitors are not intended for use in an MRI environment.
  - 40 Operation of the equipment exceeding specified physiological signal or the operational specification may cause inaccurate results.
  - 41 When the monitor is used with HF surgical equipment, the transducer and the cables must be avoided from conductive connection to the HF equipment. This is to protect against burns to the patient.
  - 42 If several items of medical equipment are interconnected, pay attention to the sum of the leakage currents, otherwise it may cause shock hazard. Consult your service personnel.
  - 43 To protect the monitor from damage during defibrillation, for accurate measurement information and to protect against noise and other interference, use only accessories specified by EDAN.
  - 44 No modification of this equipment is allowed without authorization of the manufacturer. If this equipment is modified, appropriate inspection and testing must be conducted to ensure continued safe operation.
  - 45 Clinical decision making based on the output of the device is left to the discretion of the provider.
  - 46 Route all cables carefully to avoid possible entanglement, apnea, or electrical interference.
  - 47 For the device mounted over the patient, sufficient precautionary measures should be taken to prevent it from falling on the patient.
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**WARNING**

- 48 The monitor is suitable for use in the presence of electrosurgery. When the monitor is used with HF surgical equipment, user (doctor or nurse) should be cautious about patient safety.
  - 49 The monitor can be equipped with Wi-Fi to receive RF electromagnetic energy. Therefore, any other equipment complying with CISPR radiation requirements may also interfere with the wireless communication and make it interrupted.
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
**CAUTION**










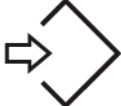




- 1 Electromagnetic Interference - Ensure that the environment in which the veterinary monitor is installed is not subject to any sources of strong electromagnetic interference, such as microwaves, radio transmitters, mobile telephones, etc.
  - 2 Keep the environment clean. Avoid vibration. Keep it far away from corrosive medicine, dust area, high temperature and humid environment.
  - 3 Do not use autoclave or gas to sterilize the monitor, recorder or any accessories.
  - 4 Do not immerse transducers in liquid. When using solutions, use sterile wipes to avoid pouring fluids directly on the transducer.
  - 5 The device and reusable accessories may be sent back to the manufacturer for recycling or proper disposal after their useful lives.
  - 6 Disposable devices are intended for single use only. They should not be reused as performance could degrade or contamination could occur.
  - 7 Remove a battery whose life cycle has expired from the monitor immediately.
  - 8 Avoid liquid splashing on the device.
  - 9 To ensure patient safety, use only parts and accessories manufactured or recommended by EDAN.
  - 10 Before connecting the monitor to the AC power, make sure the voltage and the power frequency are consistent with the requirements indicated on the device label or in this user manual.
  - 11 Protect the device against mechanical damage resulting from falls, impacts, and vibration.
  - 12 Do not touch the touch screen with a sharp object.
  - 13 A ventilated environment is required for monitor installation. Do not block up the ventilation grille at the back of the device.
  - 14 The device must be connected to the ground to avoid signal interference.
  - 15 Poor connection might be caused by frequently plugging and unplugging the power cord. Check the power cord regularly and replace it in time.
- 
-













**NOTE:**



- 1 Position the device in a location where the operator can easily see the screen and access the operating controls.
- 2 The monitor can only be used on one patient at a time.
- 3 If the monitor gets damp or liquid pours on the monitor, please contact the service personnel of EDAN.
- 4 This monitor is not a device for treatment purposes.
- 5 The pictures and interfaces in this manual are for reference only.
- 6 Regular preventive maintenance should be carried out every two years. You are responsible for any requirements specific to your country.
- 7 To protect eyes from damage, don't look directly at supplementary light for long time.
- 8 Make sure networking function is used in a secure network environment.
- 9 When there's measurement beyond range, invalid measurement or no measurement value, it will display -?-.

**1.3 Explanation of Symbols on the Monitor**

1		DEFIBRILLATION-PROOF TYPE CF APPLIED PART
2		DEFIBRILLATION-PROOF TYPE BF APPLIED PART
3		Caution
4		MR Unsafe-Keep away from magnetic resonance imaging (MRI) equipment
5		Equipotential grounding
6		Alternating Current
7		Power Supply switch
8		SERIAL NUMBER
9		Network port

10		USB (Universal Serial Bus) Connection
11		Bell cancel – AUDIO OFF
12		NIBP measurement
13		Trend
14		Picture freeze
15		Graphical recorder
16		Menu
17		Video output
18		DO NOT REUSE
19		Write data into store
20		Defibrillator synchronization/Signal output port
21		Output
22		CE marking
23		AUTHORISED REPRESENTATIVE IN THE EUROPEAN COMMUNITY

24		Date of manufacture
25		MANUFACTURER
26	P/N	Part Number
27		General symbol for recovery/recyclable
28		Disposal method
29		Operating instructions
30		Anti-theft lock
31		Gas inlet
32		Gas outlet (evac)
33		ISA equipped to measure CO <sub>2</sub> only.
34		ISA equipped to measure multiple gases.
35	<b>IPX1</b>	Ingress Protection IPX1 (Protected against vertically falling water drops)
36	<b>Rx Only</b>	Caution: Federal (U.S.) Law restricts this device to sale by or on the order of a physician.
37		Non-ionizing electromagnetic radiation
38		Refer to User Manual (Background: Blue; Symbol: White)

39		<p>Warning (Background: Yellow; Symbol &amp; outline: black)</p>
40	<p><b>ETL CLASSIFIED</b></p> 	<p>(This mark is optional.) Conforms to UL Std. 60601-1, IEC Std. 60601-2-27, IEC Std. 60601-2-30, IEC Std. 60601-2-34, IEC Std. 60601-2-49 Certified to CSA Std. C22.2 No 601.1, CSA Std. C22.2 No 60601-2-27, CSA Std. C22.2 No 60601-2-30, CSA Std. C22.2 No 60601-2-34, CSA Std. C22.2 No 60601-2-49</p>
41	<p><b>FCC ID</b></p>	<p>Federal Communications Commission: iM60 VET: SMQIM60EDAN iM70 VET: SMQIM70EDAN</p>

**NOTE:**

The user manual is printed in black and white.

## Chapter 2 Installation

### NOTE:

- 1 The monitor settings must be configured by the authorized hospital personnel.
- 2 To ensure that the monitor works properly, please read the user manual and follow the steps before using the monitor.

### 2.1 Initial Inspection

Before unpacking, check the packaging and ensure that there are no signs of mishandling or damage. If the shipping cartons are damaged, contact the carrier for compensation and package them again.

Open the package carefully and remove the monitor and accessories. Check that the contents are complete and that the correct options and accessories have been delivered.

If you have any question, please contact your local supplier.

### 2.2 Mounting the Monitor

If all situations are normal, please place the monitor on a flat, level surface, hang on the bed rail, or mount on a wall. About how to install the wall mount for the monitor, please refer to *Wall Mounting Bracket Assembly Instruction*.

### 2.3 Connecting the Power Cable

Connection procedure of the AC power line is listed below:

- 1 Make sure the AC power supply complies with the following specifications: 100 V-240 V~, 50 Hz/60 Hz.
- 2 Connect the power cord provided with the monitor. Connect the power cord to connector of the monitor. Connect the other end of the power cord to a grounded power outlet.

### NOTE:

- 1 Connect the power cable to the socket specialized for hospital use.
- 2 Only use the power cable supplied by EDAN.

### 2.4 Checking the Monitor

Make sure there is no damage on the measurement accessories and cables. Then turn on the monitor, check whether the monitor can start normally. Make sure all alarm lamps light up and the alarm sound is heard when turning on the monitor.

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### **WARNING**

If any sign of damage is detected, or the monitor displays some error messages, do not use it on any patient. Contact Customer Service Center immediately.

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**NOTE:**

- 1 Check all the functions of the monitor and make sure that the monitor is in good status.
- 2 If rechargeable batteries are provided, charge them after using the device every time, to ensure the electric power is enough.
- 3 After long-time continuous running, please restart the monitor to ensure the monitor's steady performance and long lifespan.

## 2.5 Checking the Recorder

If your monitor is equipped with a recorder, open the recorder's door to check if paper is properly installed in the slot. If no paper exists, refer to Chapter *Recording* for details.

## 2.6 Setting Date and Time

To set the date and time:

1. Select **Menu > Maintenance > User Maintain > Date/Time Setup**.
2. Adjust the date display format based on the user's habit.
3. Set the correct time of year, month, day, hour, min and sec.

## 2.7 Handing Over the Monitor

If you are handing over the monitor to the end-users directly after configuration, make sure that it is in the monitoring mode.

The users must be adequately trained to use the monitor before monitoring a patient. To achieve this, they should have access to, and read, the following documentation delivered with the monitor:

- User Manual (this book) - for full operating instructions.
- Quick Reference Card - for quick reminders during use.

## 2.8 FCC Statement

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

1. Reorient or relocate the receiving antenna.
2. Increase the separation between the equipment and receiver.
3. Connect the equipment into an outlet on a circuit different from that to which the receiver is

connected.

4. Consult the dealer or an experienced radio/TV technician for help.

This device complies with Part 15 of FCC Rules.

Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

**NOTE:**

The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate this equipment.

## 2.9 FCC RF Radiation Exposure Statement

This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body.



## Chapter 3 Basic Operation

This manual is for clinical professionals using the iM60 VET/iM70 VET veterinary monitors. Unless otherwise specified, the information here is valid for all the above products.

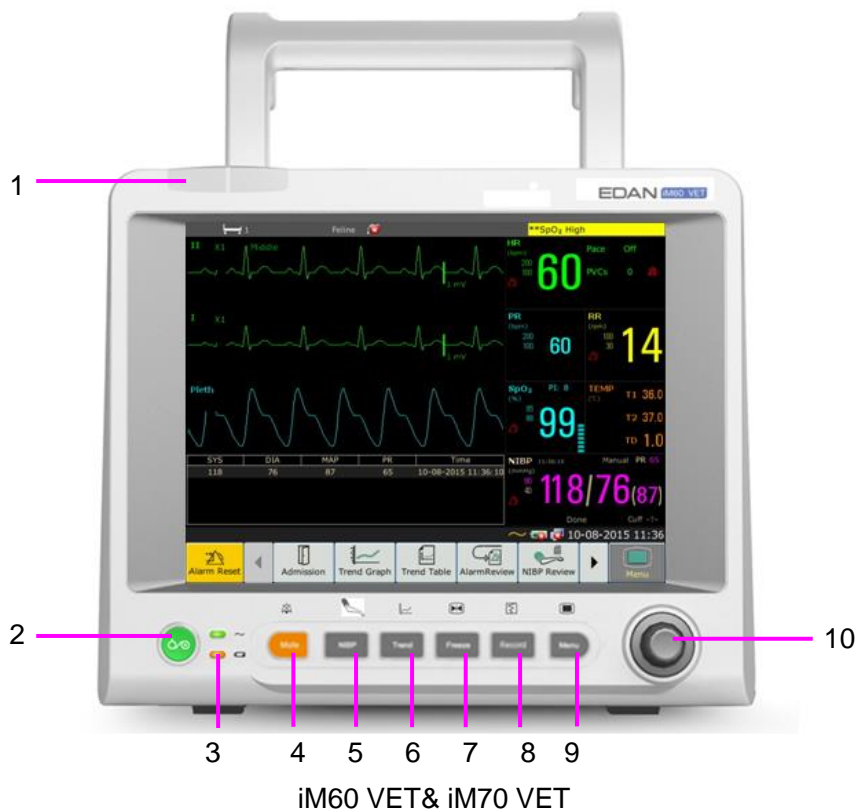
This user manual describes all features and options. Your monitor may not have all of them; they are not all available in all geographies. Your monitor is highly configurable. What you see on the screen, how the menus appear and so forth, depend on the way it has been tailored for your hospital and may not be exactly as shown here.

You may frequently use the follow functions:

- ◆ ECG monitoring (Refer to *Monitoring ECG* for more information.)
- ◆ SpO<sub>2</sub> monitoring (Refer to *Monitoring SpO<sub>2</sub>* for more information.)
- ◆ PR monitoring (Refer to *Monitoring PR* for more information.)
- ◆ NIBP monitoring (Refer to *Monitoring NIBP* for more information.)
- ◆ Alarm (Refer to *Alarms* for more information.)

### 3.1 Overview

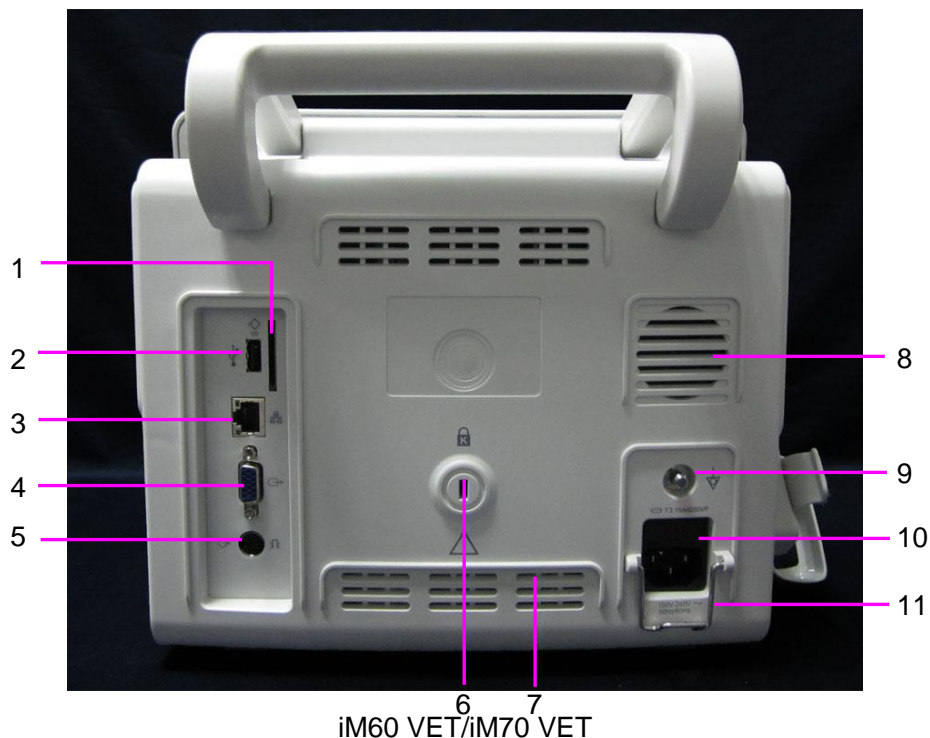
#### 3.1.1 Front View



1	Alarm indicator — when an alarm occurs, the alarm indicator will light or flash. The color of light represents the alarm level.
2	Power supply switch — when the monitor is connected to the AC power supply,

	press the key to turn the monitor on. When the monitor is turned on, press the key to turn the monitor off.
3	Battery indicator, refer to Section <i>Battery Power Indicator</i> for details.
4	Mute — Press it to suspend the output of all audible alarm signals. Upon the configuration, pressing this button to pause or turn off the audio alarm. Further information can be found in the Section <i>Audio Alarm Paused</i> and Section <i>Audio Alarm Off</i> .
5	Start / Stop NIBP measurement — Press this button to inflate the cuff and start blood pressure measurement. During the measurement, press the button to stop the measurement.
6	Trend Key — Press this button to enter trend table review interface.
7	Freeze /Unfreeze — In normal mode, press this button to freeze all the waveforms on the screen. In <b>Freeze</b> mode, press this button to restore the waveform refreshing.
8	Start / Stop Recording — Press this button to start a real-time recording. During the recording, press this button again to stop recording.
9	Menu — Press this button to return to the main interface when there is no menu open.
10	Rotary Knob (hereinafter called knob) — The user can rotate the knob clockwise or anticlockwise. This operation can make the highlighted item shift up, down, left or right to choose the desired item. Remember, when using the knob, rotate this button to highlight, and press it to select the item.

### 3.1.2 Rear View



1	SD Card
2	USB interface, this port is used to connect the USB device.
3	Network interface, this port is used to connect to the central monitoring system through the standard network wire.
4	VGA output
5	Defibrillator synchronization/ analog output/ nurse call port: When the user selects <b>Analog Output</b> , the monitor outputs the waveform through the auxiliary output port. When the user selects <b>Defibrillation</b> , the monitor outputs the defibrillator synchronization signal through the auxiliary output port. When the port is used as nurse call port, it is connected to the call system. When there is an alarm, the monitor outputs nurse call signal to notify the nurse.
6	Anti-theft lock interface
7	Heat sink
8	Speaker
9	Equipotential grounding terminal, if the monitor or other processing unit are used in internal examinations on the heart, ensure that the room incorporates an equipotential grounding system to which the monitor and other processing unit have separate connection.
10	Power Supply Inlet
11	Security lock, used to prevent the power cable from loosing or falling. Place the latch on the power cable and press it down firmly to ensure that it secures the power cable.

### 3.1.3 Side View

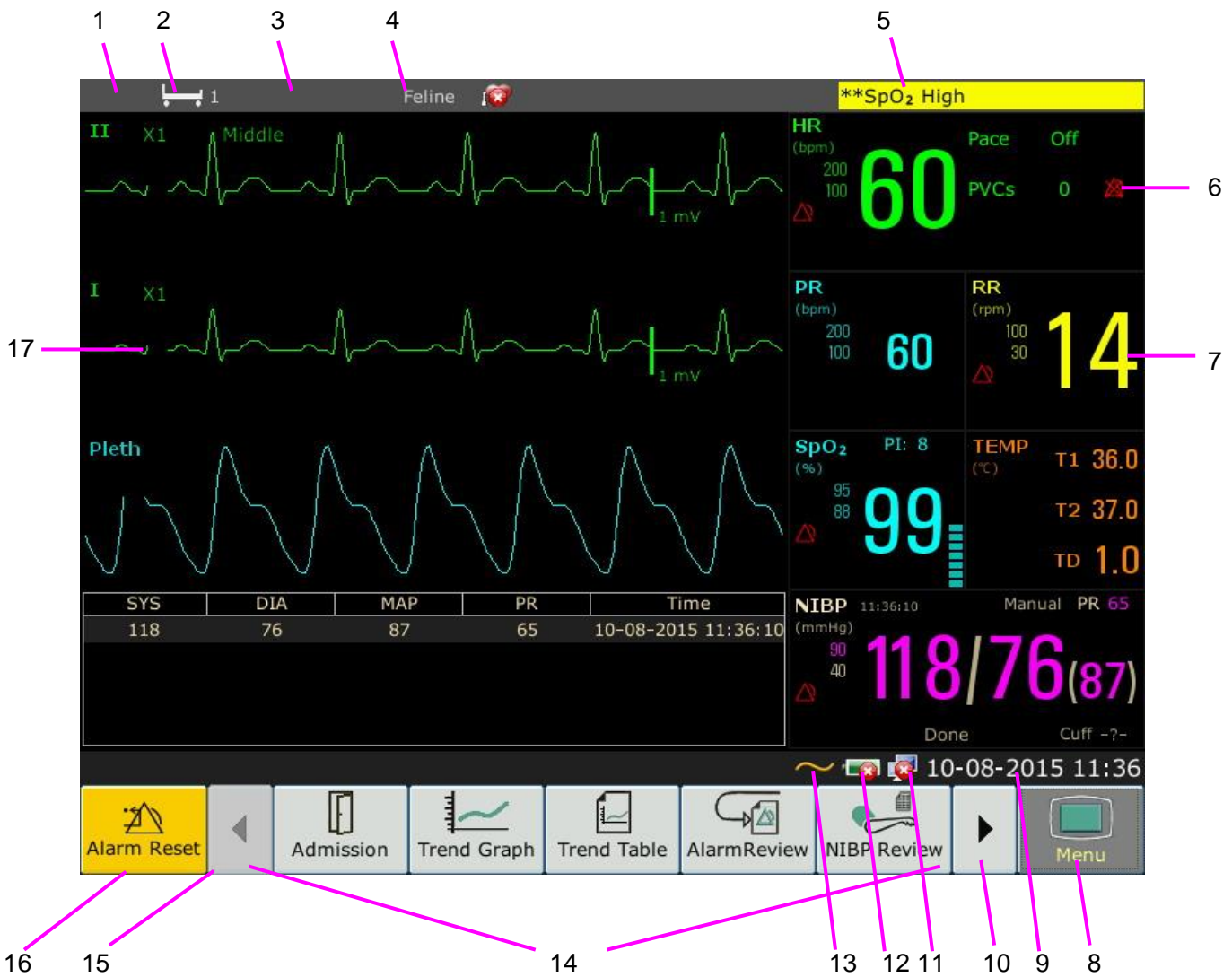


iM60 VET/iM70 VET

1	Sensor port
2	CO <sub>2</sub> module holder
3	Recorder door
4	Battery door

### 3.2 Operating and Navigating

Everything you need to operate the monitor is contained on its screen. Almost every element on the screen is interactive. Screen elements include measurement data, waveforms, screen keys, information fields, alarms fields and menus. The configurability of the monitor means that often you can access the same element in different ways. For example, you might be able to access an item through its on-screen setup menu, via a hard key, or via a shortcut key. The User Manual always describes how to access items via an on-screen menu. You may use whichever way you find most convenient.



1	Department
2	Bed number
3	Patient name
4	Patient type
5	Alarm area
6	Alarm off
7	Measurement value
8	Menu
9	Date and time
10	Scroll right to display more shortcut keys
11	Networking symbol
12	Battery status symbol
13	AC power supply symbol
14	Shortcut key area
15	Scroll left to display more shortcut keys
16	Alarm reset key
17	Parameter waveform

### 3.2.1 Using Keys

The monitor has four different types of keys. If the key sound is enabled, the monitor gives a normal key sound when the operation is valid.

#### 3.2.1.1 Permanent Keys

A permanent key is a graphical key that remains on the screen all the time to give you fast access to functions.



To display the main setup menu.



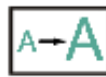
To reset the alarm.

#### 3.2.1.2 Shortcut Keys

A shortcut key is a configurable graphical key, located at the bottom of the main screen. It gives you fast access to functions. The selection of shortcut keys available on your monitor depends on your monitor configuration and on the options purchased.



Switch to the standard screen



Switch to the large font screen



Select this item by the rotary knob to enable the touch screen operation



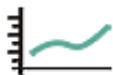
Set the module switch



Admit a patient



Change the key volume



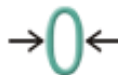
Review the trend graph



Adjust the screen brightness



Review the trend table



Zero the IBP sensor



Review the alarm event



Alarm setup



Access the NIBP review



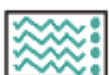
Change the beat volume



Access the ARR review



Enter standby mode



Switch to the trend screen



Enter night mode



Switch to the vital screen

### 3.2.1.3 Hardkeys

A hardkey is a physical key on a monitoring device, such as the recording key on the front panel. Refer to the illustration in *Main Unit* for more information.

### 3.2.1.4 Pop-up Keys

Pop-up keys are task-related graphical keys that appear automatically on the screen when required. For example, the confirmation pop-up key appears only when you need to confirm a change.

## 3.3 Operating Mode

### 3.3.1 Demo Mode

To change the operating mode into the demo mode, please refer to the following procedure:


Select **Menu > Common Function**, then choose **Demo Mode** from the popup interface and input password **3045**.

To exit **Demo Mode**, select **Menu > Common Function > Demo Mode**.

#### **WARNING**


Demo Mode is for demonstration purposes only. You must not change into Demo Mode during monitoring. In Demo Mode, all stored trend information is deleted from the monitor's memory.

### 3.3.2 Standby Mode

Standby mode can be used when you want to temporarily interrupt monitoring. To enter standby mode, please press the shortcut key  on the screen directly. To resume monitoring, select anything on the screen or press any key.

### 3.3.3 Night Mode

To switch to night mode, you may:

- Select the shortcut key  on the main screen, or
- Select **Menu > Common Function > Night Mode**.


#### **NOTE:**

In night mode, the sound of key, heart beat and pulse is muted; the alarm volume and screen brightness are down to their minimum; the settings including key volume, beat volume, PR volume, alarm volume and screen brightness are unavailable.

## 3.4 Changing Monitor Settings

### 3.4.1 Adjusting Screen Brightness

To change the screen brightness:

1. Select the shortcut key  on the screen directly, or
2. Select **Menu > Common Function > Brightness**, and select the appropriate setting for the screen brightness. **10** is the brightest, **1** is the least bright.

## 3.4.2 Changing Date and Time

To change the date and time, please refer to Section *Setting Date and Time*.

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### **WARNING**

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Change to date and time will influence the storage of trend data.


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## 3.5 Adjusting Volume


### 3.5.1 Adjusting Key Volume

The key volume is the volume you hear when you select any field on the monitor screen or when you turn the knob. To adjust the key volume:

1. Select the shortcut key  on the screen directly, or
2. Select **Menu > System Setup > Key Volume**, then select the appropriate setting for the key volume: five bars represent the maximum volume and one bar represents the minimum volume. If none of bars are selected, the key volume will be off.


### 3.5.2 Adjusting Alarm Volume

To change the alarm volume:

1. Select the shortcut key  on the screen directly, or
2. Select **Menu > Alarm Setup** and select the desired setting for the **AlarmVolume** item: five bars represent the maximum volume and one bar represents the minimum volume.

### 3.5.3 Adjusting Beat Volume

Beat volume is from HR or PR, depending on your setting of the beat source. To change the beat volume:

1. Select the shortcut key  on the screen directly, or
2. Select **ECG Setup > Beat Volume**, then select the appropriate setting for the beat volume: five bars represent the maximum volume and one bar represents the minimum volume. If none of bars are selected, the beat volume will be off. Beat frequency has positive correlation with measurement value.

## 3.6 Checking Your Monitor Version

To check the monitor version, please select **Menu > Common Function > About** to check the monitor software revision.



## 3.7 Networked Monitoring

Your monitor can be connected to the wired network and the wireless network. If the monitor is networked, a network symbol is displayed on the screen.

### NOTE:

Be aware that some network-based functions may be limited for monitors on wireless networks in comparison to those on wired networks.



## 3.8 Setting Languages

To change the language, please:

1. Select **Menu > Maintenance > User Maintain**, then type the correct password **ABC** into the displayed interface.
2. Select the **Language** option on the popup interface to open the language list.
3. Select the desired language from the list. To make the change validate, please restart the monitor.

## 3.9 Calibrating Screens




To calibrate the screen, please refer to the following steps:

1. Select **Menu > Maintenance > User Maintain**, input the user password **ABC**, and select **TouchScr Calibration** on the **User Maintain** menu.
2. The symbol  appears on the screen.
3. Click on the central point of the symbol .
4. After the screen calibration is finished, it will return to the **User Maintain** menu.

### NOTE:

In the screen calibration interface, the screen turns gray and no measurement data can be displayed.

## 3.10 Disabling the Touch Screen

The user can disable touch screen operation by selecting and holding the permanent key  for three seconds. A message of **Screen Locked** and the symbol  will be displayed at the bottom of screen. To enable the touch screen operation, select the symbol  by using the knob.

## 3.11 Using the Barcode Scanner

To enter the barcode setup menu, please select **Menu > Maintenance > User Maintain**. After entering the required password **ABC**, select **Other Setups > BarCode Setup**. Then the user can set serial No, last Name, first Name and so on.

**NOTE:**

While using keyboard, please set “Capslock” as “lower case” before using Bar Code Scanner.

### 3.12 Resolving IBP Label Conflicts

Each label must be unique and can only be assigned once. The measurement labels are stored in the measurement modules. If you try to use two IBP channels that have identical labels, this causes a label conflict in the monitor.

For example, an IBP channel (channel A) has already been loaded and the label Art is used for channel A. Then another IBP channel (channel B) is loaded and the label Art is also used for channel B. In this case, a label conflict will be triggered. A prompt indicating IBP label conflict will appear on the left of the screen. Additionally, at the corresponding measurements area, a label flickers to indicate a label conflict. The flickering label is the default one assigned by the system.

The IBP channel with a label conflict will not provide any measurement data; besides, the functions of setup, zeroing and calibrating are unavailable. To resolve the label conflict, you have to change the conflicting label into a non-conflicting one via the following method:

- 1 Select the IBP channel with a label conflict on the screen and open the **Options** menu.
- 2 Choose another label among the options from the **Alias** pull-down list to resolve the label conflict.

## Chapter 4 Alarms

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### **WARNING**

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

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### 4.1 Alarm Category

The monitor provides two types of alarms: physiological alarms and technical alarms. Also, the monitor provides prompts.

#### 4.1.1 Physiological alarms

If one or several physiological parameters of the currently monitored patient exceed the predefined alarm limit, the monitor will give an alarm, and this type of alarm is called physiological alarms. About the detailed alarm information, please refer to the Section *Physiological Alarm Information*.

#### 4.1.2 Technical Alarms

If one or several technical status of the device is in abnormal status, the monitor will give an alarm. And this type of alarm is called technical alarms. Technical alarms can't be disabled. About the detailed alarm information, please refer to Section *Technical Alarm Information*.

#### 4.1.3 Prompts

The monitor can give the character indication of monitoring process or other functions. And this character is called prompts. About the detailed alarm information, please refer to Section *Prompts*.

### 4.2 Alarm Levels

In terms of severity, the device's alarm levels can be classified into three categories: high level alarms, medium level alarms and low level alarms.

#### 1. High level alarms

A high level alarm intensively warns the operator of a high priority alarm condition which requires immediate operator response. Failure to respond to the cause of the alarm condition is likely to result in death or irreversible injury of the patient.

#### 2. Medium level alarms

A medium level alarm warns the operator of a medium priority alarm condition which requires prompt operator response. Failure to respond to the cause of the alarm condition is likely to result in reversible injury of the patient.

### 3. Low level alarms

A low level alarm reminds the operator of a low priority alarm condition which requires response. And the response time for a low priority alarm condition can be greater than that for a medium priority alarm condition. Failure to respond to the cause of the alarm condition is likely to result in discomfort or reversible minor injury of the patient.

The high/medium/low-level alarms are indicated by the system in following different ways:

Alarm level	Prompt
High	Mode is “DO-DO-DO-----DO-DO, DO-DO-DO-----DO-DO”, which is triggered once every 10 seconds. The alarm indicator flashes in red, with frequency of 1.4 Hz~2.8 Hz. The alarm message flashes with red background, and the symbol *** is displayed at the alarm area.
Medium	Mode is “DO-DO-DO”, which is triggered once every 25 seconds. The alarm indicator flashes in yellow, with frequency of 0.4 Hz~0.8 Hz. The alarm message flashes with yellow background, and the symbol ** is displayed at the alarm area.
Low	Mode is “DO-”, which is triggered once every 30 seconds. When physiological alarm is triggered, the alarm indicator is constantly yellow. While for technical alarm, the alarm indicator is constantly blue. The alarm message flashes with yellow background, and the symbol * is displayed at the alarm area.

The sound pressure range for auditory alarm signals is from 45 dB to 85 dB.

When different level alarms occur at the same time, alarm sound and alarm indicator prompt the highest level alarm, alarm messages display in turn.

The parameter area has two flash methods to prompt alarms: background flash and text flash. User can select one method from **Menu > Alarm Setup > Visual Effect:**

1. **Text Flash:** text flashes with frequency of 1 Hz.
2. **Background Flash:** background flashes with frequency of 1 Hz.


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### **WARNING**

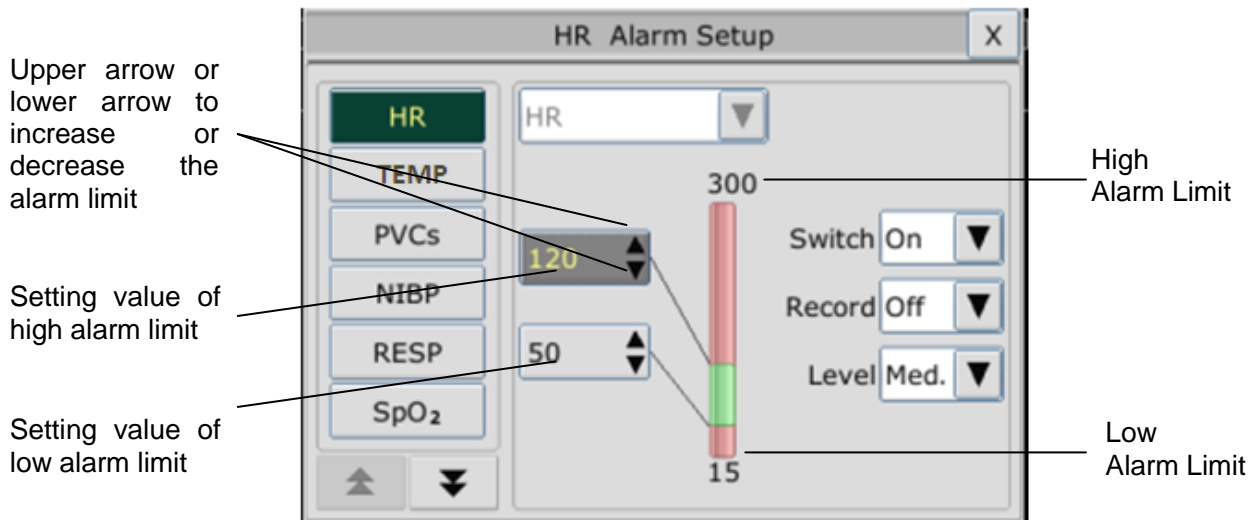
- 1 Do not rely exclusively on the audible alarm system for veterinary monitoring. Adjustment of alarm volume to a low level or off during veterinary monitoring may result in patient danger. Remember that the most reliable method of veterinary monitoring combines close personal surveillance with correct operation of monitoring equipment.
  - 2 Ensure the volume is properly set up. When the sound pressure of audible alarm is below or equivalent to the ambient noise, it may be difficult for the operator to distinguish the audio alarm.
-

## 4.3 Controlling Alarm

### 4.3.1 Setting Parameter Alarm

Parameter alarm settings including alarm switch, alarm record, alarm level and alarm limit are available on the respective alarm setup menu for each parameter. To access the menu for parameter alarm settings, use the shortcut key  or select **Menu > Alarm Setup**, and then click **Alarm Options** to open the menu shown below for alarm settings of each parameter. Also, you can access this menu via the respective parameter setup menu.


When alarm switch is off, the parameter alarm off icon  will be displayed in the corresponding parameter area.



### **WARNING**



- 1 When the alarm is set to **Off**, the monitor won't give an alarm prompt even if an alarm occurs. In order to avoid endangering the patient's life, the user should use this function cautiously.
- 2 Prior to monitoring, make sure that the alarm limit settings are appropriate for your patient.
- 3 Setting alarm limits to extreme values may cause the alarm system to become ineffective. It is recommended to use the default settings.


### 4.3.2 Audio Alarm Paused

You can temporarily prevent alarms from sounding by pressing the hardkey  on the front panel. You can set the alarm pause time as desired. The default alarm pause time is 120 s.

1. Select **Menu > Maintenance > User Maintain**, and enter the required password **ABC**.
2. Select **Alarm Setup**, and set **Pause Time** to **60 s**, **120 s**, or **180 s**.

When audio alarms are paused,


- ◆ The audio alarm is turned off, and no alarms are sounding.
- ◆ The visual alarm indications are still displayed.
- ◆ The monitor displays the audio alarm paused icon .
- ◆ The monitor displays the remaining pause time in seconds with red background.
- ◆ The hardkey  on the front panel flashes in yellow.


When the alarm pause time expires, the audio alarm paused status is automatically terminated and alarm is sounding. You can also terminate the alarm paused status by pressing the hardkey .


**NOTE:**

If a new alarm occurs during the audio alarm paused period, the new alarm will not be sounding.

### 4.3.3 Audio Alarm off

Set **Pause Time** to **Permanent**, and the monitor will enter into audio alarm off status after the hardkey  is pressed. During the audio alarm off status,

- The audio alarm is turned off, and no alarms are sounding.
- The visual alarm indications are still displayed.
- The hardkey  on the front panel flashes in yellow.

**Remind signal:** Audio alarm off symbol  and **Audio Alarm off** on a red colored background are displayed with an interval of 2 s during the audio alarm off status.

Pressing the hardkey  again can resume the audio alarm.

**NOTE:**

If a new alarm occurs during the audio alarm off period, the new alarm will not be sounding.

### 4.3.4 Alarm Reset

Select the shortcut key **Alarm Reset**  on the screen directly. When the alarm is reset,


- ◆ No alarms are sounding until a new alarm occurs.
- ◆ As for the active alarms, the visual alarm indications are still displayed.
- ◆ All latching alarms are cleared. If the alarm condition is no longer present, all alarm indications stop and the alarm is reset.
- ◆ It will not influence the configuration of physiological alarm off, audio paused, and audio off status.

**NOTE:**





If a new alarm occurs after the alarm is reset, the new alarm will be sounding.

## 4.4 Latching Alarms

To configure the alarm latching setting, select **Menu > Maintenance > User Maintain > Alarm Setup** and choose **Alarm Latch** which can be set to **On** or **Off**. When it is set to **Off**, alarm indications end when the alarm condition ends. When it is set to **On**, the visual alarm indication is still displayed after the alarm condition ends; meanwhile, the alarm time is also displayed for the latched alarm for your reference. The indication lasts until you acknowledge the alarm.

You can use the permanent key  on the screen to acknowledge the latched alarm.

## 4.5 Disabling Sensor Off Alarms

To set sensor off alarm, please select **Menu > Maintenance > User Maintain** and enter the required password **ABC**. Then select **Alarm Setup** and set **Sensor Off Alm** from the pull-down list. If it is set to **On**, and a sensor off alarm occurs, after pressing the hardkey  or permanent key  the user can disable the audio alarm signal, however, the visual alarm indications are still displayed. If it is set to **Off**, and a sensor off alarm occurs, after pressing the hardkey  or permanent key , sensor-off status will be announced with a prompt message. It means there's no audio alarm signal and alarm indicator, but prompt information displayed.

## 4.6 Network Disconnected Alarms

To configure the network disconnected alarms, select **Menu > Maintenance > User Maintain > Network Maintain** and choose **Disconnect Alarm** which can be set to **On** or **Off**. The alarm is off by default.

**NOTE:**

If **Disconnect Alarm** occurs during audio alarm paused or audio alarm off status, the monitor will prompt a sounding alarm with information of **NetWork Disconnect**. During the network disconnected status, activating audio alarm paused or audio alarm off function can disable the audio alarm signal of Disconnect Alarm.

## 4.7 Testing Alarms

When you switch the monitor on, the monitor will prompt a “Di” tone that means the audio in selftest is normal. Meantime, you must check that the alarm indicator lights are normal. This indicates that the visible and auditory alarm indicators are functioning correctly. For further testing of individual measurement alarms, perform the measurement on yourself or use a simulator. Adjust alarm limits and check that appropriate alarm behavior is observed.

## Chapter 5 Alarm Information

### 5.1 Physiological Alarm Information

#### **WARNING**

During monitoring, the physiological alarms including **ASYSTOLE**, **VFIB/VTAC**, **RESP APNEA**, **SpO<sub>2</sub> No Pulse**, **CO<sub>2</sub> APNEA**, **AG FiO<sub>2</sub> Low**, and **AG APNEA** are preset to be on. **ASYSTOLE**, **RESP APNEA**, **SpO<sub>2</sub> No Pulse**, **CO<sub>2</sub> APNEA**, **AG FiO<sub>2</sub> Low**, and **AG APNEA** cannot be turned off.

Message	Cause	Alarm Level
<b>HR High</b>	HR measuring value is above the upper alarm limit.	User-selectable
<b>HR Low</b>	HR measuring value is below the lower alarm limit.	User-selectable
<b>ST-X High</b>	ST measuring value is above the upper alarm limit. (X stands for I, II, III, aVR, aVL, aVF, V)	User-selectable
<b>ST-X Low</b>	ST measuring value is below the lower alarm limit.(X stands for I, II, III, aVR, aVL, aVF, V)	User-selectable
<b>PVCs High</b>	PVCs measuring value is above the upper alarm limit.	User-selectable
<b>ASYSTOLE</b>	No QRS is detected for 4 consecutive seconds	High
<b>VFIB/VTAC</b>	4 consecutive seconds' fibrillation wave occurs, or each RR interval for 5 consecutive ventricular beats is less than 600 ms.	High
<b>VT &gt; 2</b>	$3 \leq$ the number of consecutive PVCs $< 5$	User-selectable
<b>COUPLET</b>	2 consecutive PVCs	User-selectable
<b>BIGEMINY</b>	A dominant rhythm of N, V, N, V (N = supraventricular beat, V = ventricular beat) was detected.	User-selectable
<b>TRIGEMINY</b>	A dominant rhythm of N, N, V, N, N,V	User-selectable
<b>R ON T</b>	A type of single PVC under the condition that HR < 100, R-R interval is less than 1/3 the average interval, followed by a compensating pause of 1.25X the average R-R interval (the next R wave advances onto the previous T wave).	User-selectable
<b>PVC</b>	Single PVC detected in normal heartbeats.	User-selectable
<b>TACHY</b>	RR interval for 5 consecutive QRS complex $\leq 0.375$ s.	User-selectable
<b>BRADY</b>	RR interval for 5 consecutive QRS complex $\geq 1$ s.	User-selectable



Message	Cause	Alarm Level
<b>MISSED BEATS</b>	If HR < 120 bpm, no beats are detected for 1.75 times average RR interval; or if HR ≥120 bpm, no beats are detected for one second.	User-selectable
<b>IRR</b>	Consistently irregular heart rhythm	User-selectable
<b>PNC</b>	PACER NOT CAPTURE: no QRS complex detected in 300 ms after a pace pulse.	User-selectable
<b>PNP</b>	PACER NOT PACED: no pace pulse detected in 1.75 times RR interval after a QRS complex.	User-selectable
<b>VBRADY</b>	VENTRICULAR BRADYCARDIA: Each RR interval for 5 consecutive ventricular beats > 1000 ms.	User-selectable
<b>VENT</b>	VENTRICULAR RHYTHM: Each RR interval for 5 consecutive ventricular beats ranges from 600 ms to 1000 ms.	User-selectable
<b>RESP APNEA</b>	RESP can not be measured within the set apnea alarm delay time.	High
<b>RR High</b>	RR measuring value is above upper alarm limit.	User-selectable
<b>RR Low</b>	RR measuring value is below lower alarm limit.	User-selectable
<b>SpO<sub>2</sub> High</b>	SpO <sub>2</sub> measuring value is above upper alarm limit.	User-selectable
<b>SpO<sub>2</sub> Low</b>	SpO <sub>2</sub> measuring value is below lower alarm limit.	User-selectable
<b>SpO<sub>2</sub> No Pulse</b>	The signal of the measurement site is too weak due to insufficient blood supply and environmental factors, so the monitor can't detect the pulse signal.	High
<b>PR High</b>	PR measuring value is above upper alarm limit.	User-selectable
<b>PR Low</b>	PR measuring value is below lower alarm limit.	User-selectable
<b>T1 High</b>	Measuring value of T1 channel is above upper alarm limit.	User-selectable
<b>T1 Low</b>	Measuring value of T1 channel is below lower alarm limit.	User-selectable
<b>T2 High</b>	Measuring value of T2 channel is above upper alarm limit.	User-selectable
<b>T2 Low</b>	Measuring value of T2 channel is below lower alarm limit.	User-selectable
<b>TD High</b>	Measuring value of TD channel is above upper alarm limit.	User-selectable
<b>SYS High</b>	SYS measuring value is above upper alarm limit.	User-selectable
<b>SYS Low</b>	SYS measuring value is below lower alarm limit.	User-selectable

<b>Message</b>	<b>Cause</b>	<b>Alarm Level</b>
<b>DIA High</b>	DIA measuring value is above upper alarm limit.	User-selectable
<b>DIA Low</b>	DIA measuring value is below lower alarm limit.	User-selectable
<b>MAP High</b>	MAP measuring value is above upper alarm limit.	User-selectable
<b>MAP Low</b>	MAP measuring value is below lower alarm limit.	User-selectable
<b>PR (NIBP) High</b>	PR measuring value from the NIBP module is above upper alarm limit.	User-selectable
<b>PR (NIBP) Low</b>	PR measuring value from the NIBP module is below lower alarm limit.	User-selectable
<b>Art SYS High</b>	Art SYS measuring value is above upper alarm limit.	User-selectable
<b>Art SYS Low</b>	Art SYS measuring value is below lower alarm limit.	User-selectable
<b>Art DIA High</b>	Art DIA measuring value is above upper alarm limit.	User-selectable
<b>Art DIA Low</b>	Art DIA measuring value is below lower alarm limit.	User-selectable
<b>Art MAP High</b>	Art MAP measuring value is above upper alarm limit.	User-selectable
<b>Art MAP Low</b>	Art MAP measuring value is below lower alarm limit.	User-selectable
<b>PA SYS High</b>	PA SYS measuring value is above upper alarm limit.	User-selectable
<b>PA SYS Low</b>	PA SYS measuring value is below lower alarm limit.	User-selectable
<b>PA DIA High</b>	PA DIA measuring value is above upper alarm limit.	User-selectable
<b>PA DIA Low</b>	PA DIA measuring value is below lower alarm limit.	User-selectable
<b>PA MAP High</b>	PA MAP measuring value is above upper alarm limit.	User-selectable
<b>PA MAP Low</b>	PA MAP measuring value is below lower alarm limit.	User-selectable
<b>CVP MAP High</b>	CVP MAP measuring value is above upper alarm limit.	User-selectable
<b>CVP MAP Low</b>	CVP MAP measuring value is below lower alarm limit.	User-selectable
<b>ICP MAP High</b>	ICP MAP measuring value is above upper alarm limit.	User-selectable
<b>ICP MAP Low</b>	ICP MAP measuring value is below lower alarm limit.	User-selectable
<b>LAP MAP High</b>	LAP MAP measuring value is above upper alarm limit.	User-selectable
<b>LAP MAP Low</b>	LAP MAP measuring value is below lower alarm limit.	User-selectable
<b>RAP MAP High</b>	RAP MAP measuring value is above upper alarm limit.	User-selectable
<b>RAP MAP Low</b>	RAP MAP measuring value is below lower alarm limit.	User-selectable
<b>P1 SYS High</b>	P1 SYS measuring value is above upper alarm limit.	User-selectable
<b>P1 SYS Low</b>	P1 SYS measuring value is below lower alarm limit.	User-selectable
<b>P1 DIA High</b>	P1 DIA measuring value is above upper alarm limit.	User-selectable
<b>P1 DIA Low</b>	P1 DIA measuring value is below lower alarm limit.	User-selectable
<b>P1 MAP High</b>	P1 MAP measuring value is above upper alarm limit.	User-selectable

Message	Cause	Alarm Level
<b>P1 MAP Low</b>	P1 MAP measuring value is below lower alarm limit.	User-selectable
<b>P2 SYS High</b>	P2 SYS measuring value is above upper alarm limit.	User-selectable
<b>P2 SYS Low</b>	P2 SYS measuring value is below lower alarm limit.	User-selectable
<b>P2 DIA High</b>	P2 DIA measuring value is above upper alarm limit.	User-selectable
<b>P2 DIA Low</b>	P2 DIA measuring value is below lower alarm limit.	User-selectable
<b>P2 MAP High</b>	P2 MAP measuring value is above upper alarm limit.	User-selectable
<b>P2 MAP Low</b>	P2 MAP measuring value is below lower alarm limit.	User-selectable
<b>EtCO<sub>2</sub> High</b>	EtCO <sub>2</sub> measuring value is above upper alarm limit.	User-selectable
<b>EtCO<sub>2</sub> Low</b>	EtCO <sub>2</sub> measuring value is below lower alarm limit.	User-selectable
<b>FiCO<sub>2</sub> High</b>	FiCO <sub>2</sub> measuring value is above alarm limits.	User-selectable
<b>CO<sub>2</sub> APNEA</b>	In the set apnea alarm delay time interval, no RESP can be detected using CO <sub>2</sub> module.	High
<b>AwRR High</b>	AwRR measuring value is above upper alarm limit.	User-selectable
<b>AwRR Low</b>	AwRR measuring value is below lower alarm limit.	User-selectable
<b>EtCO<sub>2</sub> (AG) High</b>	EtCO <sub>2</sub> (AG) measuring value is above upper alarm limit.	User-selectable
<b>EtCO<sub>2</sub> (AG) Low</b>	EtCO <sub>2</sub> (AG) measuring value is below lower alarm limit.	User-selectable
<b>FiCO<sub>2</sub> (AG) High</b>	FiCO <sub>2</sub> (AG) measuring value is above alarm limits.	User-selectable
<b>AwRR (AG) High</b>	AwRR (AG) measuring value is above upper alarm limit.	User-selectable
<b>AwRR (AG) Low</b>	AwRR (AG) measuring value is below lower alarm limit.	User-selectable
<b>EtO<sub>2</sub> High</b>	EtO <sub>2</sub> measuring value is above upper alarm limit.	User-selectable
<b>EtO<sub>2</sub> Low</b>	EtO <sub>2</sub> measuring value is below lower alarm limit.	User-selectable
<b>FiO<sub>2</sub> High</b>	FiO <sub>2</sub> measuring value is above upper alarm limit.	User-selectable
<b>FiO<sub>2</sub> Low</b>	FiO <sub>2</sub> measuring value is below lower alarm limit.	User-selectable
<b>EtN<sub>2</sub>O High</b>	EtN <sub>2</sub> O measuring value is above upper alarm limit.	User-selectable
<b>EtN<sub>2</sub>O Low</b>	EtN <sub>2</sub> O measuring value is below lower alarm limit.	User-selectable
<b>FiN<sub>2</sub>O High</b>	FiN <sub>2</sub> O measuring value is above upper alarm limit.	User-selectable
<b>FiN<sub>2</sub>O Low</b>	FiN <sub>2</sub> O measuring value is below lower alarm limit.	User-selectable
<b>EtHAL High</b>	EtHAL measuring value is above upper alarm limit.	User-selectable
<b>EtHAL Low</b>	EtHAL measuring value is below lower alarm limit.	User-selectable
<b>FiHAL High</b>	FiHAL measuring value is above upper alarm limit.	User-selectable

Message	Cause	Alarm Level
<b>FiHAL Low</b>	FiHAL measuring value is below lower alarm limit.	User-selectable
<b>EtENF High</b>	EtENF measuring value is above upper alarm limit.	User-selectable
<b>EtENF Low</b>	EtENF measuring value is below lower alarm limit.	User-selectable
<b>FiENF High</b>	FiENF measuring value is above upper alarm limit.	User-selectable
<b>FiENF Low</b>	FiENF measuring value is below lower alarm limit.	User-selectable
<b>EtISO High</b>	EtISO measuring value is above upper alarm limit.	User-selectable
<b>EtISO Low</b>	EtISO measuring value is below lower alarm limit.	User-selectable
<b>FiISO High</b>	FiISO measuring value is above upper alarm limit.	User-selectable
<b>FiISO Low</b>	FiISO measuring value is below lower alarm limit.	User-selectable
<b>EtSEV High</b>	EtSEV measuring value is above upper alarm limit.	User-selectable
<b>EtSEV Low</b>	EtSEV measuring value is below lower alarm limit.	User-selectable
<b>FiSEV High</b>	FiSEV measuring value is above upper alarm limit.	User-selectable
<b>FiSEV Low</b>	FiSEV measuring value is below lower alarm limit.	User-selectable
<b>EtDES High</b>	EtDES measuring value is above upper alarm limit.	User-selectable
<b>EtDES Low</b>	EtDES measuring value is below lower alarm limit.	User-selectable
<b>FiDES High</b>	FiDES measuring value is above upper alarm limit.	User-selectable
<b>FiDES Low</b>	FiDES measuring value is below lower alarm limit.	User-selectable
<b>AG FiO<sub>2</sub> Low</b>	FiO <sub>2</sub> measure value is extremely low.	High
<b>AG APNEA</b>	In the set apnea alarm delay time interval, no RESP can be detected using AG module.	High

## 5.2 Technical Alarm Information

### NOTE:

The ECG alarm information listed in the below table describes the lead names in America. For the corresponding lead names in Europe, please refer to the Section *Installing Electrodes*.

Message	Cause	Alarm Level	Action Taken
<b>ECG</b>			
<b>ECG Lead Off</b>	1) The drive electrode or more than one ECG limb electrode falls off the skin; 2) ECG cables fall off the monitor.	Low	Make sure that all electrodes, leads and patient cables are properly connected.

<b>Message</b>	<b>Cause</b>	<b>Alarm Level</b>	<b>Action Taken</b>
<b>ECG LL Lead Off</b>	ECG electrode LL falls off the skin or the ECG cable LL falls off the monitor.	Low	Make sure that all electrodes, leads and patient cables are properly connected.
<b>ECG LA Lead Off</b>	ECG electrode LA falls off the skin or the ECG cable LA falls off the monitor.	Low	Make sure that all electrodes, leads and patient cables are properly connected.
<b>ECG RA Lead Off</b>	ECG electrode RA falls off the skin or the ECG cable RA falls off the monitor.	Low	Make sure that all electrodes, leads and patient cables are properly connected.
<b>ECG V Lead Off</b>	ECG electrode V falls off the skin or the ECG cable V falls off the monitor.	Low	Make sure that all electrodes, leads and patient cables are properly connected.
<b>ECG Signal Exceeded</b>	ECG measuring signal is beyond measuring range.	Low	Check lead connection and patient condition
<b>ECG Comm Fail</b>	ECG module failure or communication failure	High	Stop measuring function of ECG module, and notify biomedical engineer or manufacturer's service staff.
<b>ECG Noise</b>	ECG measuring signal is greatly interrupted.	Low	Check lead connection and patient condition
<b>RESP</b>			
<b>RESP Comm Fail</b>	RESP module failure or communication failure	High	Stop measuring function of RESP module, and notify biomedical engineer or the manufacturer's service staff.

Message	Cause	Alarm Level	Action Taken
<b>RESP Cardiac Artifact</b>	No RESP waveform can be detected due to apnea or shallow breathing of the patient.	High	Check whether the patient is breathing normally. Take measures to help the patient breathe normally when necessary. If the patient is breathing normally, try to adjust the electrode position on the patient in order to reduce the interference of cardiogenic artifact.
<b>RESP Noise</b>	RR cannot be measured due to patient movement.	Low	Check whether the RESP leads are well connected. Keep the patient calm for better monitoring.
<b>RR Exceed</b>	RR measuring value is out of the measure range.	Medium	Check whether interference to the respiratory signal exists. And check whether the patient is breathing normally; breathing too rapidly or too slowly may endanger patient's life.
<b>SpO<sub>2</sub></b>			
<b>SpO<sub>2</sub> Sensor Off</b>	SpO <sub>2</sub> sensor may be disconnected from the patient or the monitor.	Low	Make sure the sensor is well connected to the patient's measurement site. Make sure the monitor and cables are well connected.

Message	Cause	Alarm Level	Action Taken
<b>SpO<sub>2</sub> Comm Fail</b>	SpO <sub>2</sub> module failure or communication failure	High	Stop using measuring function of SpO <sub>2</sub> module, and notify biomedical engineer or manufacturer's service staff.
<b>SpO<sub>2</sub> Sensor Err</b>	Malfunction in the SpO <sub>2</sub> sensor or in the extension cable.	Low	Replace the SpO <sub>2</sub> sensor or the extension cable.
<b>SpO<sub>2</sub> No Sensor</b>	SpO <sub>2</sub> sensor was not connected well or connected to the monitor, or the connection is loose.	Low	Make sure the monitor and sensor are well connected, reconnect the sensor.
<b>SpO<sub>2</sub> Low Perfusion</b>	The pulse signal is too weak or the perfusion of the measurement site is too low. The SpO <sub>2</sub> value and PR value might be inaccurate then.	Low	Reconnect the SpO <sub>2</sub> sensor and change the measurement site. If problem exists, please notify biomedical engineer or manufacturer's service staff.
<b>SpO<sub>2</sub> Noisy Signal</b>	There is interference with SpO <sub>2</sub> measurement signals due to patient movement, ambient light, electrical interference or else.	Low	Check the condition of patient and avoid patient movement; make sure the cable is well connected.
<b>SpO<sub>2</sub> Light Interference</b>	Ambient light around the sensor is too strong.	Low	Reduce interference of the ambient light and avoid sensor's exposure to strong light.

Message	Cause	Alarm Level	Action Taken
<b>NIBP</b>			
<b>NIBP Comm Fail</b>	NIBP module failure or communication failure	High	Stop using measuring function of NIBP module, and notify biomedical engineer or manufacturer's service staff.
<b>NIBP Leak</b>	NIBP pump, valve, cuff or tube has a leakage.	Low	Check the connections and the wrapped cuff to see whether they are all prepared well.
<b>NIBP Excessive Pressure</b>	Pressure has exceeded the specified upper safety limit. EDAN module: in big cuff mode, the pressure is higher than 297 mmHg, in middle cuff mode, the pressure is 245 mmHg, in small cuff mode, and the pressure is higher than 147 mmHg. SunTech module: the pressure is higher than 300 mmHg.	Low	Measure again, if failure persists, stop measuring function of NIBP module and notify biomedical engineer or manufacturer's service staff.
<b>NIBP Init Pressure High</b>	The initial pressure is too high during measuring	Low	
<b>NIBP Aux Excessive Pressure</b>	Pressure has exceeded the second safety limit as specified.	High	Notify biomedical engineer or manufacturer's service staff.



Message	Cause	Alarm Level	Action Taken
<b>NIBP Time Out</b>	For EDAN module: in big and middle cuff mode, measuring time has exceeded 120 s, in small cuff mode, measuring time has exceeded 90 s. For SunTech module: Measuring time has exceeded 120 s, no value is displayed in the monitor.	Low	Measure again or use other measuring method.
<b>NIBP Self Test Error</b>	Sensor or other hardware errors.	Low	If failure persists, stop using measuring function of NIBP module and notify biomedical engineer or manufacturer's service staff.
<b>NIBP Cuff Type Error</b>	The cuff type used isn't consistent with the patient type.	Low	Confirm the patient type and change the cuff.
<b>NIBP System Pressure Abnormality</b>	Atmospheric pressure or system pressure is abnormal. The valve is occluded so that deflation is failed.	Low	Check whether the airway is occluded or pressure sensor works properly. If the problem still exists, contact your service personnel.
<b>NIBP System Failure</b>	NIBP is not calibrated.	High	Contact your service personnel.
<b>NIBP Weak Signal</b>	Cuff is too loose or patient pulse is too weak.	Low	Use other methods to measure blood pressure.
<b>NIBP Range Exceeded</b>	Maybe the patient blood pressure value is beyond the measurement range.	High	Use other methods to measure blood pressure.

Message	Cause	Alarm Level	Action Taken
<b>NIBP Loose Cuff</b>	Cuff is not properly wrapped or no cuff is connected.	Low	Properly wrap the cuff.
<b>NIBP Interference</b>	Signal noise is too large or pulse rate is not regular due to the patient movement.	Low	Make sure that the patient under monitoring is motionless.
<b>NIBP Leak Test Error</b>	Fail to deflate normally during the leak test, so NIBP leak test cannot be finished.	Low	Test again. If the problem still exists, contact your service personnel.
<b>TEMP</b>			
<b>TEMP T1 Sensor Off</b>	Temperature cable of TEMP channel may be disconnected from the monitor.	Low	Make sure that the cable is properly connected
<b>TEMP T2 Sensor Off</b>	Temperature cable of TEMP channel2 may be disconnected from the monitor.	Low	Make sure that the cable is properly connected.
<b>Excessive T1</b>	TEMP1 measuring value is beyond measuring range.	High	Check sensor connection and patient condition
<b>Excessive T2</b>	TEMP2 measuring value is beyond measuring range.	High	Check sensor connection and patient condition
<b>TEMP Comm Fail</b>	TEMP module failure or communication failure.	High	Stop measuring function of TEMP module, and notify biomedical engineer or Manufacturer's service staff.
<b>T1 Calibration Failed</b>	T1 calibration failed.	High	Please check whether the module works properly.

Message	Cause	Alarm Level	Action Taken
<b>T2 Calibration Failed</b>	T2 calibration failed	High	Please check whether the module works properly.
<b>IBP</b>			
<b>YY Sensor Off</b> (YY stands for the IBP label name: Art, PA, CVP, RAP, LAP, ICP, P1 and P2)	IBP sensor falls off.	Medium	Check the sensor connection and reconnect the sensor.
<b>IBP Catheter Off</b>	IBP catheter falls off due to patient movement.	High	Check the catheter connection and reconnect it.
<b>IBP Sensor Err</b>	Malfunction in the IBP sensor or in the extension cable.	Medium	Replace the IBP sensor or the extension cable.
<b>YY Comm Fail</b> (YY stands for the IBP label name: Art, PA, CVP, RAP, LAP, ICP, P1 and P2)	IBP module failure or communication failure	High	Stop measuring function of IBP module, and notify biomedical engineer or Manufacturer's service staff.
<b>AG</b>			
<b>AG Comm Fail</b>	AG module failure or communication failure.	High	Stop measuring function of AG module, and notify biomedical engineer or Manufacturer's service staff.
<b>CO<sub>2</sub> Out Of Range</b>	The CO <sub>2</sub> concentration exceeds the accuracy range of AG module.	High	
<b>N<sub>2</sub>O Out Of Range</b>	The N <sub>2</sub> O concentration exceeds the accuracy range of AG module.	High	
<b>AA Out Of Range</b>	The anesthesia gas concentration exceeds the accuracy range of AG module.	High	
<b>O<sub>2</sub> Out Of Range</b>	The O <sub>2</sub> concentration exceeds the accuracy range of AG module.	High	

Message	Cause	Alarm Level	Action Taken
<b>AG Baro Press Out Of Range</b>	The barometric pressure exceeds the specified working barometric pressure range.	High	Make sure the AG module is used within the specified barometric pressure range.
<b>AG Mixed Agents MAC &lt; 3</b>	Two types of anesthetic agents are present in the gas mixture, and the concentration is low.	Low	Adjust the concentration of the anesthetic agents if necessary.
<b>AG Mixed Agents MAC ≥ 3</b>	Two types of anesthetic agents are present in the gas mixture, and the concentration is high.	Medium	Adjust the concentration of the anesthetic agents if necessary.
<b>AG TEMP Out Of Range</b>	The temperature of the AG module exceeds the specified working temperature range.	High	Make sure the AG module is used within the specified temperature range.
<b>AG Zero Required</b>	Zeroing of AG module is required.	Medium	Perform zero calibration.
<b>AG Replace Adapter</b>	Replacement of the adapter is required.	Medium	Replace the adapter.
<b>AG Replace O<sub>2</sub> Sensor</b>	Replacement of the O <sub>2</sub> sensor is required.	Medium	Stop measuring function of AG module, and notify biomedical engineer or Manufacturer's service staff.
<b>AG Motor Error</b>	Malfunction in the AG motor.	High	
<b>O<sub>2</sub> Cali Required</b>	O <sub>2</sub> sensor requires calibration.	Low	
<b>AG Software Error</b>	Malfunction in the AG software.	High	
<b>AG Hardware Error</b>	Malfunction in the AG hardware.	High	
<b>AG Uncalibrated</b>	AG module calibration is not completed.	High	
<b>AG Calibration Fail</b>	Calibration of the sidestream AG module fails.	Medium	
<b>O<sub>2</sub> Sensor Error</b>	Malfunction in the O <sub>2</sub> sensor inside the sidestream AG module.	High	

Message	Cause	Alarm Level	Action Taken
<b>AG AA Id Unreliable</b>	1) Mainstream: The airway adapter was replaced without a zeroing. 2) More than 2 anesthetic agents are present in the breathing circuit. 3) High concentrations of solvents, cleaning agents or other interfering gases are present in the breathing circuit.	Medium	1) Perform a zeroing after replacing the adapter. 2) Reduce the number of anesthetic agent types. 3) Replace the sampling tube or reduce the interfering gases.
<b>Sample Line Occluded</b>	The sampling tube is occluded.	Medium	Replace the sampling tube.
<b>AG No Adapter</b>	No adapter is connected.	Medium	Connect the adapter correctly.
<b>No Sample Line</b>	No sampling tube is connected.	Medium	Connect the sampling tube correctly.
<b>AG Occlusion</b>	AG module sample line occluded	High	Replace the sampling line.
<b>CO<sub>2</sub></b>			
<b>CO<sub>2</sub> Comm. Failed</b>	CO <sub>2</sub> module failure or communication failure	High	Check if the water tray has been fixed.
<b>CO<sub>2</sub> Zero Required</b>	Zero calibration failure	Low	Disconnect the sampling cannula or adapter from the airway; initiate the zeroing before making sure that no expired air is inside the sampling cannula and adapter.

Message	Cause	Alarm Level	Action Taken
<b>CO<sub>2</sub> Check Adapter</b>	<p>1) For the Respiration CO<sub>2</sub> module: The cannula is off or disconnected.</p> <p>2) For the EDAN CO<sub>2</sub> module: The water trap is disconnected or not properly connected.</p>	Low	<p>1) For the Respiration CO<sub>2</sub> module: Check whether the adapter is properly connected or replace the adapter.</p> <p>2) For the EDAN CO<sub>2</sub> module: Properly connect the water trap.</p>
<b>CO<sub>2</sub> Sensor Over Temp</b>	CO <sub>2</sub> sensor temperature exceeds +40 °C.	High	Stop using measuring function of CO <sub>2</sub> module, notify biomedical engineer.
<b>CO<sub>2</sub> Out Of Range</b>	The CO <sub>2</sub> concentration exceeds the accuracy range of CO <sub>2</sub> module.	High	Reduce CO <sub>2</sub> concentration.
<b>CO<sub>2</sub> Sensor Faulty</b>	CO <sub>2</sub> module failure	High	Stop measuring function of CO <sub>2</sub> module, notify biomedical engineer.
<b>CO<sub>2</sub> Occlude</b>	Water trap of SideStream is occluded.	High	Make sure the gas exhaust works well
<b>Others</b>			
<b>Battery Low</b>	Battery Low	High	Please change the battery or charging.
<b>Recorder Out Of Paper</b>	Recorder Out Of Paper	Low	Please install the paper
<b>Recorder setup needed</b>	The user presses the <b>RECORD</b> button when the monitor is not installed with a recorder.	Low	Notify the manufacturer's service staff to install and set the recorder.

Message	Cause	Alarm Level	Action Taken
<b>Insufficient storage space</b>	Less than 10 M space is left in the storage-device.	Low	Delete some data in the storage device or use another storage device.
<b>Read-only storage device</b>	The storage device is read-only.	Low	Repair the storage device or replace it with a new one.
<b>Network Disconnect</b>	In distributed alarm system, the monitor's network is disconnected.	Low	Check if the network cable is well connected.

### 5.3 Prompts

Message	Cause
<b>ECG ARR Learning</b>	The QRS template building required for Arr. Analysis is in process.
<b>VFIB/VTAC Off</b>	VFIB/VTAC alarm is set to <b>Off</b> .
<b>SpO<sub>2</sub> Search Pulse</b>	SpO <sub>2</sub> module is analyzing the patient signal and searching for the pulse to compute the saturation, when sensor is connected with patient.
<b>Manual Measuring</b>	In manual measuring mode
<b>Continual Measuring</b>	In continuous measuring mode
<b>Auto Measuring</b>	In automatic measuring mode
<b>Measur. Canceled</b>	Press the "Start/stop NIBP measurement" button to stop the measurement.
<b>Calibrating</b>	During calibrating
<b>Calibrat. Canceled</b>	Calibration is over.
<b>Leak. Test Running</b>	The leakage test is in process.
<b>Leak.Test Canceled</b>	Pneumatic test over
<b>STAT Measuring</b>	Block vessel to puncture in this mode.
<b>Manometer Mode</b>	Calibrate in this mode.
<b>Calibrating With 0 mmHg</b>	Calibrating With 0 mmHg
<b>Calibrating With 250 mmHg</b>	Calibrating With 250 mmHg
<b>Calibration 0 mmHg done</b>	Calibration 0 mmHg done
<b>Calibration 250 mmHg done</b>	Calibration 250 mmHg done

<b>Message</b>	<b>Cause</b>
<b>Leakage Test Ok</b>	There is no leak.
<b>Resetting</b>	NIBP module in resetting
<b>Please Start</b>	NIBP module is in idle status.
<b>Done</b>	NIBP measurement is completed.
<b>Place Probe On Measure Place</b>	Probe isn't placed on the measurement site.
<b>CO<sub>2</sub> Standby</b>	Turn from measuring mode to standby mode, making the module in energy-saving status.
<b>CO<sub>2</sub> Sensor Warms Up</b>	The CO <sub>2</sub> module is in warm-up state.
<b>CO<sub>2</sub> Zero Start</b>	CO <sub>2</sub> module starts zero calibration.
<b>CO<sub>2</sub> Zero OK</b>	CO <sub>2</sub> module completes zero calibration.
<b>Please Press 'Zero'.</b>	Enter the IBP zeroing menu, and zeroing is not performed yet.
<b>Zero OK</b>	IBP completes zeroing.
<b>Pulsatile Pressure Zero Fail.</b>	During the zeroing process, pressure fluctuation is excessive.
<b>Pressure out of normal range,Fail.</b>	During the zeroing process, pressure value is beyond the zeroing range.
<b>Sensor Off, Fail!</b>	Perform zeroing when the sensor is off.
<b>Invalid Time,Zero Fail.</b>	Time is not set up prior zeroing.
<b>Unable to Calibrate in Demo Mode</b>	Perform zeroing in Demo Mode.
<b>Zeroing...</b>	Zeroing is in progress.
<b>Please Press 'Calibrate'.</b>	Enter the Calibration menu, and Calibration is not performed yet.
<b>Calibration OK</b>	Calibration is completed.
<b>Pulse Pressure Calibration Failed</b>	During the Calibration process, pressure fluctuation is excessive.
<b>Pressure out of range</b>	During the Calibration process, pressure value is beyond the Calibration range.
<b>Zeroing and Calibration Failed</b>	Zeroing is not performed prior calibration.
<b>Sensor Off,Fail.</b>	Perform calibration when the sensor is off.
<b>Invalid Time,Calibration Fail.</b>	Time is not set up prior calibration.



Message	Cause
<b>Unable to Calibrate in Demo Mode</b>	Perform calibration in Demo Mode.
<b>Calibrating...</b>	Calibration is in progress.
<b>IBP alias collision</b>	The same IBP label appears.
<b>AG Self-Testing.....</b>	AG module is performing a power-on self-test.
<b>AG Span Calib In Progress</b>	The calibration of AG module is in progress.
<b>MultiGas Zero in Progress</b>	The zeroing of AG module is in progress.

## 5.4 Adjustable Range of Alarm Limits

ECG alarm limits are listed as follows: unit (bpm)

	ALM HI	ALM LO
HR	350	15

ST analysis alarm limits are listed as follows: unit (mV)

	ALM HI	ALM LO
ST	2.0	-2.0

PVCs alarm upper limits are listed as follows:

	ALM HI	ALM LO
PVCs	100	1

RESP alarm limits are listed as follows: unit (rpm)

	ALM HI	ALM LO
RESP	150	6

SpO<sub>2</sub> alarm limits are listed as follows (unit %):

	ALM HI	ALM LO
SpO <sub>2</sub>	100	20

PR alarm limits is listed as follows: unit (bpm)

	ALM HI	ALM LO
PR	300	30

TEMP alarm limits are listed as follows:

	ALM HI	ALM LO
T1	50 °C (122 °F)	0 °C (32 °F)
T2	50 °C (122 °F)	0 °C (32 °F)
TD	50 °C	0.1 °C

NIBP alarm limits are listed as follows: unit (mmHg, kPa, 1 mmHg=0.133 kPa)

EDAN module:

Patient Type		ALM HI	ALM LO
Big	SYS	270	40
	DIA	215	10
	MAP	235	20
	PR (NIBP)	240	40
Middle	SYS	230	40
	DIA	180	10
	MAP	195	20
	PR (NIBP)	240	40
Small	SYS	135	40
	DIA	100	10
	MAP	110	20
	PR (NIBP)	240	40

SunTech Module

Patient Type		ALM HI	ALM LO
Big/Small	SYS	265	40
	DIA	200	20
	MAP	222	27

IBP alarm limits are listed as follows: unit (mmHg)

	ALM HI	ALM LO
Art	300	0
RAP	40	-10
LAP	40	-10
CVP	40	-10

PA	120	-6
ICP	40	-10
P1	300	-50
P2	300	-50

CO<sub>2</sub> alarm limits are listed as follows:

	ALM HI	ALM LO
EtCO <sub>2</sub>	150 mmHg	0
FiCO <sub>2</sub>	50 mmHg	0 mmHg
AwRR	150 rpm	2 rpm

AG alarm limits are listed as follows:

	ALM HI	ALM LO
FiCO <sub>2</sub>	25.0%	0.1%
EtCO <sub>2</sub>	25.0%	0%
FiO <sub>2</sub>	100.0%	18.0%
EtO <sub>2</sub>	100.0%	0%
FiN <sub>2</sub> O	100.0%	0%
EtN <sub>2</sub> O	100.0%	0%
EtDes	18.0%	0%
FiDes	18.0%	0%
EtIso	5.0%	0%
FiIso	5.0%	0%
EtHal	5.0%	0%
FiHal	5.0%	0%
EtSev	8.0%	0%
FiSev	8.0%	0%
EtEnf	5.0%	0%
FiEnf	5.0%	0%
awRR	150 rpm	0 rpm
Apnea Time	40 s	20 s

## Chapter 6 Managing Patients

### 6.1 Admitting a Patient

The monitor displays physiological data and stores it in the trends as soon as a patient is connected. This allows you to monitor a patient who is not yet admitted. It is however important to admit patients properly so that you can identify your patient on recordings, reports, and networked devices.

During admission you enter data that the monitor needs for safe and accurate operation. For example, the patient category setting determines the algorithm the monitor uses to process and calculate some measurements, the safety limits that are applied for some measurements, and the alarm limit ranges.

To admit a patient, please:

1. Select the **Admission** key on the screen or.
2. Select **Menu > Patient Setup > New Patient**, then a message is displayed to ask the user to confirm to update patient.
3. Click on **No** to cancel this operation; click on **Yes**, the **Patient Info** window is displayed.
4. Enter the patient information:
  - **MRN**: Enter the patient's medical record number.
  - **Last Name**: Enter the patient's last name (family name).
  - **First Name**: Enter the patient's first name.
  - **Doctor**: Enter the attending doctor for the patient.
  - **Gender**: **Male**, **Female** and **N/A**.
  - **Type**: Choose the patient type, either **Feline**, **Canine**, or **Other**.
  - **Cuff Type**: **Big**, **Middle**, **Small**.

Cuff type	Big	Middle	Small
Cuff size	20.5 cm ~43 cm	13 cm~21.5 cm	< 15cm

- **BloodType**: **N/A**, **A**, **B**, **AB** and **O**.
- **Pace**: Choose **On** or **Off** (You must select **On** if your patient has a pacemaker).
- **Date of Birth**: Enter the patient's date of birth.
- **Date of Admission**: Enter the patient's date of admission.
- **Height**: Enter the patient's height.
- **Weight**: Enter the patient's weight.
- **Bed No.:** Select a bed No. from 1 to 254.

#### 6.1.1 Patient Category and Paced Status

The patient category setting determines the algorithm which the monitor uses to process and

calculate some measurements, the safety limits that are applied for some measurements, and the alarm limit ranges.

The paced setting determines whether the monitor shows pacemaker pulses or not. When **Pace** is set to **Off**, pace pulses are filtered and therefore do not show in the ECG wave.

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### **WARNING**

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- 1 Changing the patient category may change the arrhythmia and NIBP alarm limits. Always check alarm limits to make sure that they are appropriate for your patient.
  - 2 For paced patients, you must set Paced to **On**. If it is incorrectly set to **Off**, the monitor could mistake a pace pulse for a QRS and fail to give an alarm during asystole.
- 

## 6.2 Quick Admit

If you do not have the time or information to fully admit a patient, you can use Quick Admit to quickly admit a patient and complete the rest of the patient information later. To quickly admit a patient, please:

1. Select the shortcut key  on the screen directly, or
2. Select **Menu > Patient Setup > Quick Admit**, then a message is displayed to ask the user to confirm to update patient.
3. Click on **No** to cancel this operation; click on **Yes** to continue and the **Quick Admit** window is displayed.
4. Configure **Type**, **Cuff Type** and **Pace** to the correct setting and click **Yes** to finish the quick patient admission operation. If you want to quit the operation, click **No**.

## 6.3 Editing Patient Information

To edit the patient information after a patient has been admitted, select **Menu > Patient Setup > Patient Info.**, and make the required changes on the popup interface.

## 6.4 Updating a Patient

You should always perform an update before starting monitoring for a new patient. When you select **Menu > Patient Setup > Quick Admit**, or **Menu > Patient Setup > New Patient**, a message of **Press 'Yes' to create new patient profile by clearing all current patient data...** is displayed.

- If the user selects **Yes**, the monitor will update the patient information.
- If the user selects **No**, the monitor won't update the patient information and returns to patient setup interface.

### **NOTE:**

Admitting or updating patient will clear the history data in the monitor associated with the patient.

## Chapter 7 User Interface

### 7.1 Setting Interface Style


The user can set the interface based on the requirement, and the set options include the following:

- Sweep of the waveform.
- Parameters needing to be monitored.

Changing some settings may have the risk, so only the authorized person can change them. After changing the settings, please notify the operator.

### 7.2 Selecting Display Parameters

The user can select the display parameters based on the monitoring and measurement requirements. To select the parameter, please:

1. Select the shortcut key  on the screen directly, or
2. Select **Menu > System Setup > Module Switch**.
3. Select the required parameters from the popup interface.
4. Exit the menu and the screen will adjust the parameters automatically.

### 7.3 Changing Waveform Position

The user can exchange the waveform positions of parameter A and parameter B with the following method:

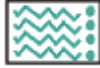
1. Select waveform A and open the setup menu of waveform A.
2. Select **Change** from the popup menu and select the desired label name of waveform B from the pull-down list.

### 7.4 Changing Interface Layout

Select **Menu > Display Setup** to open the **Display Setup** menu on which you can

- Select a function screen based on the clinical requirements by configuring **View Selection**.
- Select the maximum number of waveforms displayed on the screen by configuring **Wave. Num.**.
- Decide whether the control bar is displayed or not displayed on the screen by setting **Control Bar** to **On** or **Off**.

## 7.5 Viewing Trend Screen

To view the trend screen, the user can press the shortcut key  on the screen directly or select **Menu > Display Setup > View Selection > TrendScreen**.

## 7.6 Viewing OxyCRG Screen

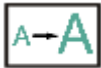
To view the oxygen screen, the user can select **Menu > Display Setup > View Selection > oxyCRG**. OxyCRG is in the bottom half part of wave area; it consists of HR trend, SpO<sub>2</sub> trend and RR trend or compressed respiration waveform.

Select oxyCRG waveform to open **OxyCRG Setup** menu, you can set:

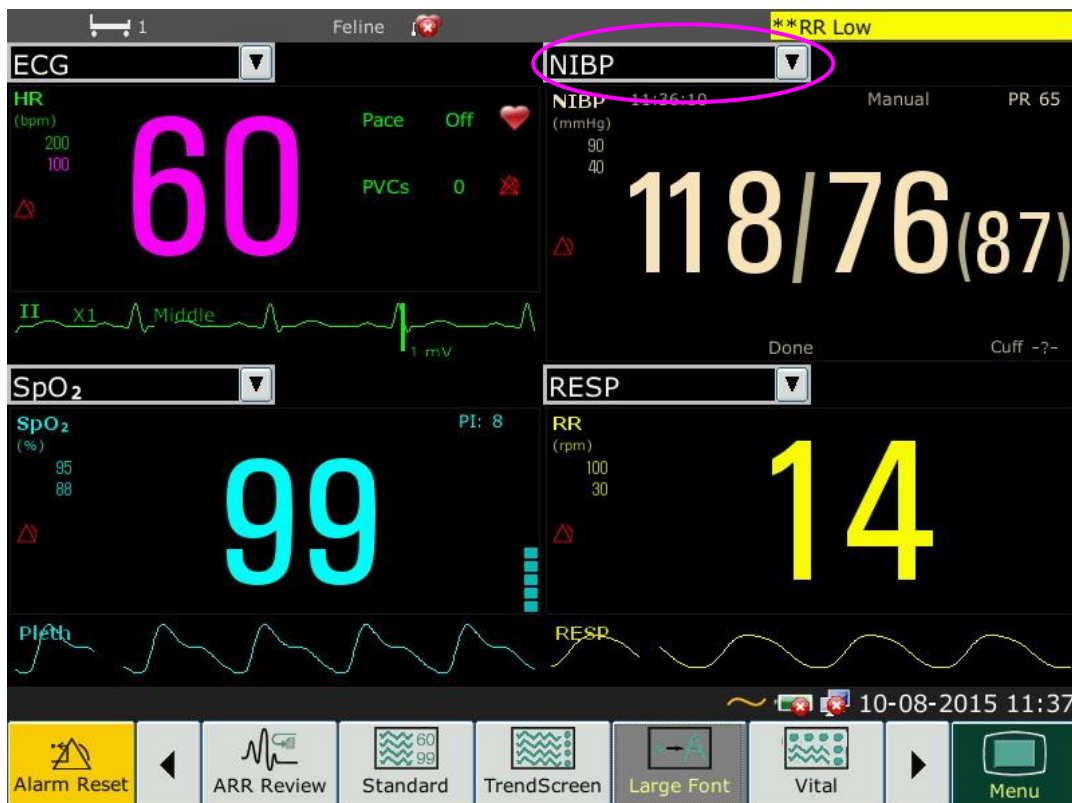
1. **Interval:** set the interval to **1 min**, **2 min** and **4 min**.
2. **Parameter:** to select **RESP** or **RR**.

## 7.7 Viewing Large Font Screen


To open the large font screen, please refer to the following steps:

1. Select the shortcut key  on the screen directly or.
2. Select **Menu > Display Setup > View Selection > Large Font** to open this interface.

You can view any available parameter by selecting the parameter from the pull-down list on each section.



## 7.8 Viewing the Vital Screen

To view the vital screen, the user can press the shortcut key  on the screen directly or select **Menu > Display Setup > View Selection > Vital**.

## 7.9 Changing Parameter and Waveform Colors

The user can set the display colors of parameter and waveform as desire. To change the display color, please select **Menu > Maintenance > User Maintain**, enter the required password **ABC**. Then select **Color Setup** to make color changes on parameter and waveform.

## 7.10 User Configuration

Users can save the current monitor's configuration, delete the saved user configuration and rename it. Three pieces of user configuration can be saved in the monitor.

To save the user configuration:

1. Select **Menu > Maintenance > User Maintain**, enter the required password **ABC** and then select **User Configure**.
2. Click on **Save**, enter a file name for the configuration and confirm it. A message will display after the operation.

To delete the user configuration:

1. Select **Menu > Maintenance > User Maintain**, enter the required password **ABC** and then select **User Configure**.
2. Select the configuration file needed to delete from the list, click on **Delete** and confirm the operation. A message will display after the operation.

To rename the user configuration:

1. Select **Menu > Maintenance > User Maintain**, enter the required password **ABC** and then select **User Configure**.
2. Select a configuration file needed to rename from the list and click on **Rename**.
3. Enter a name for the configuration file and confirm it.

## 7.11 Default Configuration

To set default configuration, select **Menu > Default**. On the **Default** menu, users can choose a factory configuration based on the patient category. Also, users can choose a user configuration saved in the monitor if it is available. For more information about user configuration, refer to *User Configuration*.

To check the configuration currently used, select **Menu > Default**. The one labeled with ● is current configuration. If there's no labeled configuration, it means the currently used configuration is not one of them.



## Chapter 8 Monitoring ECG

### 8.1 Overview

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

### 8.2 ECG Safety Information

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#### **WARNING**

- 1 Only use the ECG leads supplied by the manufacturer when using the monitor for ECG monitoring.
  - 2 When connecting the cables and electrodes, make sure no conductive part is in contact with the ground. Verify that all ECG electrodes, including neutral electrodes, are securely attached to the patient but not the conductive part or ground.
  - 3 Place the electrode carefully and ensure a good contact. Check every day whether there is skin irritation resulted from the ECG electrodes. If yes, replace electrodes every 24 hours or change their sites.
  - 4 Store the electrodes in room temperature. Open the electrode package immediately prior to use. Never mix electrode types or brands. This may lead to problem due to impedance difference. When applying the electrodes, avoid bones close to skin, obvious layers of fat and major muscles. Muscle movement can result in electrical interference. Applying electrodes on major muscles, for example on muscles of thorax, may lead to erroneous arrhythmia alarm due to excessive muscle movement.
  - 5 Check if the lead connection is correct before monitoring. If you unplug the ECG cable from the socket, the screen will display the error message "ECG LEAD OFF" and the auditory alarm is activated.
  - 6 If the ECG signal exceeds the measuring range, the monitor will indicates it by a message "ECG Signal Exceeded".
  - 7 In order to avoid being burnt, please keep the electrodes far away from the radio knife while using electrosurgical equipment.
  - 8 When using Electrosurgery (ES) equipment, do not place an electrode near the grounding plate of the Electrosurgery device: otherwise there will be a great deal of interference with the ECG signal.
  - 9 The electrodes should be made of the same metal materials.
  - 10 ECG cables can be damaged when connected to a patient during defibrillation or using other high frequency equipment. Check cables for functionality before using them again. It is recommended to use the ECG cables which are defibrillator-proof to avoid burn.
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**WARNING**

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- 11 Line isolation monitor transients may resemble actual cardiac waveforms and thus inhibit heart rate alarms. When the electrode or lead is loose or fallen, the monitor is easily affected by the transient response of certain types of insulation monitors. The transient monitor signal produced by poor insulation of the line may be very similar to the actual heart waveform, which will prevent the monitor from prompting a heart rate alarm. In order to avoid this, user should check lead wires for damage and ensure good skin contact prior to and during use. Always use fresh electrodes and follow proper skin preparation techniques.
  - 12 According to AAMI specifications the peak of the synchronized defibrillator discharge should be delivered within 60 ms of the peak of the R wave. The synchronization pulse output on the veterinary monitors is delayed by a maximum of 35 ms from the R wave peak. Your biomedical engineer should verify that your ECG/Defibrillator combination does not exceed the recommended maximum delay of 60 ms.
  - 13 Before outputting signals with defibrillator synchronization or ECG, check if the output is functioning normally.
  - 14 ECG accessories are not suitable for DIRECT CARDIAC APPLICATION. (Refer to IEC60601-1 for more information about the definition of DIRECT CARDIAC APPLICATION.)
  - 15 The monitor can only be used on one patient at a time. Monitoring more than one patient simultaneously may result in hazards to the patient.
  - 16 Pacemaker Failure: During a complete cardiac block or when pacemaker is unable to pacing/capture, high P-wave (greater than 1/5 of the average height of the R-wave) may be incorrectly counted by the monitor, which leads to a missing asystole.
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**NOTE:**

- 1 Interference from a non-grounded instrument near the patient and ESU interference can cause inaccuracy of the waveform.
- 2 IEC/EN60601-1-2 (protection against radiation is 3 v/m) specifies that the electrical field density exceeding 3 v/m may cause measurement error in various frequencies. It is accordingly suggested that do not use equipment generating electrical radiation near ECG/RESP monitoring devices.
- 3 The simultaneous use of cardiac pacemaker and other patient-connected equipment may cause safety hazard.
- 4 If the pacemaker signals are beyond the claimed range, the heart rate may be calculated incorrectly.
- 5 In the default settings of the monitor, the ECG waveforms are the first two waveforms from top in the waveform area.
- 6 For measurements in or near the heart we recommend connecting the monitor to the

potential equalization system.

- 7 For protecting environment, the used electrodes must be recycled or disposed of properly.

## 8.3 ECG Display

The figure below is for reference only.



The symbol “①” indicates lead name of display waveform: there are other leads for selection, such as I, II, III, aVR, aVF, aVL, V (for 5 leads). If you want to change the lead, please refer to Section *Selecting Calculation Lead*.

The symbol “②” indicates Filter setting, there are three options: **Middle**, **Strong**, **Weak**. If you want to change it, please refer to Section *Changing the ECG Filter Setting*.

The symbol “③” indicates waveform gain: there are several options, such as **X0.125**, **X0.25**, **X0.5**, **X1**, **X2** and **Auto**. If you want to change it, please refer to Section *Changing the Size of the ECG Wave*.

### 8.3.1 Changing the Size of the ECG Wave

If any of the displayed ECG waveform is too small or clipped, you can change the size of it on the screen. First select **ECG Waveform Setup** > **ECG Gain**, then select an appropriate factor from the pop-up box to adjust the ECG waveform.

**X0.125** to make strength of ECG signal waveform of 1mV become 1.25 mm;

**X0.25** to make strength of ECG signal waveform of 1mV become 2.5 mm;

**X0.5** to make strength of ECG signal waveform of 1mV become 5 mm;

**X1** to make strength of ECG signal waveform of 1mV become 10 mm;

**X2** to make strength of ECG signal waveform of 1mV become 20 mm;

**Auto** let the monitor choose the optimal adjustment factor for all the ECG waves.

#### **NOTE:**

The effect of ECG wave gain is subject to the size of the wave area. Whichever wave gain is chosen, the ECG wave has to be displayed within the wave area.

### 8.3.2 Changing the ECG Filter Settings

The ECG filter setting defines how ECG waves are smoothed. An abbreviation indicating the filter type is shown underneath the lead label on the monitor display. Filter settings do not affect ST measurement.

To change the filter setting, in the **ECG Setup** menu, select **Filter** and then select the appropriate setting.

- **Middle:** Use this mode under normal measurement conditions.
- **Strong:** The filter reduces interference to the signal. It should be used if the signal is distorted by high frequency or low frequency interference. High frequency interference usually results in large amplitude spikes making the ECG signal look irregular. Low frequency interference usually leads to a wandering or rough baseline. In the operating room, the Filter reduces artifacts and interference from electro-surgical units. Under normal measurement conditions, selecting **Strong** may suppress the QRS complexes too much and thus interfere with the clinical evaluation of the ECG displayed on the monitor.
- **Weak:** Use when diagnostic quality is required. The unfiltered ECG wave is displayed so that changes such as R-wave notching or discrete elevation or depression of the ST segments are visible.

## 8.4 Selecting Calculation Lead

To set the calculation lead, select **ECG Setup > Calc. Lead**, or on the Normal display interface, click on the calculation lead waveform area, select Calc. Lead from the popup interface to make the appropriate setting. For 3 Leads, II, I, and III are selectable; For 5 Leads, II, I, III, aVR, aVL, aVF, and V are selectable;

- The normal QRS should be either completely above or below the baseline and it should not be biphasic. For paced patients, the QRS complexes should be at least twice the height of pace pulses.
- The QRS should be tall and narrow.
- The P-waves and the T-waves should be less than 0.2 mV.

#### **NOTE:**

Make sure you have selected the best lead with the best waveform amplitude and highest signal-to-noise ratio. Choosing the best lead is important for heart beat test, heart beat classification and ventricular fibrillation detection.

## 8.5 Monitoring Procedure

### 8.5.1 Preparation

The skin is a poor conductor of electricity; therefore preparation of the patient's skin is important to facilitate good electrode contact to skin.

- Select sites with intact skin, without impairment of any kind.
- Shave hair from sites, if necessary.
- Wash sites thoroughly with soap and water. (Never use ether or pure alcohol, because this increases skin impedance).
- Rub the skin briskly to increase capillary blood flow in the tissues and remove skin scurf and grease.

### 8.5.2 Connecting ECG Cables

1. Attach clip or snap to electrodes prior to placement.
2. Put the electrodes on the patient. Before attaching, apply some conductive jelly on the electrodes if the electrodes are not electrolyte self-supplied.
3. Connect the electrode lead to the patient's cable.

#### **CAUTION**

To protect the monitor from damage during defibrillation, for accurate ECG information and to protect against noise and other interference, use only ECG electrodes and cables specified by EDAN.

### 8.5.3 Selecting Lead Type

To change the lead type, please:

1. Select the ECG parameter area, open the **ECG Setup** menu;
2. Set **Lead Type** to **3 Leads**, **5 Leads** based on the lead used.

### 8.5.4 Installing Electrodes

#### **NOTE:**

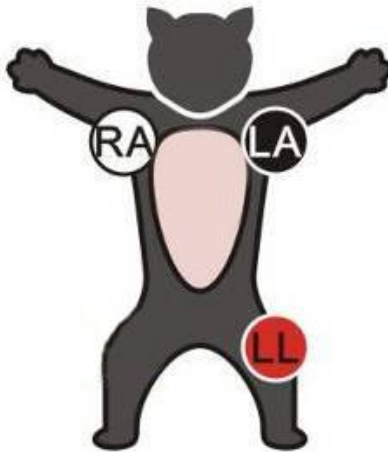
The following table gives the corresponding lead names used in Europe and America respectively. (Lead names are represented by R, L, F, N, C in Europe, whose corresponding lead names in America are RA, LA, LL, RL, V.)

AHA (American Standard)		IEC (Europe Standard)	
Electrode Labels	Color	Electrode Labels	Color
RA	White	R	Red
LA	Black	L	Yellow
LL	Red	F	Green
RL	Green	N	Black
V	Brown	C	White

### 8.5.4.1 Electrode Placement for 3-lead

Take the American standard for example, see the following figure:

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

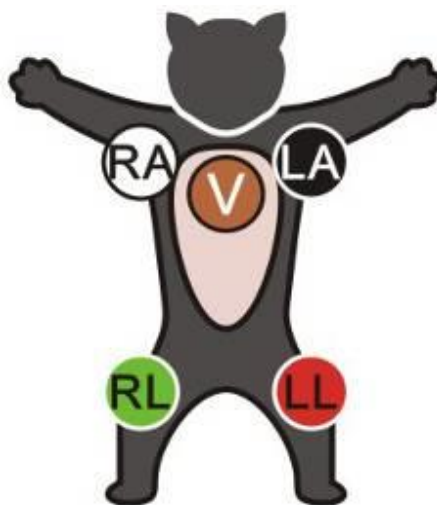


Electrode Placement for 3-lead

### 8.5.4.2 Electrode Placement for 5-lead

Take the American standard for example, see the following figure:

- ◆ RA placement- on the right foreleg.
- ◆ LA placement – on the left foreleg.
- ◆ RL placement – on the right hind leg.
- ◆ LL placement – on the left hind leg.
- ◆ V placement –on the chest, the position depends on your required lead selection.



Electrode Placement for 5-lead

**NOTE:**

To ensure patient safety, all leads must be attached to the patient.

### 8.5.4.3 Recommended ECG Lead Placement for Surgical Patients

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#### **WARNING**

When using Electrosurgery (ES) equipment, leads should be placed in a position in equal distance from Electrosurgery electrotome and the ES grounding plate to avoid cautery. Electrosurgery equipment wire and ECG cable must not be tangled up.

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Monitoring ECG leads are mainly used for monitoring the patient's vital signs. When using the veterinary monitor with other electrosurgery equipment, it is advised to use the counteracting defibrillation ECG lead.

The placement of the ECG leads will depend on the type of surgery that is being performed. For example, in an open chest surgery the electrodes may be placed laterally on the chest or on the back. In the operating room, artifacts may affect the ECG waveform due to the use of ES (Electrosurgery) equipment. To help reduce this you can place the electrodes on the right and left shoulders, the right and left sides near the abdomen, and the chest lead on the left side at mid-chest. Avoid placing the electrodes on the forelimbs. Otherwise the ECG waveform will be too small.

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#### **WARNING**

ECG cables can be damaged when connected to a patient during defibrillation or using other high frequency equipment. Check cables for functionality before using them again. It is recommended to use the ECG cables which are defibrillator-proof.

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#### **NOTE:**

- 1 If an ECG waveform is not accurate, while the electrodes are tightly attached, try to change the displayed lead.
- 2 Interference from a non-grounded instrument near the patient and ESU interference can cause inaccuracy of the waveform.

## 8.6 ECG Menu Setup

### 8.6.1 Setting Alarm Source

To change the alarm source, please select **ECG Setup > Alarm Source**, then a pop-up box is displayed:

**HR:** the monitor considers the HR as HR/PR alarm source;

**PR:** the monitor considers the PR as HR/PR alarm source;

**AUTO:** If the Alarm Source is set to **AUTO**, the monitor will use the heart rate from the ECG measurement as the alarm source whenever the ECG measurement is switched on and at least one ECG lead can be measured without a technical condition. The monitor will automatically switch

to PR as the alarm source if:

- a valid ECG lead can no longer be measured and
- a PR source is switched on and available.

The monitor then uses the pulse rate from the measurement currently active as system pulse. While PR is the alarm source, all arrhythmia and ECG HR alarms are switched off. If an ECG lead becomes available again, the monitor automatically uses HR as alarm source.

## 8.6.2 Setting Beat Source


To change the beat source, select either **ECG Setup > Beat Source** or **PR Setup > Beat Source**. Select from the following options:

**HR:** HR is HR/PR beat source;

**PR:** PR is HR/PR beat source;

**AUTO:** If the Beat Source is set to **AUTO**, the monitor will use HR as the beat source whenever the ECG measurement is switched on, and at least one ECG lead can be measured. The monitor will automatically switch to PR as the beat source if:

- a valid ECG lead can no longer be measured and
- a PR source is switched on and available.

If an ECG lead becomes available again, the monitor automatically uses HR as beat source and the monitor gives a "Di" tone with a blinking heart  displaying in the HR parameter box when one heartbeat is detected. While a pulse is detected, the monitor gives a "Da" tone.

## 8.6.3 Smart Lead Off

When **Lead Type** is **5 Leads** and **Smart LeadOff** is set to **On**, if the selected ECG waveform cannot be measured because of lead-off or other reasons, it will automatically switch to another available lead channel via which a waveform can be measured. And the lead name above the display ECG waveform also automatically turns into the current one.

To change the smart lead off setting, select **ECG Setup > Smart LeadOff**, and select the desired setting.

## 8.6.4 ECG Display

Display: It varies with **Lead Type**.

When **Lead Type** is set to **3 Leads**, **Display** can be set to **Normal**, and it can display one ECG waveform on the main screen.

When **Lead Type** is set to **5 Leads**, **Display** can be set to **Normal**, **Full-Scr** and **Half-Scr**. Select **Normal** to display two ECG waveforms on the main screen; select **Full-Scr** to display seven ECG waveforms which occupy the area of seven waveforms on the main screen; Select **Half-Scr** to display seven ECG waveforms on the screen, occupying the area of four waveforms.




**NOTE:**

If **3 Leads** is selected in the **ECG Setup** menu, only **Normal** can be selected for **Display** in the sub-menu.

### 8.6.5 Setting Pace Status

It is important to set the paced status correctly when you start monitoring ECG. To change the paced status in the ECG Setup menu, select **Pace** to toggle between **On** or **Off**. When **Pace** is set to **On**:

- Pace Pulse Rejection is switched on. This means that pacemaker pulses are not counted as extra QRS complexes.

- Paced symbol is displayed as  on the main screen. At this time, the artifact is displayed on the screen instead of the actual pacemaker crest. All pacemaker crests are the same, so do not give a diagnostic explanation about the size and shape of the pacemaker crest.

If monitoring a patient without a pacemaker, set **Pace** to **Off**.

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**WARNING**

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- 1 For patients with pacemakers, the pace must be switched On. Otherwise, the pacing impulse may be counted as regular QRS complexes, which could prevent an asystole event from being detected. When changing settings and admitting patients, please make sure the pace mode is always correct.
  - 2 External pacing electrodes: When using pacemakers with external pacing electrodes on the patient, the quality of arrhythmia is severely degraded due to the high energy level in the pacemaker pulse. This can cause arrhythmia algorithms can not detect the pacemaker without capturing or asystole.
- 
- 

Some pace pulses can be difficult to reject. When this happens, the pulses are counted as a QRS complex, and could result in an incorrect HR and failure to detect cardiac arrest or some arrhythmias. Be sure to check the paced symbol on the display screen has correctly detected the pacing pulse. Keep pacemaker patients under close observation.

### 8.6.6 ECG Calibration

This item is used to calibrate ECG waveform. When you select this item from **ECG Setup** menu again, the ECG waveform calibration ends.

**NOTE:**

The patient can't be monitored during ECG calibration.

### 8.6.7 ECG Waveform Settings

To change this speed, select **ECG Waveform Setup** > **Sweep**, then select an appropriate setting from the pop-up list. The bigger the value is, the wider the waveform is.

Select **ECG Waveform Setup** > **Cascade**: Turn on or off ECG cascade. Cascade means the ECG

waveforms displayed on the screen all occupy the area of two waveforms. This function is valid only when Display is set to **Normal**.

## 8.7 ST Segment Monitoring

The monitor performs ST segment analysis on normal and atrially paced beats and calculates ST segment elevations and depressions. This information can be displayed in the form of ST numerics and ST templates on the monitor.

ST segment monitoring function is shut off by default. You can switch it to **On** when necessary. When using the ST analysis function, the ST analysis results will be displayed on the right of the main screen.

### NOTE:

- 1 ST-segment analysis is not clinically validated for use on animal patients.
- 2 ST analysis is always performed using a dedicated filter which ensures diagnostic quality. If you are monitoring ECG using an ECG filter mode other than **Weak**, the ST segment of the ECG wave may look different from the ST segment of the ST template for the same wave. For diagnostic evaluation of the ST segment, always set the filter to **Weak** or use the ST template.
- 3 Reliable ST monitoring may be influenced in following situations:
  - You are unable to get a lead with low noise.
  - If there is arrhythmia such as atrial fibrillation/flutter, the ECG baseline may be irregular.
  - The patient is continually performing ventricular paced.
  - The dominant template can not be obtained for a long time.
  - The patient has left bundle branch block.

When any of above situations happens, ST monitoring should be switched off.

- 4 The ST algorithm has been tested for accuracy of the ST segment data. The significance of the ST segment changes need to be determined by a clinician.
- 5 If you use ST analysis, you must adjust the ST measurement point when you start the monitor. If the patient's heart rate or ECG waveform changes significantly, this will affect the size of the QT interval, so the ST point must be placed. If the equipotential or ST points are not set correctly, the ST fragments of the artifacts may be depressed or raised. Always ensure that the ST measurement point is suitable for your patient.
- 6 ST values may be affected by such factors as some drugs or metabolic and conduction disturbances.
- 7 ST is calculated with a fixed delay from the R position. Changes in heart rate or the width of QRS may affect ST.

### 8.7.1 Setting ST Analysis

To change ST analysis, please select **ECG Setup** > **ST Analysis**, then select **On** or **Off** from the pop-up list.

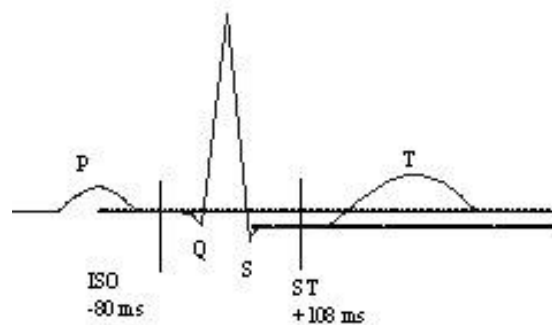
### 8.7.2 ST Display

Your monitor screen may be configured to look slightly different from the illustrations.

<b>ST</b>	I	0.08	aVR	-0.09	V	0.04
	II	0.10	aVL	0.03		
	III	0.02	aVF	0.06		

### 8.7.3 About ST Measurement Points

The ST value for each beat complex is the vertical difference between the ISO point and the ST point, as shown in the diagram below. The isoelectric (ISO) point provides the baseline, and the ST point is at the midpoint of the ST segment. The J point is where the QRS complex changes its slope; as it is a fixed distance away from the ST point, it can be useful to help you position the ST point correctly.



DEF POINT

The ST and ISO measurement points need to be adjusted when you start monitoring, and if the patient's heart rate or ECG morphology changes significantly. Always ensure that ST measurement points are appropriate for your patient. Abnormal QRS complex is not considered in ST segment analysis.

### 8.7.4 Adjusting ST and ISO Measurement Points

Depending on your monitor's configuration, the ST point can be positioned, too.

These two points can be adjusted by turning the knob. When adjusting ST measurement point, the system will show the ST Measurement Point Window. The system displays the QRS complex template in the window. It is adjustable for the highlight bar in the window. You may select ISO or ST, switch the knob left or right to move the cursor line. When the cursor is at the required position, you may select the base point or the measurement point.

## 8.8 Arr. Monitoring

### 8.8.1 Arrhythmia Analysis

The arrhythmia algorithm is used to monitor ECG of patients in clinics, and detect the changes of heart rate and ventricular rhythm, and also save arrhythmia events and generate alarming information. The arrhythmia analysis is not clinically validated for use on animal patients. Arrhythmia algorithm can monitor paced and non-paced patients. Qualified personnel can use arrhythmia analysis to evaluate patient's condition (such as heart rate, PVCs frequency, rhythm and ectopic beat) and decide the treatment. Besides detecting change of ECG, arrhythmia algorithm can also monitor patients and give proper alarm for arrhythmia.

The monitor can support up to 16 different arrhythmia analyses.

<b>ARR Types</b>	<b>Occurring Condition</b>
<b>ASYSTOLE</b>	No QRS is detected for 4 consecutive seconds
<b>VFIB/VTAC</b>	4 consecutive seconds' fibrillation wave occurs, or each RR interval for 5 consecutive ventricular beats is less than 600 ms.
<b>VT &gt; 2</b>	$3 \leq$ the number of consecutive PVCs $< 5$
<b>COUPLET</b>	2 consecutive PVCs
<b>BIGEMINY</b>	A dominant rhythm of N, V, N, V (N = supraventricular beat, V = ventricular beat) was detected.
<b>TRIGEMINY</b>	A dominant rhythm of N, N, V, N, N, V
<b>R ON T</b>	A type of single PVC under the condition that HR < 100, R-R interval is less than 1/3 the average interval, followed by a compensating pause of 1.25X the average R-R interval (the next R wave advances onto the previous T wave).
<b>PVC</b>	Single PVC detected in normal heartbeats.
<b>TACHY</b>	RR interval for 5 consecutive QRS complex $\leq 0.375$ s.
<b>BRADY</b>	RR interval for 5 consecutive QRS complex $\geq 1$ s.
<b>MISSED BEATS</b>	If HR < 120 bpm, no beats are detected for 1.75 times average RR interval; or if HR $\geq 120$ bpm, no beats are detected for one second.
<b>IRR</b>	Consistently irregular heart rhythm
<b>PNC</b>	PACER NOT CAPTURE: no QRS complex detected in 300 ms after a pace pulse.
<b>PNP</b>	PACER NOT PACED: no pace pulse detected in 1.75 times RR interval after a QRS complex.
<b>VBRADY</b>	VENTRICULAR BRADYCARDIA: Each RR interval for 5 consecutive ventricular beats > 1000 ms.

ARR Types	Occurring Condition
<b>VENT</b>	VENTRICULAR RHYTHM: Each RR interval for 5 consecutive ventricular beats ranges from 600 ms to 1000 ms.

Selecting an ECG lead for Arrhythmia:

In arrhythmia monitoring, it is important to select the appropriate lead.

For non-paced patients, the guidelines are:

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

For paced patients, in addition to above guidelines, the pacemaker should also:

- not wider than normal QRS
- The QRS complexes should be at least twice the height of the pacing pulse
- large enough to be detected, without repolarization signal

According to Standard ISO60601-2-27, the minimum detection level of the QRS complex is set to 0.15 mV, to prevent the detection of P-wave or baseline noise as QRS complexes. Adjusting ECG displayed waveform size (gain adjustment) won't influence ECG signals which are used for arrhythmia analysis. If the ECG signal is too small, a false asystole alarm may occur.

**Aberrantly-Conducted Beats:**

As not recognizing the P waves, the monitoring system is difficult to distinguish between aberrantly-conducted beats and ventricular heartbeat. If the aberrantly-conducted beat is similar to ventricular tachycardia, it may be classified as ventricular. Make sure to select such a lead, the aberrantly-conducted beats have an R wave that is as narrow as possible to minimize the incorrect calls. The ventricular should have a different appearance from "normal heartbeat". Physicians should be more alert to these patients.

**Intermittent bundle branch block:** bundle branch block or other bundle obstruction phenomenon is a challenge for arrhythmia algorithm. If the QRS wave during the block has a considerable change in morphology compared to the normal QRS of learning, the blocked heartbeat may be misclassified as ventricular tachycardia, resulting in an incorrect chamber alarm. Make sure to select such a lead, which blocks the heartbeat of the R wave as narrow as possible to minimize the wrong classification. Ventricular heartbeat should have a different appearance from "normal heartbeat". Physicians should be more alert to these patients.

**NOTE:**


- 1 Heart rate reading may be affected by cardiac arrhythmias. Do not rely entirely on heart rate alarms when monitoring patients with arrhythmia. Always keep these patients under close surveillance.
- 2 Since the arrhythmia detection algorithm sensitivity and specificity is less than 100%, sometimes there may be some false arrhythmias detected and also some true arrhythmia events may not be detected. This is especially true when the signal is noisy.

## 8.8.2 ARR Analysis Menu

### 8.8.2.1 Switching ARR Analysis On and Off

To switch ARR Analysis on or off, in the **ECG Setup** menu, select **ARR Analysis** to toggle between **On** and **Off** from the popup interface.

### 8.8.2.2 PVCs Alarm

Select **On** in the menu to enable prompt message when an alarm occurs; select **Off** to disable the alarm function, and there will be a symbol  beside **PVCs**.

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#### **WARNING**

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When the PVCs Alarm is set to **Off**, the monitor won't give an alarm prompt even if an alarm occurs. In order to avoid endangering the patient's life, the user should use this function cautiously.

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### 8.8.2.3 ARR Selflearning

Pick this item **ARR Selflearn** to start a learning procedure, and **ECG ARR LEARNING** is displayed on the screen.

The ARR selflearning will start automatically in the following status:

- Connecting or switching calculation leads;
- Admitting a patient;
- Changing patient type or lead type;
- Changing pacemaker status;
- Exiting demo or standby mode.

#### **NOTE:**


- 1 During the relearning phase of the algorithm, arrhythmia detection may not be available. So you should closely monitor the patient condition during and for several minutes after the learning phase to allow the algorithm to reach optimal detection performance.
- 2 Take care to initiate ARR selflearning only during periods of predominantly normal rhythm and when ECG signal is relatively noise-free. If ARR selflearning takes place during arrhythmia, the ectopics may be incorrectly learned as normal QRS complex. This may result in missed detection of subsequent events of arrhythmia.
- 3 If ARR selflearning is performed during ventricular rhythm, ventricular heartbeats may be erroneously identified as normal QRS complexes. This may lead to missed ventricular tachycardia and ventricular fibrillation events.

Due to this reason, you should:

- 1) Take care that ARR selflearning may start automatically;
- 2) Response to lead off information;
- 3) Always check the correctness of arrhythmia alarm.

#### 8.8.2.4 ARR Alarm

By selecting **ECG Setup > ARR Analysis > ARR Alarm Setup**, the arrhythmia alarms can be individually switched on or off. They are: **R-ON-T, VT > 2, COUPLET, PVC, BIGEMINY, TRIGEMINY, TACHY, BRADY, MISSED BEATS, IRR, PNC, PNP, VBRADY** and **VENT**.

**VFIB/VTAC** alarm is preset to be on. To switch it on or off, select **Menu > Maintenance > User Maintain**, and enter the required password **ABC**. Select **Alarm Setup > VFIB/VTAC** from the popup list to toggle between **On** and **Off**. When **VFIB/VTAC** is set to **Off**, the monitor displays the alarm off symbol , and **VFIB/VTAC Off** is displayed on a red colored background.

**ASYSTOLE** alarm is preset to be on and cannot be turned off.

## Chapter 9 Monitoring RESP

### 9.1 Overview

The monitor measures respiration from the amount of thoracic impedance between two ECG electrodes. The change of impedance between the two electrodes, (due to the thoracic movement), produces a respiratory waveform on the screen.

### 9.2 RESP Safety Information

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#### **WARNING**

- 1 If you do not set the **Hold High** and **Hold Low** for the respiration correctly in manual detection mode, it may not be possible for the monitor to detect apnea. If you set the **Hold High** and **Hold Low** too low, the monitor is more likely to detect cardiac activity, and to falsely interpret cardiac activity as respiratory activity in the case of apnea.
  - 2 Respiration measurements can not detect all underexposure sudden events, nor can they distinguish between central, obstructive and mixed respiratory asphyxial events. It only prompts alarm in a predetermined time if the last breath is detected and the next breath is not detected, so it can not be used for diagnostic purposes.
  - 3 If operating under conditions according to the EMC Standard EN 60601-1-2 (Radiated Immunity 3 V/m), field strengths above 3 V/m may cause erroneous measurements at various frequencies. Therefore it is recommended to avoid the use of electrically radiating equipment in close proximity to the respiration measurement unit.
  - 4 Cardiogenic artifact in impedance respiration monitoring may make it difficult to detect breaths or may otherwise be counted as breaths. In some instances, the breath rate may also correspond to the heart rate making it difficult to determine if the signal is due to breathing or the cardiac cycle. Do not rely on RESP monitoring as the sole method for detecting cessation of breathing. Follow hospital guidelines and best clinical practices for apnea detection including monitoring additional parameters that indicate the patient's oxygenation status, such as EtCO<sub>2</sub> and SpO<sub>2</sub>.
  - 5 For the diagnosis of apnea, the safety and effectiveness of respiration measurements have not been validated.
  - 6 To monitor the respiration, only non-ESU-proof accessories can be used. This is because the internal impedance of the ESU-proof accessories required to be used for electrosurgical operation is too large.
  - 7 Some implantable pacemakers can adjust their triggering frequency according to the "minute ventilation rate." Impedance respiration measurements may cause these pacemakers to react incorrectly. To prevent this, turn off the respiration measurement.
  - 8 In manual detection mode, after changing the gain of the respiration wave, be sure to check the setting of hold high and hold low.
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**WARNING**

- 9 When ECG electrode is placed on patient's limb, the impedance respiration may be unreliable.
- 10 Respiration measurement cannot be performed when ESU is used.

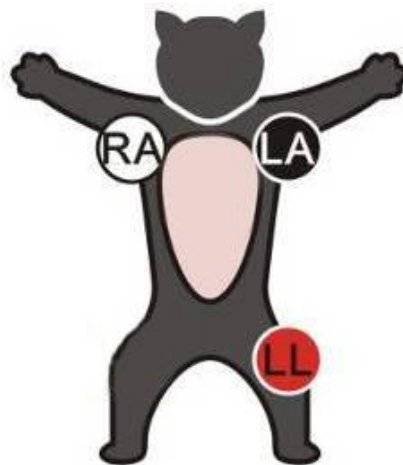
**NOTE:**

The RESP monitoring is not recommended to be used on patients who are very active, as this can cause false alarms.

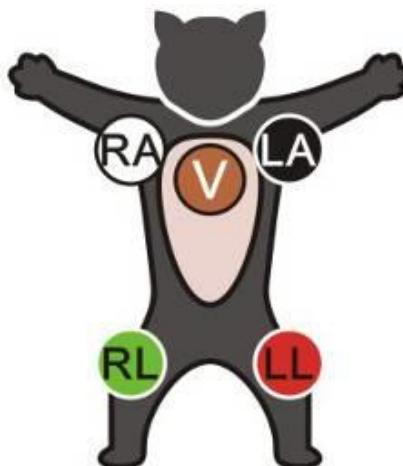
### 9.3 Electrode Placement for Monitoring RESP

Correct patient skin preparation techniques for electrode placement are important for RESP measurement: you will find this information in the chapter on ECG.

The RESP signal is always measured between two of the ECG electrodes. There are two standard ECG leads for selection: I lead (RA and LA) and II lead (RA and LL).



Electrodes Placement for 3-lead



Electrodes Placement for 5-lead

## 9.4 Cardiac Overlay

Cardiac activity that affects the RESP waveform is called cardiac overlay. It happens when the RESP electrodes pick up impedance changes caused by the rhythmic blood flow. Correct 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.

## 9.5 Chest Expansion

Some patients expand their chests laterally. In these cases it is best to place the two respiratory electrodes in the right mid-axillary and left lateral chest areas at the patient's maximum point of breathing movement to optimize the respiratory wave.

## 9.6 Abdominal Breathing

Some patients 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.

### **NOTE:**

Place the red and green electrodes diagonally to optimize the respiration waveform. Avoid the liver area and the ventricles of the heart in the line between the RESP electrodes so as to avoid cardiac overlay or artifacts from pulsating blood flow.

## 9.7 Selecting RESP Lead

To change RESP lead, in the **RESP Setup** menu, select **RESP Lead** to pick up the appropriate lead from the pop-up list.

## 9.8 Changing Hold Type

To change the calculation mode, in the **RESP Setup** menu, set **Hold Type** to **Manual** or **AUTO**. When it is set to the **AUTO** mode, **Hold High** and **Hold Low** are unavailable, and the monitor can calculate the respiration rate automatically. When it is set to the **Manual** mode, you can adjust the broken lines in RESP area by the **Hold High** and **Hold Low** items.

## 9.9 Changing the Size of the Respiration Wave

Select the RESP waveform area to open the **RESP Wave Setup** menu:

- Select **AMP**, and choose an appropriate value. The bigger the value is, the higher the waveform amplitude will be.
- Select **Sweep**: select an appropriate setting from the pop-up list.

## 9.10 Changing the Apnea Time

The apnea alarm is a high priority red alarm used to detect apneas. The apnea alarm delay time defines the time period between the point where the monitor cannot detect any respiration activity and the indication of the apnea alarm. Users should set it cautiously.

1. In the **RESP Setup** menu, select **Apnea Alm**.
2. Select the appropriate setting from the popup list.

## Chapter 10 Monitoring SpO<sub>2</sub>

### 10.1 Overview

SpO<sub>2</sub> is used to measure arterial blood oxygen saturation, which is the percentage of oxyhemoglobin in the arterial blood. SpO<sub>2</sub> parameter can also provide pulse rate (PR) and a plethysmogram wave (Pleth).

### 10.2 SpO<sub>2</sub> Safety Information

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#### **WARNING**

- 1 Do not use the SpO<sub>2</sub> sensors if the packaging or the sensor is damaged and return them to the vendor.
  - 2 If the SpO<sub>2</sub> sensor cannot work properly, please reconnect the sensor or change a new one.
  - 3 Correct and proper sensor application: if the sensor is too loose, it might compromise the optical alignment, and even cause the sensor to fall off. If the sensor is too tight, (such as the application site is too large or becomes too large due to edema), excessive pressure and local tissue ischemia, hypoxia and lack of nutrition may occur on the application site. Prolonged and continuous monitoring may increase the risk of Skin irritations or lacerations. To avoid these damages, users should periodically check surrounding skin of application site according to the patient's condition and pressure sensor, inspect if there is sign of stress-related damage in surrounding tissue, and regularly change the application site. For the patients whose fluid is easy to transfer and/or the patients with systemic or localized edema, users should inspect the skin and change application site more frequently.
  - 4 Use only EDAN permitted sensors and extension cables with the monitor. Other sensors or extension cables may cause improper monitor performance and/or minor injury to users and patients.
  - 5 When serious arrhythmia is present, the SpO<sub>2</sub> pulse rate may differ from ECG heart rate but this does not indicate an inaccurate PR (SpO<sub>2</sub>) value.
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#### **NOTE:**

- 1 Avoid placing the sensor on extremities with an arterial catheter, or intravascular venous infusion line.
- 2 When a trend toward patient deoxygenation is indicated, analyze the blood samples with a laboratory co-oximeter to completely understand the patient's condition.
- 3 If the surrounding temperature increases, the operator should pay attention to the site of poor perfusion, and increase the frequency of checking the skin and changing the measurement site to prevent burns. If the initial skin temperature is less than 35°C,

the temperature of all the listed sensors on the skin will not exceed 41°C during working.

- 4 SpO<sub>2</sub> waveform is not directly proportional to the pulse volume.
- 5 The device is calibrated to display functional oxygen saturation.
- 6 A Functional tester or simulator can not be used to assess the SpO<sub>2</sub> accuracy. However, it can be used to demonstrate that a particular monitor reproduces a calibration curve that has been independently demonstrated to meet a particular accuracy.
- 7 The materials with which the patient or any other person can come into contact conform to the standard of EN ISO 10993-1: 2009.

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

1. Select the correct patient category setting, as this is used to optimize the calculation of the SpO<sub>2</sub> and pulse numeric.
2. During measurement, ensure that the application site:
  - has a pulsatile flow, ideally with a good circulation perfusion.
  - has not changed in its thickness, causing an improper fit of the sensor.

#### Measurement Procedure

1. Switch on the monitor.
2. Attach the sensor to the appropriate site of the patient; the preferred sensor site is on the tongue. Alternatively, the sensor may be placed to the ear or toe.
3. Plug the connector of the sensor extension cable into the SpO<sub>2</sub> socket.



Mounting of the Sensor

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**WARNING**

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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 application site at least every four hours.

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**NOTE:**

- 1 Injected dyes such as methylene blue or intravascular dyshemoglobins such as methemoglobin and carboxyhemoglobin may lead to inaccurate measurements.
- 2 Inspect the sensor to ensure that the light emitter and receiver are aligned with each other and there is no gap between the sensor and the measurement site. All the light emitted by the light emitter must pass through the patient's tissue.
- 3 Clean and remove any substances from the application site.

## 10.4 Measurement Limitations

Certain patient conditions can affect the measurements and cause the loss of the pulse signal.

Inaccurate measurements can be caused but not limited by:

- incorrect sensor application
- high levels of ambient light sources, such as surgical lights (especially those with a xenon light source), bilirubin lamps, fluorescent lights, infrared heating lamps, and direct sunlight
- failure to cover the sensor with opaque material in high levels of ambient light conditions
- dysfunctional hemoglobins
- low peripheral perfusion
- excessive or violent patient movement
- venous pulsations
- intravascular dyes, such as indocyanine green or methylene blue
- externally applied coloring agents
- defibrillation
- placement of the sensor on an extremity with a blood pressure cuff, arterial catheter, or intravascular line
- electromagnetic interference

Loss of pulse signal can occur for the following reasons:

- the sensor is applied too tightly
- a blood pressure cuff is inflated on the same extremity as the one with the sensor attached
- there is arterial occlusion proximal to the sensor
- low peripheral perfusion

**NOTE:**

- 1 To prevent interference from ambient light, ensure that the sensor is properly applied, and cover the sensor site with opaque material.
- 2 Adjacent SpO<sub>2</sub> sensors may interfere with each other (eg, multiple SpO<sub>2</sub> measurements in the same patient). Be sure to cover the sensor with opaque

material to reduce cross-interference.

- 3 Move the sensor to a less active site, and keep the patient still, if possible.
- 4 For Nellcor SpO<sub>2</sub> module, the algorithm automatically extends the amount of data required for measuring SpO<sub>2</sub> and PR depending on the measurement conditions. During normal measurement conditions the averaging time is 6 to 7 seconds. During conditions such as those caused by low perfusion, interference (e.g., external interference such as ambient light or patient movement), or a combination of these, the algorithm automatically extends the amount of data required beyond 7 seconds. If the resulting dynamic averaging time exceeds 20 seconds, the screen will display prompt message "SpO<sub>2</sub> Search Pulse" and SpO<sub>2</sub> and PR will continue to be updated every second. As these conditions extend, the amount of data required continues to increase. If the dynamic averaging time reaches 40 seconds, the screen will display high-level alarm message "SpO<sub>2</sub> No Pulse" indicating a loss-of-pulse condition.

## 10.5 Assessing the Validity of a SpO<sub>2</sub> Reading

You can check the quality of the pleth wave and the stability of the SpO<sub>2</sub> values to assess whether the sensor functions properly and whether the SpO<sub>2</sub> readings are valid. Always use these two indications simultaneously to assess the validity of a SpO<sub>2</sub> reading.

Generally, the quality of the SpO<sub>2</sub> pleth wave reflects the quality of the light signals obtained by the sensor. A wave of poor quality manifests a decline of the signal validity. On the other hand, the stability of the SpO<sub>2</sub> values also reflects the signal quality. Different from varying SpO<sub>2</sub> readings caused by physiological factors, unstable SpO<sub>2</sub> readings are resulted from the sensor's receiving signals with interference. The problems mentioned above may be caused by patient movement, wrong sensor placement or sensor malfunction. To obtain valid SpO<sub>2</sub> readings, try to limit patient movement, check the placement of the sensor, measure another site or replace the sensor.

### **NOTE:**

- 1 The pulse rate accuracy is obtained by comparison to the pulse rate generated with an arterial oxygen simulator (also an electronic pulse simulator).
- 2 During monitoring, if the monitor's reading differs significantly from the patient's physiological condition, it indicates that the signal may be disturbed, resulting in an inaccurate reading. In this case, the artifact can disguise as a similar reading, causing the monitor to fail to send an alarm. In order to ensure reliable monitoring, it is necessary to regularly check whether the sensor is wearing properly and the signal quality is good.

## 10.6 SpO<sub>2</sub> Alarm Delay

There is a delay between a physiological event at the measurement site and the corresponding alarm at the monitor. This delay has two components:

1. The time between the occurrence of the physiological event and when this event is

represented by the displayed numerical values. This delay depends on the algorithmic processing time and the sensitivity setting. The lower the sensitivity configured, the longer the time needed until the numerical values reflect the physiological event.

2. The time between the displayed numerical values exceeding an alarm limit and the alarm indication on the monitor. This delay is the combination of the configured alarm delay time plus the general system delay time.

## 10.7 Perfusion Index (PI)\*

\* Only applicable to the EDAN SpO<sub>2</sub> module.

PI is a numeric value indicating perfusion level. It reflects the perfusion level at the monitoring site.

As the measurement of SpO<sub>2</sub> is based on the pulsation caused by the blood flow through the vessel, PI is in relation to the strength of the pulse. Also, you can use PI as a signal quality indicator for the measurement of SpO<sub>2</sub>.

PI is indicated by a value ranging from 0 to 10. The bigger the value is, the better the perfusion and the signal quality will be. The perfusion level and the signal quality are at their maximum when the value reaches 10. When PI is below 2, it indicates the low perfusion and the poor signal quality at the monitoring site; you need to reposition the sensor or find a better site.

The PI value will be displayed in the SpO<sub>2</sub> parameter area.

## 10.8 Setting Pitch Tone

If tone modulation is on, the PR sound lowers when the SpO<sub>2</sub> level drops. In the **SpO<sub>2</sub> Setup** menu, select pitch tone to toggle between **On** and **Off**.

## 10.9 Setting Sensitivity

The different sensitivity indicates different refresh frequency. **High** indicates the refresh frequency of SpO<sub>2</sub> value is the most frequent. To change the sensitivity, please follow the steps:

- 1 Select the **SpO<sub>2</sub> Setup** menu;
- 2 Select **Sensitivity** on the interface and select the desired sensitivity from the popup list.

## 10.10 SatSeconds Alarm Management\*

\* Only applicable to the Nellcor SpO<sub>2</sub> module.

### 10.10.1 Describing SatSeconds

With traditional alarm management, upper and lower alarm limits are set for monitoring oxygen saturation. During monitoring, as soon as an alarm limit is violated by as little as one percentage point, an alarm is immediately triggered. When the SpO<sub>2</sub> level fluctuates near an alarm limit, the alarm is triggered each time the limit is violated. Such frequent alarms can be distracting.



With the SatSeconds technique, upper and lower SpO<sub>2</sub> alarm limits are set in the same way as traditional alarm management. However, you can also set a SatSeconds limit that allows monitoring of SpO<sub>2</sub> below the selected lower alarm limit and above the selected upper alarm limit for a period of time before an alarm is triggered.

The method of calculation is as follows:

The number of percentage points that the SpO<sub>2</sub> falls outside the alarm limit is multiplied by the number of seconds that the SpO<sub>2</sub> level remains outside that limit. This can be stated as an equation:

$$\text{Points} \times \text{Seconds} = \text{SatSeconds}$$

Where:

Points = SpO<sub>2</sub> percentage points outside of the limit

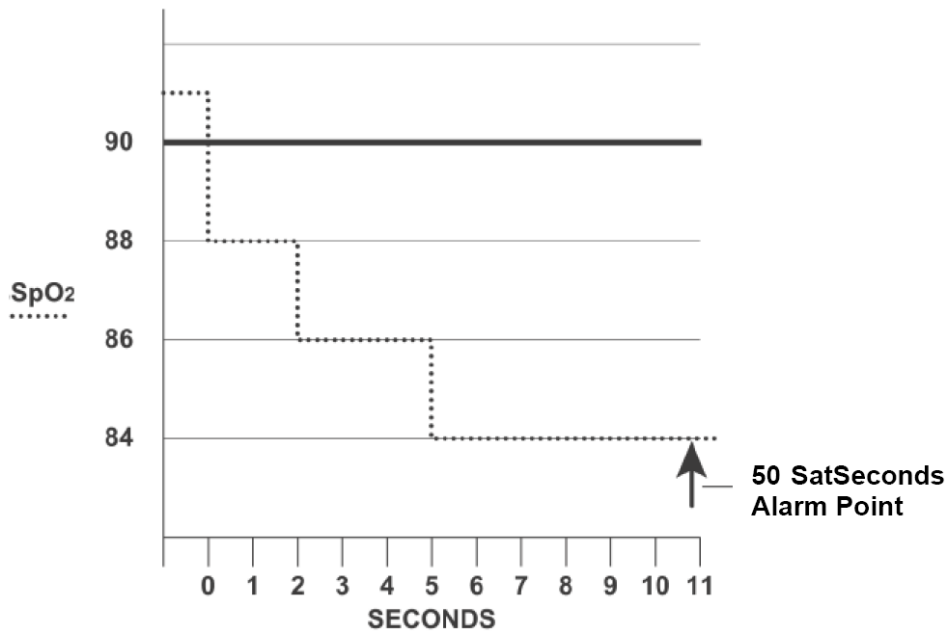
Seconds = number of seconds that SpO<sub>2</sub> remains at that point outside of the limit

The alarm response time, assuming a SatSeconds limit set at 50 and a lower alarm limit set at 90, is described and illustrated below.

In this example, the SpO<sub>2</sub> level drops to 88 (2 points below the limit) and remains there for a period of 2 seconds (2 points  $\times$  2 seconds = 4 SatSeconds). The SpO<sub>2</sub> then drops to 86 for 3 seconds and then to 84 for 6 seconds. The resulting SatSeconds values are shown below:

SpO <sub>2</sub>	×	Seconds	=	SatSeconds
2	×	2	=	4
4	×	3	=	12
6	×	6	=	36
Total SatSeconds			=	52

After approximately 10.7 seconds, a SatSeconds alarm will be triggered, because the limit of 50 SatSeconds has been exceeded. See arrow (↑) in the following figure.



Alarm Response with SatSeconds

Saturation levels may fluctuate rather than remaining steady for a period of several seconds. Often, the patient SpO<sub>2</sub> may fluctuate above and below the alarm limit, re-entering the non-alarm range several times. During such fluctuation, the monitor integrates the number of SpO<sub>2</sub> points, both positive and negative, until either the SatSeconds limit is reached, or the patient SpO<sub>2</sub> returns within a normal range and remains there.

### 10.10.2 SatSeconds “Safety Net”

The SatSeconds “Safety Net” is for patients whose saturation makes frequent excursions below or above the SpO<sub>2</sub> limit but does not remain in violation long enough for the SatSeconds limit to be reached. If three or more SpO<sub>2</sub> alarm limit violations occur within a 60-second period, an alarm will be triggered even if the SatSeconds limit has not been reached.

### 10.10.3 Setting SatSeconds Duration

You can set **SatSeconds** to **Off** or to the duration among **10**, **25**, **50** and **100**. To configure the SatSeconds settings, enter the **SpO<sub>2</sub> Setup** menu and select the desired SatSeconds setting from the **SatSeconds** list.

## Chapter 11 Monitoring PR

### 11.1 Overview

The pulse numeric counts the arterial pulsations that result from the mechanical activity of the heart in beats per minute (bpm). You can obtain a pulse from any measured SpO<sub>2</sub> signal or any arterial pressure.

### 11.2 Setting PR Source

The monitor provides PR source options. You can select SpO<sub>2</sub> or arterial pressure labels as the PR source in the **PR Source** list on the **PR Setup** menu.

#### **NOTE:**

In the **PR Source** list, an arterial pressure label accompanied with a label with brackets indicates this label is in conflict. Do not select a conflicting label as the PR source.

### 11.3 Setting PR Volume

Select **PR Setup > PR Volume**, then select the appropriate setting for the PR volume: five bars represent the maximum volume and one bar represents the minimum volume. If none of bars are selected, the PR volume will be off. Beat frequency of pulse has positive correlation with measurement value.

### 11.4 Selecting the Active Alarm Source

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

- **HR:** if you want HR to be the active alarm source.
- **PR:** if you select PR as the active alarm source, the monitor will prompt you to confirm your choice. Be aware that if you select PR as the alarm source, ECG HR alarms are switched off.
- **AUTO:** If the Alarm Source is set to Auto, the monitor will use the heart rate from the ECG measurement as the alarm source whenever the ECG measurement is switched on and at least one ECG lead can be measured without a technical alarm condition. The monitor will automatically switch to PR for the alarm source if:
  - a valid ECG lead can no longer be measured and
  - a PR source is switched on and available.

The monitor uses the pulse rate from the currently active measurement as system pulse. While PR is the alarm source, all arrhythmia and ECG HR alarms are switched off. If an ECG lead becomes available again, the monitor automatically uses HR as alarm source.

#### **NOTE:**

Pulse alarms are only generated when the active alarm source is set to **PR**, a pulse source is set as system pulse and pulse alarms are switched on.

## Chapter 12 Monitoring NIBP

### 12.1 Overview

This monitor uses the oscillometric method for measuring NIBP.

Oscillometric devices measure the amplitude of pressure changes in the occluding cuff as the cuff deflates from above systolic pressure. The amplitude suddenly increases as the pulse breaks through the occlusion in the artery. As the cuff pressure decreases further, the pulsations increase in amplitude, reach a maximum (which approximates to the mean pressure), and then diminish.

### 12.2 NIBP Safety Information

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**WARNING**

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- 1 Do not measure NIBP on patients with sickle-cell disease or any condition where skin damage has occurred or is expected.
  - 2 Do not measure NIBP on the limb of the same side with a mastectomy.
  - 3 Use clinical judgment to decide whether to perform frequent blood pressure measurements on patients with severe blood clotting disorders because of the risk of hematoma in the limb fitted with the cuff.
  - 4 Do not apply the cuff to a limb that has an intravenous infusion or catheter in place. This could cause tissue damage around the catheter when infusion is slowed or blocked during cuff inflation.
  - 5 Do not attach the cuff to a limb being used for IV infusions as the cuff inflation can block the infusion, potentially causing harm to patient.
  - 6 Do not apply the cuff to a limb where intravascular access or therapy, or an arterio-venous (A-V) shunt is present, otherwise, it may result in injury to the patient.
  - 7 Ensure that the correct cuff type is selected before performing measurements. Do not apply the higher big cuff inflation, overpressure limits and measurement duration for small patients. Not using the small cuff mode on a small patient can block the blood flow, potentially causing harm to the patient.
  - 8 Make sure that the air conduit connecting the blood pressure cuff and the monitor is neither blocked nor tangled.
  - 9 Measuring of blood pressure can temporarily cause malfunctioning of other medical monitoring devices on the same limb.
  - 10 NIBP readings can be affected by the measurement site, the position of the patient, exercise, or the patient's physiologic conditions.
  - 11 Continuous cuff pressure due to connection tubing kinking can block the blood flow, and may result in injury to the patient.
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**WARNING**

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12 Verifying the calibration is only applicable for big cuff mode, and it can not be operated in automatic measuring interval. Continuous measuring can not be operated in automatic measuring interval either.

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**NOTE:**

- 1 It is suggested that the user should not start NIBP measuring when the low battery displays, or the monitor may be turned off automatically.
- 2 If you spill liquid onto the equipment or accessories, particularly if there is a chance that it can get inside the tubing or the measurement device, contact your service personnel.
- 3 Continuous use of the automatic measuring mode for short intervals may lead to the discomfort of patient. Continuous measuring and automatic measuring may result in tissue damage or ischemia to the patient.
- 4 NIBP measurement can be affected by extremes of temperature, humidity and altitude.
- 5 NIBP measurement value should be explained by qualified professionals.
- 6 The pulse rate based on the NIBP measurement may differ from the heart rate based on the ECG waveform. NIBP measures the number of peripheral pulse pulsations, and the heart rate is measured by the electrical signal of the heart. When the electrical signals of the heart occasionally fail to cause the peripheral blood vessels to pulse or the patient's peripheral perfusion is poor, the difference happens.

## 12.3 Measurement Limitations

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

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

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

## 12.4 Measurement Methods

There are three methods of measuring NIBP:

- **Manual** - measurement on demand.
- **Auto** - continually repeated measurements (between 1 and 480 minute adjustable interval). After the first measurement starts manually, the monitor will automatically measure NIBP as preset interval.
- **Continuous**- the measurement will run consecutively in five minutes, then the monitor enters manual mode.

### **WARNING**

Prolonged non-invasive blood pressure measurements in Auto mode may be associated with purpura, ischemia and neuropathy in the limb wearing the cuff. When monitoring a patient, examine the extremities of the limb frequently for normal color, warmth and sensitivity. If any abnormality is observed, stop the blood pressure measurements.

## 12.5 Measurement Procedures

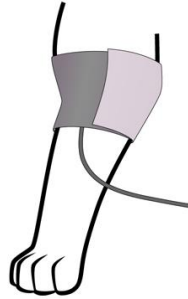
To obtain accurate measurements, the following operating steps need to be observed:

Ensure the patient position in normal use, including:

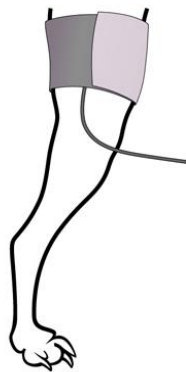
- ◆ Middle of the cuff at the level of the right atrium of the heart;
- ◆ For the patient whose hair is too thick, please cut or remove the hair appropriately'
- ◆ When performing measurement, please keep the patient still, and do not apply external pressure against the cuff.

To start the measurement:

1. Connect the air hose and switch on the monitor.
2. Apply the blood pressure cuff to the patient's limb or tail and follow the instructions below.
  - Ensure that the cuff is completely deflated.
  - Apply the appropriate size cuff to the patient (About the cuff size selection, please refer to Section *NIBP accessories*), and make sure that the symbol "Φ" is over the artery. Ensure that the cuff is not wrapped too tightly around the limb. Excessive tightness may cause discoloration and eventual ischemia of the extremity.
    - ◆ Make sure that the cuff edge falls within the range of the mark <->. If it does not, use a larger or smaller cuff that fits better.
    - ◆ For feline patient, place the cuff above the elbow of the limb to obtain measurements from the brachial artery:




- ◆ For canine patient, the right lateral recumbent position is preferred. Place the cuff around the thigh to obtain measurements from the femoral artery:



3. Check whether the patient mode is appropriately selected. Access the **Patient Setup** menu from **Menu**. Turn the knob to select the required **Cuff Type** in the **Patient Info.** menu.
4. Select a measurement mode in the **NIBP Setup** menu. Refer to Section **Operation Prompts** for details.



5. Press the  button on the front panel to start a measurement.
6. Wait until the first reading is taken.

**NOTE:**

- 1 The width of the cuff is approximately 40% of the limb/tail circumference. The inflatable part of the cuff should be long enough to encircle 80%-100% of the measurement site. The wrong size of cuff can cause erroneous readings. If the cuff size is in question, use another cuff with suitable size to avoid errors.
- 2 Please make sure the cuff is well connected. A leak of air may cause measurement error.
- 3 Please select the cuff with the suitable size. An unsuitable cuff may cause incorrect measurements.
- 4 Avoid incursion of liquid into the cuff. If this happens, please desiccate the cuff completely.
- 5 If an NIBP measurement is suspect, repeat the measurement. If you are still uncertain about the reading, use another method to measure the blood pressure.

### 12.5.1 Operation Prompts

#### 1. Manual Measuring

Access the **NIBP Setup** menu and set the **Measure Mode** item to **Manual**. Then press the



button on the front panel to start a manual measurement.

#### 2. Automatic Measurement

Access the **NIBP Setup** menu and set the **Measure Mode** item to **Auto**, then press the



button on the front panel to start the automatic measurement according to the selected time interval.

During the idle period of measurement process, press the



button on the front panel at

any time to start a manual measurement. Then press the



button on the front panel to stop manual measurement and the system continues to execute auto measurement program according to the selected time interval.

#### 3. Continuous measurement

Access the **NIBP Setup** menu and pick the **Continuous** item to start a continuous measurement. The continuous measurement will last 5 minutes.

#### 4. Stopping continuous measurement

During continuous measurement, press the



button on the front panel at any time to stop measurement.

### 12.5.2 Correcting the Measurement if Limb is not at Heart Level

To correct the measurement if the limb is not at heart level to the displayed value:

Add 0.75 mmHg (0.10 kPa) for each centimeter higher or	Deduct 0.75 mmHg (0.10 kPa) for each centimeter lower or
Add 1.9 mmHg (0.25 kPa) for each inch higher	Deduct 1.9mmHg (0.25 kPa) for each inch lower

### 12.6 NIBP Multi-Review Window

To set the display of NIBP measurements, select **NIBP Setup > Review**:

- ◆ When it is set to **On**, a window for NIBP measurements will be displayed at the waveform area on the main interface, and the size of this window varies depending on the numbers of displayed waveforms.



- ◆ When it is set to **Off**, the window is unavailable on the screen.

## 12.7 Resetting NIBP

When the pressure does not work properly and the system fails to give a message for the problem, pick **Reset** in the **User Maintain > NIBP Maintain** menu to activate self-test procedure, and thus restore the system from abnormal performance.

## 12.8 Calibrating NIBP

NIBP is not user-calibrated. Cuff-pressure transducers must be verified and calibrated, if necessary, at least once every two years by a qualified service professional. See the Service Manual for details.

## 12.9 Leakage Test

Leakage test is used to detect the air tightness of the NIBP pump, valve, and trachea. If not, the system will display NIBP leakage. NIBP leak detection should be performed at least once every two years or when you think the measurement is inaccurate.

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### **WARNING**

This leakage test other than being specified in the EN 1060-1 standard is to be used by the user to simply determine whether there are air leaks in the NIBP airway. If at the end of the test the system gives the prompt that the NIBP airway has air leaks, please contact the manufacturer for repair.

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### Procedure of Leakage Test

1. Connect the cuff securely with the socket for NIBP air hole.
1. Wrap the cuff around the cylinder of an appropriate size, don't wrap the cuff around the patient.
2. Make sure the **Cuff Type** has been set to **Big**.
3. Access **Menu > User Maintain > NIBP Maintain**. Select **Leakage Test**. Then the prompt **Leak. Test Running** will appear indicating that the system has started the leakage test.

#### **For EDAN module:**

The system will automatically inflate the pneumatic system to about 180 mmHg. After 20 seconds to 40 seconds, if system leakage has detected, the system will automatically open the deflating valve to stop the leak test and indicates NIBP Leak. If no system leakage is detected when the pneumatic system is inflated to 180 mmHg, the system will perform a deflation to an approximate value of 40 mmHg and subsequently perform the second phase leak test. After 20 seconds to 40 seconds, the system will automatically open the deflating valve and provide corresponding indication based on the test result.

**For SunTech module:****NOTE:**

When applying high pressures; take special care to increase the pressure at a rate that will not cause unwanted overpressure errors (300 mmHg).

Manually inflate the pneumatic system to approximately 250 mmHg. Start the timer and wait 60 seconds for the pneumatic system to reach its pressure equilibrium point. After the waiting period, record the pneumatic pressure level (P1) and wait another 60 seconds and record the pneumatic pressure level again (P2). Safety circuitry on the module only allows the pressure in the pneumatic system to remain above 10mmHg for 180 seconds. When this safety time limit is exceeded, the valves will open releasing the pressure. Subtract P2 from P1 and this is the leak rate per minute.

2. If the alarm information **NIBP Leak** appears, it indicates that the airway may have air leaks. In this case, the user should check for loose connection. After confirming secure connections, the user should re-perform the leakage test. If the failure prompt still appears, please contact the manufacturer for repair.

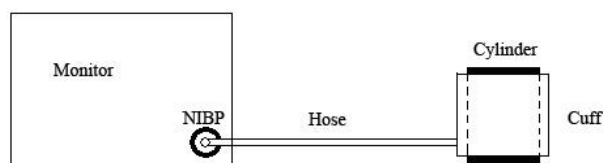


Diagram of NIBP Air Leakage Test

## 12.10 Setting Inflation Mode

To change the inflation mode:

1. Select **NIBP Setup > Inflation Mode**;
2. Choose **Manual** or **AUTO** from the pull-down list.
  - ♦ If **Manual** is chosen, the preset value by users will be adopted as the inflation value when measuring blood pressure.
  - ♦ If **AUTO** is chosen, the default value will be adopted as the inflation value when measuring blood pressure.

## Chapter 13 Monitoring TEMP

### 13.1 Overview

Body temperature is measured by means of a thermistor probe (a semiconductor whose resistance changes with temperature) that is applied to the skin or to the rectum.

Two TEMP probes can be used simultaneously to measure two TEMP values and get the temperature difference. The standard configuration is skin probe.

### 13.2 TEMP Safety Information

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**WARNING**

- 1 Verify probe cables fault detection before the beginning of monitoring phase. Unplug the temperature probe cable of the channel from the socket, and then the screen will display the error message **TEMP T1 Sensor Off** and the auditory alarm is activated. It is the same to the other channel.
  - 2 Take the TEMP probe and cable carefully. When they are not in use, you should coil up the probe and cable into a loose circle. If the wire inside the cable is tensely pulled, it may cause mechanical damage to the probe and the cable.
- 

**NOTE:**

- 1 The materials with which the patient or any other person can come into contact conform to the standard of EN ISO 10993-1: 2009.
- 2 The reference body site temperature is the same as the temperature of the measuring site.

### 13.3 TEMP Monitoring Setup

With a reusable TEMP probe you can plug the probe directly into the monitor. Apply the TEMP probes securely to the patient. Switch on the monitor.

It takes 5 minutes for the body temperature to stabilize.

### 13.4 Calculating Temp Difference

The monitor can calculate and display the difference between two temperature values by subtracting the second value from the first. The difference is labeled TD.

## Chapter 14 Monitoring IBP

### 14.1 Overview

IBP is measured by means of a catheter inserted directly into the circulatory system. A pressure transducer connected to the catheter converts the mechanical force exerted by the blood into an electrical signal, which is displayed graphically as pressure versus time on a monitor screen or numerically on digital display.

The monitor measures direct blood pressure of one selected blood vessel through two channels or four channels, and displays waveforms and pressure of measured direct blood pressure (SYS, DIA and MAP).

### 14.2 IBP Safety Information

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**WARNING**

- 1 The operator should avoid contact with the conductive parts of the appurtenance when it is connected or applied.
  - 2 When the monitor is used with HF surgical equipment, the transducer and the cables must be avoided from conductive connection to the HF equipment. This is to protect against burns to the patient.
  - 3 Disposable IBP transducer or domes should not be reused.
  - 4 If any kind of liquid, other than solution to be infused in pressure line or transducer, is splashed on the equipment or its accessories, or enters the transducer or the monitor, contact the Hospital Service Center immediately.
  - 5 All invasive procedures have risks to the patient. Use aseptic technique and follow catheter manufacturer's instructions.
  - 6 Mechanical shock to the invasive blood pressure transducer may cause severe shifts in zero and calibration, and then cause erroneous readings.
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**NOTE:**

- 1 Use only the pressure transducer listed in the IBP Accessories
- 2 If measuring intracranial pressure (ICP), adjust the transducer on the same level with the puncture position. Incorrect leveling may lead incorrect values.
- 3 Confirm you set correct alarm limit for labels, the alarm limit you set are stored for its label only. Changing label may change the alarm limit.
- 4 Don't perform IBP calibration when a patient is being monitored.
- 5 When using high frequency ventilation, make sure that the ventilator catheter is not connected to or indirectly connected to the arterial catheter at zero pressure. This can lead to less pressure variations, thus interfere the zeroing process.

## 14.3 Monitoring Procedures

Preparatory steps for IBP measurement:

1. Plug the pressure cable into the corresponding socket and switch on the monitor.
2. Prepare the flush solution.
3. Flush through the system, exhaust all air from the tube, and ensure that the transducer and stopcocks are free of air bubbles.
4. Connect the patient catheter to the pressure line, making sure that there is no air present in the catheter or pressure line.
5. Position the transducer so that it is at the same level with the patient's heart.
6. For the label name selection, please refer to [Selecting a Pressure for Monitoring](#).
7. To zero the transducer, please refer to [Zeroing the Pressure Transducer](#).

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### **WARNING**

If there are air bubbles in the tube system, you should flush the system with the solution again. The bubbles may cause erroneous pressure readings.

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### 14.3.1 Selecting a Pressure for Monitoring

Tell the monitor which pressure you want to monitor by selecting its pressure label. The label is a unique identifier for each type of pressure. When you choose a label, the monitor uses that label's stored settings, for example color, wave scale and alarm settings. The label also determines which algorithm is used to process the pressure signal, so an incorrect label can lead to incorrect pressure values. To select the label, please refer to the following table:

Label	Description
ART	Arterial blood pressure
PA	Pulmonary artery pressure
CVP	Central venous pressure
ICP	Intracranial pressure
LAP	Left atrial pressure
RAP	Right atrial pressure
P1-P2	Alternative non-specific pressure labels

**NOTE:**

The pressure option is only valid when the label is P1/P2 and does not take effect under other labels.

### 14.3.2 Zeroing the Pressure Transducer

To avoid inaccurate pressure readings, the monitor requires a valid zero. Zero the transducer in accordance with your hospital policy (at least once per day). 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 not correct.

When using a pressure module, the zero information is stored in the module.

The zeroing procedure is listed as below:

1. Turn off the stopcock to the patient.
2. Vent the transducer to atmospheric pressure, to compensate for the static and atmospheric pressure exerted on the transducer.
3. In the setup menu for the pressure, select **Zero**.
4. When you see the message **Zero Ok**, please close the stopcock to atmospheric pressure, and open the stopcock to the patient.

### 14.3.3 Troubleshooting the Pressure Zeroing (Taking Art for Example)

The status message lists the probable cause of an unsuccessful calibration.

Message	Corrective Action
Art ZERO FAIL	Make sure that the transducer is not attached to the patient.
Art SENSOR OFF, FAIL	Make sure that transducer is not off, and then proceed zeroing.
IN DEMO, FAIL	Make sure that the monitor is not in DEMO mode. Contact service technician if necessary.
PRESSURE OVER RANGE, FAIL	Make sure that the stopcock is vented to atmosphere. If the problem persists, please contact service technician.
PULSATILE PRESSURE ZERO FAIL	Make sure that the transducer is vented to air, not connected to a patient, and try again.

### 14.3.4 IBP Calibration

IBP is not user-calibrated. Calibration should be performed by a qualified service professional as frequently as dictated by your Hospital Procedures Policy.

## 14.4 Changing the IBP Waveform Ruler

The top, middle and bottom rulers are available for each channel of IBP waveform. Users can adjust the top, middle or bottom rulers manually:

1. Open the menu **Wave Setup** of IBP by clicking on the IBP waveform area.

2. Select a suitable ruler from the options **TopRuler**, **MidRuler** and **BotRuler**.

## 14.5 IBP Waveform Overlapping

The monitor can display IBP overlapped waveforms. To set IBP waveform overlapping:

1. Select **Menu > Maintenance > User Maintain > Other Setups**, and set **IBP Wave Overlapping** to **On** or **Off**.
2. Click the IBP waveform area to show the **IBP Wave Setup** menu.
3. Select **Add IBP Waves** and then select the IBP waves for overlapping from the pop-up list. A maximum of four overlapping waveforms can be displayed.
4. After exiting the interface, the main screen will display the overlapped IBP waves. The flashing label is the main label of the waveform area.

Click the IBP overlapping waveform area on the main screen, and then select **Setup Rulers**. The user can select a suitable ruler for the overlapped waveforms from the options **TopRuler** and **BotRuler**.

## Chapter 15 Monitoring CO<sub>2</sub>

### 15.1 Overview

The monitor provides the sidestream and mainstream methods for CO<sub>2</sub> monitoring. EDAN module and Respironics Sidestream CO<sub>2</sub> module are used for sidestream measuring, and Respironics Mainstream CO<sub>2</sub> module is used for mainstream measuring. Respironics CO<sub>2</sub> module is plug-and-play and the monitor can automatically identify its sidestream and mainstream modules.

The principle of CO<sub>2</sub> measurement is primarily based on the fact that CO<sub>2</sub> molecule can absorb 4.3µm infrared ray. Absorption intensity is proportional to CO<sub>2</sub> concentration of patient sample, the CO<sub>2</sub> concentration will compute according to the detecting CO<sub>2</sub> absorption intensity of patient sample.

- Sidestream measurement takes a sample of the respiratory gas with a constant sample flow from the patient's airway and analyzes it with a remote CO<sub>2</sub> sensor. You can measure Sidestream CO<sub>2</sub> using the monitor's built-in CO<sub>2</sub> measurement. Respiration rate is calculated by measuring the time interval between detected breaths.
- Mainstream measurement uses a CO<sub>2</sub> sensor attached to an airway adapter directly inserted into the patient's breathing system.

### 15.2 CO<sub>2</sub> Safety Information

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#### **WARNING**

- 1 Do not use the device in the environment with flammable anesthetic gas.
  - 2 The device should be used by trained and qualified medical personnel authorized by EDAN.
  - 3 Nitrous oxide, elevated levels of oxygen, helium, xenon, halogenated hydrocarbons, and barometric pressure can influence the CO<sub>2</sub> measurement.
  - 4 The monitor will be damaged if any pipelines from the CO<sub>2</sub> module's air inlet /the air outlet are plugged by water or other materials.
  - 5 The accuracy of the CO<sub>2</sub> measurement will be affected by the following reasons: the airway was highly obstructed; the leakage of air way connection or quick variation of environment temperature.
  - 6 Follow precautions for electrostatic discharge (ESD) and electromagnetic interference (EMI) to and from other equipment.
  - 7 Do not place the sensor cables or tubing in any manner that may cause entanglement or strangulation.
  - 8 When using mechanical ventilation, gas compensation should be well set. Inappropriate setting may cause incorrect measurement result.
  - 9 Please avoid dead area when connecting airway, otherwise the measurement value may be lower.
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**WARNING**

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- 10 Respiration module is not equipped with automatic air pressure compensation, before you start the CO<sub>2</sub> measurement for the first time, you must set the correct altitude. Incorrect altitude settings can cause incorrect CO<sub>2</sub> readings. EDAN EtCO<sub>2</sub> module is equipped with automatic air pressure compensation, and manual setting is not required.
  - 11 Leakage in the respiratory system or sampling system may result in a significant low display of the EtCO<sub>2</sub> value. Always keep all components connected firmly and check for leaks according to standard clinical procedures.
  - 12 The EtCO<sub>2</sub> reading is not always closely related to the paCO<sub>2</sub> value, especially in neonatal patients, and patients with pulmonary disease, with pulmonary embolism or inappropriate ventilation.
  - 13 Don't measure CO<sub>2</sub> while nebulized medications are being delivered.
  - 14 The CO<sub>2</sub> module temporarily stops measuring during zeroing.
- 
- 

**NOTE:**

- 1 After the low battery alarm appears, please do not start the CO<sub>2</sub> measurement, or the monitor may turn off for the low capacity of battery.
- 2 For disposal of hospital waste such as accumulated fluids, calibration gases, sampled gases, where not otherwise specified, follow local regulations regarding disposal of hospital waste.
- 3 If the measurement or sensor fails, stop measurement before the qualified service personnel solves the problem.

## 15.3 Monitoring Procedures

### 15.3.1 Zeroing the sensor

For the EDAN EtCO<sub>2</sub> module:

EDAN EtCO<sub>2</sub> module itself has automatic zero function, only when the measurement is abnormal or measurement results are doubtful, the user can perform manual zero as following steps:

1. Wait until the monitor's warm-up message disappears; keep the monitor away from CO<sub>2</sub> source.
2. In the **CO<sub>2</sub> Setup** menu, set **Work Mode** to **Measure**.
3. Select **Zero Calibration** in **CO<sub>2</sub> Setup** menu.
4. After the zeroing calibration is completed, the zeroing message disappears, and the CO<sub>2</sub> monitoring can be performed.

For the Respiration Sidestream CO<sub>2</sub> Module:

1. Connect the sample line to the module correctly, wait until the monitor's warm-up message

disappears, keep the inlet of sample line away from CO<sub>2</sub> source.

2. In the **CO<sub>2</sub> Setup** menu, set **Work Mode** to **Measure**.
3. Select **Zero Calibration** in **CO<sub>2</sub> Setup** menu.
4. After the zeroing calibration is completed, the zeroing message disappears, and the CO<sub>2</sub> monitoring can be performed. If the monitor displays **Breath Detected** or **Zero Required**, zeroing has failed. Zero calibration must be performed again.

For the Respironics Mainstream CO<sub>2</sub> Module:

1. Wait until the monitor's warm-up message disappears; correctly install the mainstream CO<sub>2</sub> sensor to airway adaptor and remove it from breathing circuit, keep the monitor away from CO<sub>2</sub> source.
2. In the **CO<sub>2</sub> Setup** menu, set **Work Mode** to **Measure**.
3. Select **Zero Calibration** in **CO<sub>2</sub> Setup** menu.
4. After the zeroing calibration is completed, the zeroing message disappears, and the CO<sub>2</sub> monitoring can be performed. If the monitor displays **Breath Detected** or **Zero Required**, zeroing has failed. Zero calibration must be performed again.

Note: CO<sub>2</sub> source includes ventilator, patient's and operator's breath.

## 15.3.2 Sidestream CO<sub>2</sub> Module

### 15.3.2.1 Measurement Steps

#### EDAN EtCO<sub>2</sub> Module

1. Fix the water trap to the water trap holder on the left side of the monitor, confirm it is well fixed.
2. Connect the sampling cannula or the sampling line to the water trap.
3. Set **Work Mode** to **Measure**.
4. For intubated patients, an airway adaptor is required. For non-intubated patients, place the nasal cannula or the sampling mask onto the patient.

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#### **CAUTION**

1. The water trap collects water drops condensed in the sampling line and therefore prevents them from entering the module. If the water trap is nearly filled, you should replace it to avoid blocking the airway.
  2. Based on a sample gas temperature of 37 °C, a room temperature of 23 °C and sample relative humidity of 100%, the water trap will be filled after approximately 90 hours with the flowrate of 100 ml/min and approximately 130 hours with the flowrate of 70 ml/min. In clinical practice, the water trap can be used for a longer time before it is filled. It is recommended to replace the water trap once every month.
-

**CAUTION**

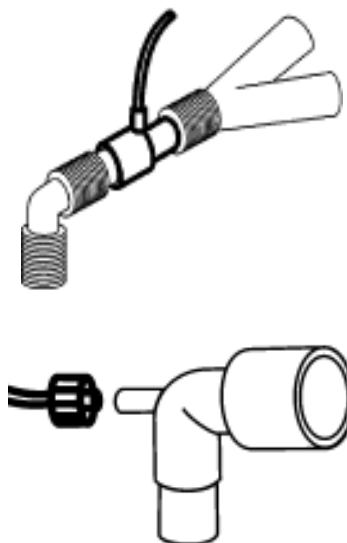
- 3 When replacing the water trap or suspecting the measurement value, please check if the O-rings of the water trap holder are normal and well installed. If the O-rings get damaged or loose, contact EDAN's service staff.
- 4 To prevent the module from abnormal work, please ensure the water trap detection button is not mistakenly touched when water trap is not installed.
- 5 Please replace and discard the water trap when blocking. Don't reuse it, otherwise the reading is not accurate and even the device may be damaged.

**NOTE:**

- 1 Disconnect the water trap from the holder or set **Work Mode** to **Standby** when the module is not in use.
- 2 To avoid patient cross infection, do not connect the exhaust tube to the ventilator circuit. If the sampled gas is returned to the breathing system, always use the bacterial filter of the sample gas return kit.

**Respironics Sidestream Module**

- 1 Plug the sensor cable into the monitor's CO<sub>2</sub> input connector. Allow the sensor two minutes for warm-up.
- 2 Appropriately connect the cannula, airway adapter or sample line to the sensor. It will click into place when seated correctly.
- 3 To zero the sensor, please refer to zeroing the sensor.
- 4 For intubated patients, an airway adapter is required;



Air adapter

For non-intubated patients: Place the nasal cannula onto the patient.

**NOTE:**

- 1 You must perform a zero calibration as described in this procedure each time the ambient temperature changes more than 10 °C (for example during transport).
- 2 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.
- 3 Always disconnect the cannula, airway adapter or sample line from the sensor when the sensor is not in use.
- 4 To extend the lifetime of the module, set **Work Mode** to **Standby** when the module is not in use.
- 5 The sidestream CO<sub>2</sub> module continuously extracts a quantity of gas from the patient's airway per minute. Please do not use this module in any patient who will be affected by this sampling rate.
- 6 If the catheter falls off during the measurement, it is necessary to re-zero after the catheter is well connected, and then measurement can be performed.

### 15.3.2.2 Removing Exhaust Gases from the System

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**WARNING**

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Do not connect the exhaust tube to the ventilator circuit, connect the outlet to a scavenging system, cross infection can occur if sampling gas is returned to the breathing system. When using the sidestream CO<sub>2</sub> measurement on patients who are receiving or have recently received anesthetics, please avoid exposing medical staff to anesthetics.

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Use an exhaust tube to remove the sample gas to a scavenging system. Attach it to the sidestream sensor at the outlet connector.

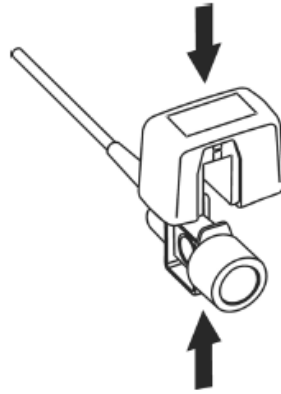
### 15.3.3 Mainstream CO<sub>2</sub> Module

**NOTE:**

You must perform a zero calibration as described in this procedure each time you use a new airway adapter.

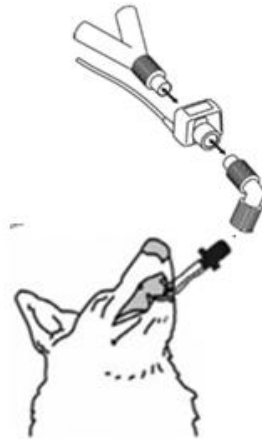
#### 15.3.3.1 Measurement Steps

- 1 Attach the sensor connector to the CO<sub>2</sub> connector on the monitor.
- 2 Wait two minutes, allowing the sensor to reach its operating temperature and a stable thermal condition.
- 3 Choose the appropriate airway adapter and connect it to the sensor head. The airway adapter clicks into place when seated correctly.



Connecting Sensor

- 4 To zero the sensor, please refer to zeroing the sensor.
- 5 Install the airway adapter at the proximal end of the circuit between the elbow and the ventilator Y-section.



Connecting Airway Adapter

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**WARNING**

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- 1 No routine user calibration is required.
  - 2 Accuracy is affected by temperature and barometric pressure.
- 

**NOTE:**

- 1 If the catheter falls off during the measurement, it is necessary to re-zero after the catheter is well connected, and then measurement can be performed.
- 2 Replace the airway adapter, if excessive moisture or secretions are observed in the tubing or if the CO<sub>2</sub> waveform changes unexpectedly without a change in patient status.
- 3 To avoid cross infection, use only sterilized, disinfected or disposable airway adapters.

- 4 Inspect the airway adapters prior to use. Do not use it if airway adapter appears damaged or broken. Observe airway adapter color coding for patient population.
- 5 Periodically check the flow sensor and tubing for excessive moisture or secretion buildup.
- 6 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.
- 7 To avoid dead space, place the sensor as close to the patient as possible.

## 15.4 Setting CO<sub>2</sub> Corrections

Temperature, water vapor in the patient's breath, barometric pressure, and the proportions of O<sub>2</sub>, N<sub>2</sub>O and Helium in the mixture all influence CO<sub>2</sub> absorption. If values seem inaccurately high or low, check that the monitor is using the appropriate corrections.

For the EDAN sidestream module, the following items are available in the **CO<sub>2</sub> Other Setup** menu: **N<sub>2</sub>O Compens.**, **O<sub>2</sub> Compens.**, **Anest. Agent**, **Vapor Compens.** and **Pump Rate**. The concentration of compensated gas should be set based on the current gas concentration which is supplied for patient. As for O<sub>2</sub> and N<sub>2</sub>O, Make the supplied gas concentration multiply to its volume to get the concentration. For instance, supply 100% O<sub>2</sub>, and its volume is 60%, then O<sub>2</sub> compensation is:  $100\% * 60\% = 60\%$ . AG concentration is decided by anaesthesia apparatus.

For the Respironics CO<sub>2</sub> modules, there are **Baro Press**, **O<sub>2</sub> Compens**, **Anes Agent** and **Balance Gas** in the **CO<sub>2</sub> Other Setup** menu. The concentration of compensated gas (including O<sub>2</sub> and AG) should be set based on the current gas concentration which is supplied for patient. The selection of balance gas depends on actual situation. For instance, N<sub>2</sub>O should be selected as balance gas if the real balance gas is N<sub>2</sub>O.

### **NOTE:**

Make sure compensation value is correctly set, otherwise the measurement accuracy may be affected.

## 15.5 Setting Apnea Alarm Time

This determines the time limit after which the monitor gives an alarm if the patient stops breathing.

1. Select **CO<sub>2</sub> Setup > Apnea Alm**;
2. Choose the apnea alarm time from the pop-up list.

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### **WARNING**

Safety and effectiveness of the respiration measurement method in the detection of apnea has not been established.

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## 15.6 Setting CO<sub>2</sub> Waveform

Open the menu **CO<sub>2</sub> Wave Setup** by clicking on the CO<sub>2</sub> waveform area:

- ◆ Choose **Mode** and set it to **Curve** or **Filled** from the pop-up list;
- ◆ Choose **Sweep** and select a suitable setting from the pop-up list. The bigger the value is, the wider the waveform will be.

## Chapter 16 Monitoring AG

### 16.1 Overview

The monitor uses ISA sidestream gas analyzer (hereinafter called ISA analyzer) and IRMA mainstream module (hereinafter called IRMA module) to monitor the anesthetic gas which can be used to measure the gases of feline, canine and other patients during anesthesia, recovery and respiratory care. And the anesthetic gas includes Halothane (HAL), Isoflurane (ISO), Enflurane (ENF), Sevoflurane (SEV), Desflurane (DES), CO<sub>2</sub> and N<sub>2</sub>O.

### 16.2 Safety Information

#### 16.2.1 Safety Information for ISA Analyzer

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**WARNING**

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- 1 The ISA analyzer is intended for use by authorized and trained medical personnel only.
  - 2 Use only Nomoline sampling lines manufactured by PHASEIN.
  - 3 The ISA analyzer must not be used with flammable anesthetic agents.
  - 4 Carefully route the sampling line to reduce the risk of patient entanglement or strangulation.
  - 5 Do not re-use disposable sampling line.
  - 6 Do not lift the monitor by the sampling line as it could disconnect from the monitor, causing the monitor to fall on the patient.
  - 7 Used disposable sampling lines shall be disposed of in accordance with local regulations for medical waste.
  - 8 Use the appropriate sampling line configurations according to patient's size.
  - 9 Do not use the ISA analyzer with metered-dose inhalers or nebulized medications as this may clog the bacteria filter.
  - 10 Check that the gas sample flow is not too high for the present patient category.
  - 11 Since a successful zeroing requires the presence of ambient air (21% O<sub>2</sub> and 0% CO<sub>2</sub>) in the gas analyzer, ensure that the ISA is placed in a well ventilated place. Avoid breathing near the ISA side stream gas analyzer before or during the zeroing procedure.
  - 12 The Nomoline sampling line and its interfaces are non-sterile devices. To avoid damage, do not autoclave any part of the sampling line.
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**WARNING**

- 13 Never sterilize or immerse the ISA analyzer in liquid.
  - 14 Measurements can be affected by mobile and RF communications equipment. Make sure that the ISA analyzer is used in the electromagnetic environment specified in this manual.
  - 15 ISA analyzer is intended only as an adjunct in patient assessment. It must be used in conjunction with other assessments of clinical signs and symptoms.
  - 16 Replace the sampling line if the sampling line input connector starts flashing red, or a Nomoline occlusion message is displayed on the host.
  - 17 ISA analyzers are not designed for MRI environments.
  - 18 Use of high frequency electrosurgical equipment in the vicinity of the monitor may produce interference and cause incorrect measurements.
  - 19 Do not use external ambient cooling of the ISA device.
  - 20 Do not apply negative pressure to the Nomoline to remove condensed water.
  - 21 Too strong positive or negative pressure in the patient circuit might affect the sample flow.
  - 22 Exhaust gases should be returned to the patient circuit or a scavenging system.
  - 23 Always use a bacteria filter on the evac side if sampled gas is intended to be re-breathed.
  - 24 Do not place the ISA analyzer in any position that might cause it to fall on the patient.
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**CAUTION**

- 1 The ISA analyzers should be securely mounted in order to avoid the risk of damage to the ISA.
  - 2 Do not apply tension to the ISA analyzer cable.
  - 3 Do not operate the ISA analyzer outside the specified operating temperature environment.
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### 16.2.2 Safety Information for IRMA Module

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**WARNING**

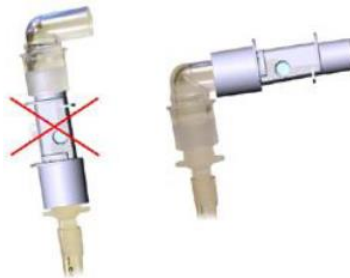
- 1 The IRMA probe is intended for use by authorized and trained medical personnel only.
  - 2 The IRMA probe must not be used with flammable anesthetic agents.
  - 3 Disposable IRMA airway adapters shall not be reused. Used disposable airway adapters shall be disposed of in accordance with local regulations for medical wastes.
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**WARNING**

- 4 Use only PHASEIN manufactured oxygen sensor cells. Depleted oxygen sensors shall be disposed of in accordance with local regulations for batteries.
- 5 Use the appropriate IRMA adapter according to the patient's size.
- 6 Measurements can be affected by mobile and RF communications equipment. It should be assured that the IRMA probe is used in the electromagnetic environment specified in this manual.
- 7 Do not place the IRMA airway adapter between the endotracheal tube and an elbow as this may allow patient secretions to block the adapter windows and result in incorrect operation.



- 8 To keep secretions and moisture from pooling on the windows or oxygen sensor port, always position the IRMA probe in a vertical position with the LED pointing upwards.
- 9 Do not use the IRMA airway adapter with metered dose inhalers or nebulized medications as this may affect the light transmission of the airway adapter windows.
- 10 The IRMA probe is intended only as an adjunct in patient assessment. It must be used in conjunction with other assessment of clinical signs and symptoms.
- 11 Incorrect probe zeroing will result in false gas readings.
- 12 Incorrect agent selection by the user for IRMA AX (no automatic agent identification) will result in false agent readings.
- 13 Using IRMA AX (no automatic identification) with gas mixtures containing more than one agent will result in false agent readings.
- 14 Replace the adapter if rainout/condensation occurs inside the airway adapter.
- 15 Use only PHASEIN manufactured IRMA airway adapters.

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**CAUTION**

- 1 Do not apply tension to the probe cable.
  - 2 Do not operate the IRMA probe outside the specified operating temperature environment.
  - 3 Do not leave depleted oxygen sensors mounted in the IRMA probe, even if the probe is not in use.
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**NOTE:**

For disposal of hospital waste such as accumulated fluids, calibration gases, sampled gases, where not otherwise specified, follow local regulations regarding disposal of hospital waste.

## 16.3 Monitoring Steps

### 16.3.1 Monitoring Steps for ISA Analyzer

#### 16.3.1.1 Performing a Pre-use Check

Before connecting the Nomoline sampling line to the breathing circuit, do the following:

1. Connect the sampling line to the ISA gas inlet connector (LEGI).
2. Check that the LEGI shows a steady green light (indicating that the system is OK).
3. For ISA OR+ and ISA AX+ module with O<sub>2</sub> option fitted: Check that the O<sub>2</sub> reading on the monitor is correct (21%).
4. Breathe into the sampling line and check that valid CO<sub>2</sub> waveforms and values are displayed on the monitor.
5. Occlude the sampling line with a fingertip and wait for 10 seconds.
6. Check that an occlusion alarm is displayed and that the LEGI shows a flashing red light.
7. If applicable: Perform a tightness check of the patient circuit with the sampling line attached.

#### 16.3.1.2 Leakage Check

1. Connect a new Nomoline sampling line with male luer lock to the ISA LEGI and check that the LEGI shows a steady green light.
2. Connect a short silicon tubing with an inner diameter of 3/32" (2.4 mm) to the Nomoline male luer.
3. Exhale a long breath into the silicon tubing until the CO<sub>2</sub> concentration is greater than 4.5 vol% or 34 mmHg.
4. Quickly connect the silicon tubing tightly to the exhaust port.
5. Wait 1 minute until the CO<sub>2</sub> concentration has stabilized. Note the value.
6. Wait 1 minute and check that the CO<sub>2</sub> concentration has not decreased more than 0.4 vol% or 3 mmHg. If it has decreased more there is a major leakage in the ISA unit or in the Nomoline. Do not operate the ISA if there is a major leakage in the unit.

#### 16.3.1.3 System Setup for Analyzer

If your system is using the plug-in and measure ISA analyzer, please follow the setup instructions below:

1. Connect the ISA analyzer interface cable to the monitor.
2. Connect a Nomoline sampling line to the ISA analyzer input connector.

3. Connect the gas sample exhaust port to a scavenging system or return the gas to the patient circuit.
4. Power up the monitor.
5. A green LED indicates that the ISA analyzer is ready for use.
6. Perform a pre-use check as described in section Perform a pre-use Check.

#### 16.3.1.4 Zeroing

The infrared module needs to establish a zero reference level for the CO<sub>2</sub>, N<sub>2</sub>O and anesthetic agent gas measurement. This zero calibration is here referred to as "zeroing".

ISA analyzer performs zeroing automatically by switching the gas sampling from the respiratory circuit to ambient air. The automatic zeroing is performed every 24 hours, and takes less than 3 seconds for ISA CO<sub>2</sub> module and less than 10 seconds for ISA analyzer.

If the ISA analyzer is fitted with an oxygen sensor, the automatic zeroing will also include room air calibration of the oxygen sensor.

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#### **WARNING**

Since a successful zeroing requires the presence of ambient air (21% O<sub>2</sub> and 0% CO<sub>2</sub>), ensure that the ISA analyzer is placed in a well ventilated place. Avoid breathing near the ISA analyzer before or during the zeroing procedure.

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#### 16.3.1.5 Cleaning

The ISA sidestream gas analyzers and Nomoline Adapter can be cleaned using a cloth moistened (not wet) with max 70% ethanol or isopropyl alcohol.

To prevent cleaning liquids and dust from entering the ISA gas analyzer through its LEGI connector, keep the Nomoline Family sampling line connected while cleaning the analyzer.

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#### **CAUTION**

Never immerse the ISA sidestream gas analyzer in liquid.

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#### 16.3.1.6 Maintenance

Once every year, or whenever gas readings are questionable, perform a leakage check according to *Section 16.3.1.2* and verify gas readings with a reference instrument or with calibration gas.

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#### **WARNING**

The Nomoline sampling lines are non-sterile devices. To avoid damage, do not autoclave any parts of the sampling line.

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### 16.3.1.7 Replacement of Consumables

The Nomoline and Nomoline Airway Adapter Set are single-patient use products.

The Nomoline Adapter is a multiple-patient use product.

The T-adapter and Nomo Extension are single-patient use products.

Nomoline Family sampling lines and all consumables mentioned above should be replaced according to good clinical practice or when the sampling line gets occluded. Occlusion occurs when water, secretion etc. is aspirated from the respiratory circuit to such extent that ISA cannot maintain the normal 50 ml/min sample flow. This situation is indicated by a red flashing gas inlet connector and an alarm message; Replace the Nomoline and wait until the gas inlet connector switches to green indicating that the ISA gas analyzer is ready for use.

### 16.3.1.8 MAC Calculation

The MAC value is calculated and displayed by using end-tidal (Et) gas concentrations according to the following formula:

$$MAC = \frac{\% Et(AA1)}{X(AA1)} + \frac{\% Et(AA2)}{X(AA2)} + \frac{\% Et(N_2O)}{100}$$

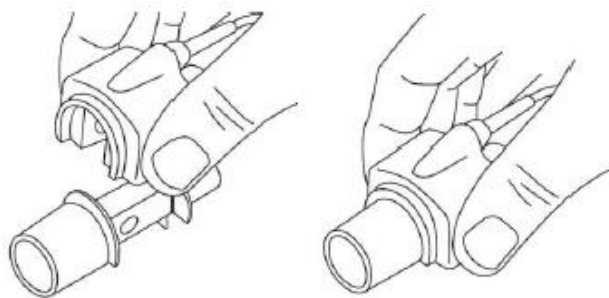
X (AA): HAL=0.75%, ENF=1.7%, ISO=1.15%, SEV=2.05%, DES=6.0%

#### **NOTE:**

Altitude, patient age and other individual factors are not considered in the formula above.

### 16.3.2 Monitoring Steps for IRMA Module

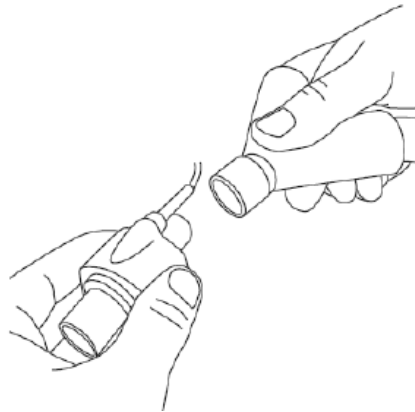
- 1 Plug the IRMA connector into the IRMA input and switch the power on.
- 2 Snap the IRMA sensor head on the top of the IRMA airway adapter. It will click into place when properly seated.



- 3 A green LED indicates that the IRMA probe is ready for use.



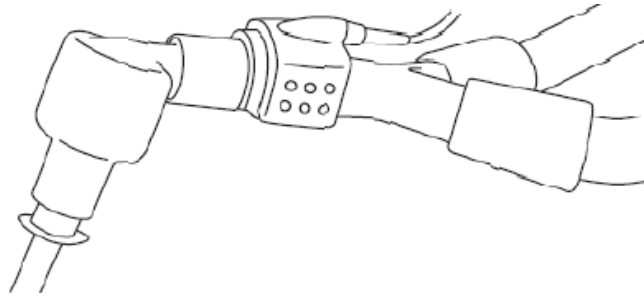
- 4 Connect IRMA /airway adapter 15 mm male connector to the breathing circuit Y-piece.



- 5 Connect the IRMA /airway adapter 15 mm female connector to the patient's endotracheal tube.



Alternatively, connect an HME (Heat Moisture Exchanger) between the patient's endotracheal tube and the IPMA probe. Placing an HME in front of the IRMA probe protects the airway adapter from secretions and effects of water vapor and eliminates the need of changing the adapter. It allows free positioning of the IRMA probe as well.



- 6 Unless the IRMA probe is protected with an HME always position the IRMA probe with the status LED pointing upwards.



### 16.3.2.1 Placement of IRMA Probe

When connecting IRMA probe to a patient circuit, it is important to avoid a direct contact between the IRMA probe and the patient's body. If, for whatever the reason, the IRMA probe is in direct contact with any parts of the patient's body, an insulation material shall be placed between the IRMA probe and the body.

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#### **WARNING**

The IRMA probe is not intended to be in long term skin contact.

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### 16.3.2.2 Performing a Pre-use Check

Prior to connecting the IRMA airway adapter to the breathing circuit, verify gas readings and waveforms on the monitor before connecting the airway adapter to the patient circuit.

Perform the tightness check of the patient circuit with the IRMA probe snapped on the IRMA airway adapter.

### 16.3.2.3 Zeroing

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#### **WARNING**

Incorrect probe zeroing will result in false gas readings.

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In order to secure high precision of the IRMA probe measurements the following zeroing recommendations should be followed.

Zeroing is performed by snapping a new IRMA airway adapter onto the IRMA probe, without

connecting the airway adapter to the patient circuit, and then using the host instrument to transmit a zero reference command to the IRMA probe.

Special care should be taken to avoid breathing near the airway adapter before or during the zeroing procedure. The presence of ambient air (21% O<sub>2</sub> and 0% CO<sub>2</sub>) in the IRMA airway adapter is of crucial importance for a successful zeroing. If a “ZERO-REQ” alarm should appear directly after a zeroing procedure, the procedure has to be repeated.

Always perform a pre-use check after zeroing the probe.

#### **Zeroing for IRMA AX+ probes:**

Zeroing should be performed every time the IRMA airway adapter is replaced, or whenever an offset in gas values or an unspecified gas accuracy message is displayed.

Allow 30 seconds for warm up of the IRMA AX+ probes after power on and after changing the IRMA airway adapter before proceeding with the Zeroing Procedure. The green LED on the probe will be blinking for approximately 5 seconds while zeroing is in progress.

#### **16.3.2.4 Cleaning**

The IRMA probe can be cleaned using a cloth moistened with maximum 70% ethanol or maximum 70% isopropyl alcohol.

Remove the disposable IRMA airway adapter prior to cleaning the IRMA probe.

#### **CAUTION**

- 1 The IRMA airway adapters are non-sterile devices. Do not autoclave the devices as this will damage them.
- 2 Never immerse the IRMA probe in liquid.

#### **16.3.2.5 Maintenance**

Gas readings should be verified at regular intervals with a reference instrument or by conducting the gas check. The suggested interval is once every year.

#### **16.3.2.6 MAC Calculation**

The MAC value may be calculated and displayed by using end-tidal (ET) gas concentrations according to the following formula:

$$\text{MAC} = \% \text{ET}(\text{AA}_1) / \text{X}(\text{AA}_1) + \% \text{ET}(\text{AA}_2) / \text{X}(\text{AA}_2) + \% \text{ET}(\text{N}_2\text{O}) / 100$$

X(AA): HAL=0.75%, ENF=1.7%, ISO=1.15%, SEV=2.05%, DES=6.0%

### **16.4 Setting Apnea Alarm Time**

This determines the time limit after which the monitor gives an alarm if the patient stops breathing.



- 1 Select the **CO<sub>2</sub> (AG) Setup > Apnea Alarm**;
- 2 Choose the apnea alarm time from the pull-down list.

## 16.5 Working Status of ISA analyzer

Working status of the ISA analyzer can be indicated by the indicator. For the detailed information, please refer to the following table.

Indication	Status
Steady green light	System OK
Blinking green light	Zeroing in progress
Steady blue light	Anesthetic agent present
Steady red light	Sensor error
Blinking red light	Check sampling line

## 16.6 Working Status of IRMA Module

The working status of the IRMA module can be transmitted by the IRMA probe. For the detailed information, please refer to the following table.

Indication	Status
Steady green light	System OK
Blinking green light	Zeroing in progress
Steady blue light	Anesthetic agent present
Steady red light	Sensor error
Blinking red light	Check adapter

## 16.7 O<sub>2</sub> Compensations

The following models need O<sub>2</sub> compensation: IRMA AX+, ISA AX+. For the compensation details, please refer to the following table.

O <sub>2</sub> Range	Set O <sub>2</sub> Range
0 to 30 vol%	Low
30 to 70 vol%	Med.
70 to 100 vol%	High

## 16.8 Effects of Humidity

The partial pressure and the volume percentage of CO<sub>2</sub>, N<sub>2</sub>O, O<sub>2</sub> and anesthetic agents depend on the amount of water vapor in the measured gas. The O<sub>2</sub> measurement will be calibrated to show 20.8 vol% at actual ambient temperature and humidity level, instead of showing actual partial pressure. 20.8 vol% O<sub>2</sub> corresponds to the actual O<sub>2</sub> concentration in room air with 0.7 vol% H<sub>2</sub>O concentration (at 1013 hPa this equals for example 25 °C and 23% RH). The measurement of CO<sub>2</sub>, N<sub>2</sub>O, and anesthetic agents (e.g. all gases measured by the IR-bench) will always show the actual partial pressure at the current humidity level.

In the alveoli of the patient, the breathing gas is saturated with water vapor at body temperature (BTPS).

When the breathing gas flows through the sampling line, the gas temperature will adapt to ambient before reaching the gas analyzer. As the NOMO section removes all condensed water, no water will reach the ISA gas analyzer. The relative humidity of the sampled gas will be about 95%.

If CO<sub>2</sub> values at BTPS are required, the following equation can be used:

$$EtCO_2(BTPS) = EtCO_2 * \left( 1 - \left( \frac{3.8}{P_{amb}} \right) \right)$$

where:

$EtCO_2$  = EtCO<sub>2</sub> value sent from ISA [vol %]

$P_{amb}$  = Ambient pressure sent from ISA [kPa]

3.8 = Typical partial pressure of water vapor condensed between patient circuit and ISA [kPa]

EtCO<sub>2</sub>(BTPS) = EtCO<sub>2</sub> gas concentration at BTPS [vol%]

O<sub>2</sub> is assumed to be room air calibrated at a humidity level of 0.7 vol% H<sub>2</sub>O.



## Chapter 17 Freeze

When monitoring a patient, the user may freeze the waveforms and examine them. Generally, the user can review a frozen waveform of a maximum of 120 seconds. The freeze function of this monitor has the following features:

- Freeze status can be activated on any operating screen.
- Once entering the Freeze status, the system exits all other operating menus. Besides, the system freezes all waveforms in the Waveform area of the Basic Screen, and also freezes Full Lead ECG waveforms and extra waveforms on the Full Lead ECG interface (if any). Nevertheless the Parameter area refreshes normally.
- The frozen waveforms can be reviewed and recorded.


### 17.1 Entering/Exiting Freeze Status

#### 17.1.1 Entering Freeze Status


In the Non-Freeze status, press the  button on the control panel of the monitor to exit the current menu. Press the  button again, freeze status is entered and the popup **Freeze** menu is displayed. In Freeze status, all waveforms are frozen and will no longer be refreshed.

#### 17.1.2 Exiting Freeze Status


In the Freeze status, executing any of the following operations will command the system to exit the Freeze status:

- Exit the **Freeze** menu;
- Press the  button on the control panel again;
- Execute any operation that may trigger the adjustment of the screen or the display of a new menu.

After exiting Freeze status, the system will clear screen waveforms and resume displaying real-time waveforms. In the Screen Refresh mode, the system will sweep the waveforms from left to right in the Waveform Area.

Press the  button on the control panel, and the **Freeze** menu will appear on the bottom part of the screen. At the same time, the system freezes the waveforms.

#### **NOTE:**

Pressing the  button repeatedly over a short period of time may result in discontinuous waveforms on the screen.

## 17.2 Reviewing Frozen Waveform

By moving the frozen waveform, you may review a waveform of 120 seconds before it is frozen. For a waveform of less than 120 seconds, the remaining part is displayed as a straight line. Select **Time** on the **Freeze** menu and use the up/down arrow keys to move the frozen waves so that you can review the other parts of the frozen waves not displayed on the current screen.

## Chapter 18 Review

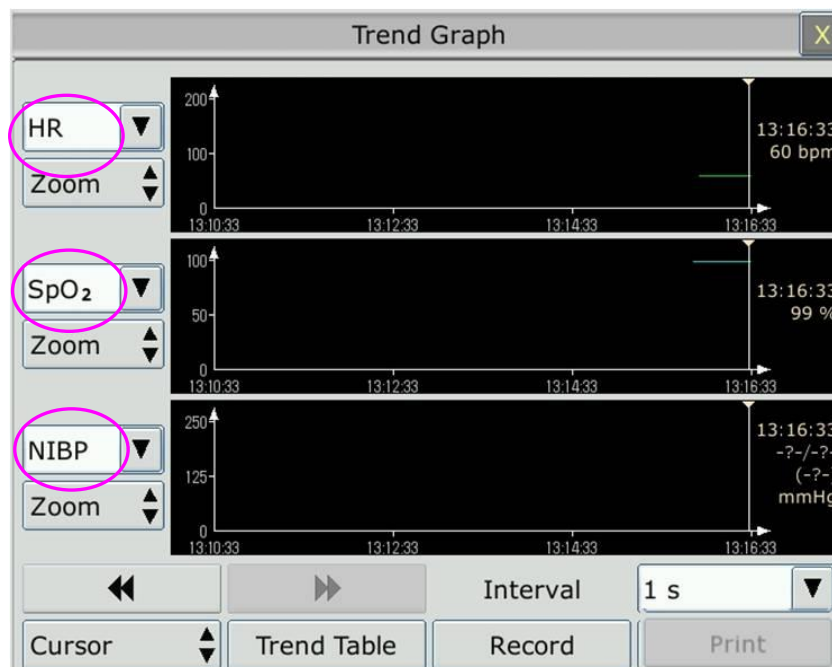
The monitor provides 120-hour trend data of all parameters, storage of 1200 NIBP measurement results, 200 arrhythmia events and 200 alarm events. This chapter gives detailed instruction for review of all data.

### 18.1 Trend Graph Review

- The latest 1-hour trend is displayed every 1 or 5 seconds.
- The latest 120-hour trend is displayed every 1, 5 or 10 minutes.

To review Trend Graph, please press the **Trend Graph** key on the screen or select **Menu > Review > Trend Graph**, then the trend graph interface is displayed.

In the trend graph, the y-axis stands for the measurement value and x-axis stands for the time.



#### 18.1.1 Selecting Trend Graph of Specific Parameter

The monitor can review trend graph of different parameters. To change the existing trend graph, please select **Menu > Review > Trend Graph** and select a required parameter name from the popup list.

#### 18.1.2 Adjusting Trend Scale

You can use **Zoom** on the trend graph review interface to adjust the trend scale. Once you adjust the trend scale on the trend graph review interface, you also change the trend scale of the related parameters for the screen trend displayed on the main screen.



### 18.1.3 Setting Interval

The monitor can support five kinds of resolutions. To set an appropriate resolution, please select **Menu > Review > Trend Graph** and an interface is displayed. Choose **Interval** on the interface to open the list and select an appropriate resolution among **1 s, 5 s, 1 min, 5 min** and **10 min**.

**NOTE:**

Please select 1 sec interval if completed NIBP data is expected to display on the screen.

### 18.1.4 Scrolling Left and Right the Screen

All trend graphs can't be displayed on the current screen due to the screen limitation. The user can scroll left and right the screen manually to see measurement trends that do not fit in the current view by selecting and pressing the symbol  and  displayed on the trend graph.

### 18.1.5 Switching to the Trend Table

The user can switch to the trend table interface on the **Trend Graph** interface. To do so, please select **Menu > Review > Trend Graph** and select the **Trend Table** option from the popup interface.





## 18.2 Trend Table Review

To review the trend table, please press the **Trend Table** key on the screen or select **Menu > Review > Trend Table**, then the trend table is displayed.

### 18.2.1 Setting Interval

The monitor can support eleven kinds of interval. To set an appropriate resolution, please select **Menu > Review > Trend Table** and an interface is displayed. Choose **Interval** on the interface to open the list and select an appropriate interval among **1 sec, 5 sec, 30 sec, 1 min, 3 min, 5 min, 10 min, 15 min, 30 min, 60 min** and **NIBP**.

### 18.2.2 Scrolling the Screen

All trend tables can't be displayed on the current screen due to the screen limitation. The user can scroll left, right, up and down the screen manually to see measurement trend tables that do not fit in the current view by selecting and pressing the symbol , ,  and  displayed on the trend graph.



### 18.2.3 Switching to Trend Graph

The user can switch to the trend graph on the **Trend Table** interface. To do so, please select **Menu > Review > Trend Table** and select the **Trend Graph** option from the popup interface.

## 18.3 NIBP Review

To review the NIBP measurement data, select the **NIBP Review** key on the screen or select **Menu > Review > NIBP Review**, then the **NIBP Review** window is displayed.

### 18.3.1 Scrolling the Screen

All measurement data can't be displayed on the current screen due to the screen limitation. The user can scroll up and down the screen manually to see measurement data that doesn't fit in the current view by selecting and pressing the symbol  and  displayed on the **NIBP Review** interface.



## 18.4 Alarm Review

To review the alarm event, select the **Alarm Review** key on the screen or select **Menu > Review > Alarm Review**, then the **Alarm Review** Window is displayed.

### NOTE:

The monitor can store a maximum of 200 alarm events. As soon as the alarm event storage is full, the earliest alarm event will be replaced by the latest one.

### 18.4.1 Scrolling the Screen

All alarm events can't be displayed on the current screen due to the screen limitation. The user can scroll up and down the screen manually to see alarm events that don't fit in the current view by selecting and pressing the symbol  and  displayed on the **Alarm Review** interface.

### 18.4.2 Selecting Alarm Event of Specific Parameter

The monitor can review alarm event of the specific parameters. To view the alarm event of the specific parameter, please select **Menu > Review > Alarm Review** and choose **Event Type** to select the required parameter name from the popup list.


### 18.4.3 Setting Time Index

The user can set end time of alarm review by selecting the **Time Index** option displayed on the alarm review interface.



If the user selects **Current Time** on the popup interface, the alarm events occurring before the current time are displayed on the alarm event review interface.

If the user selects **User Define**, he can define the review time by setting time box displayed on the interface. The alarm events occurring before the **User Define** option are displayed on the alarm event review interface.

## 18.5 Arr Review

Select **ARR Review** key  on the screen or **ECG Setup > Arr Analysis> Arr Review** or **Menu > Review > ARR Review** to open the Arr review interface. The interface displays the latest arrhythmia events.

### 18.5.1 Scrolling the Screen

All arrhythmia events can't be displayed on the current screen due to the screen limitation. The user can scroll up and down the screen manually to see the other arrhythmia events that do not fit in the current view by selecting and pressing the symbol  and  displayed on the **Arrhythmia Review** interface.

### 18.5.2 Arrhythmia Alarm Review

You may select an alarm event by the knob and access the alarm review interface to get more information. On the alarm review interface, you can:

- ◆ Right or left shift the waveform to review the complete 8-second waveform.
- ◆ Select **Record** and output the arrhythmia waveform by the recorder.
- ◆ Select another name from the pull-down list of **Rename** for the arrhythmia event to change its name.
- ◆ Select **Delete** to remove a specific arrhythmia event.
- ◆ Select **Alarm List** or exit the menu to get back to the arrhythmia review interface.

#### NOTE:

- 1 If there are more than 200 arrhythmia events, the monitor will only keep the recent ones.
- 2 The name of arrhythmia event will be shown on the alarm status area.



## Chapter 19 Calculation and Titration Table

The monitor provides calculation function and titration table. Calculations are patient data that are not directly measured but calculated by the monitor.

The monitor can perform drug calculation, hemodynamic calculation, oxygenation calculation, ventilation calculation and renal function calculation.

### NOTE:

The drug calculation function acts only as a calculator. The patient weights in Drug Calculation menu and in Patient Information menu are independent of each other. Therefore changing the Weight in Drug Calculation menu will not change the weight in the Patient Information menu.

## 19.1 Drug Calculation

### 19.1.1 Calculation Procedures

1. The drug calculation window is displayed by selecting **Menu > Common Function > Calculation > Drug Dose**.
2. Select the right pull-down box of the **Drug** option and select the required drug name among the 15 drugs which are listed as follows. And the drug name of **Drug A, Drug B, Drug C, Drug D** and **Drug E** can be defined by the user.
  - Drug A, Drug B, Drug C, Drug D and Drug E
  - AMINOPHYLLINE
  - DOBUTAMINE
  - DOPAMINE
  - EPINEPHRINE
  - HEPARIN
  - ISUPREL
  - LIDOCAINE
  - NIPRIDE
  - NITROGLYCERIN
  - PITOCIN
3. The system generates values that can't be treated the calculation results. The user must enter the correct parameter value based on the doctor's instruction.
4. Manually enter the value of patient weight or directly obtain the value from the monitor by selecting **Get Info**.
5. Enter the correct parameter value.
6. Confirm whether the calculation result is correct.

The following formulas are applied to dose calculation:

Concentrate = Amount / Volume

INF Rate = DOSE / Concentrate

Duration = Amount / Dose

Dose = Rate × Concentrate

DRIP Rate = INF Rate / 60 × DROP Size

### 19.1.2 Calculation Unit

Each drug has the fixed unit or unit series to calculate. Among the same unit series, the unit binary varies with the entered parameter value.

The calculation units of the drugs are listed as follows:

Drug	Unit
DRUG A, DRUG B, DRUG C, AMINOPHYLLINE, DOBUTAMINE, DOPAMINE, EPINEPHRINE, ISUPREL, LIDOCAINE, NIPRIDE, NITROGLYCERIN	g, mg, mcg
DRUG D, PITOCIN, HEPARIN	Ku, mu, Unit
DRUG E	mEq

When defining a drug, select Drug A, Drug B, Drug C, Drug D, and Drug E based on the unit series.

#### NOTE:

- 1 The drug calculation is displayed as invalid value before the user edits the drug name and patient weight, and the user can't enter any value.
- 2 Drip Rate and Drop Size are invalid.



### 19.1.3 Titration Table

After completing the drug calculation, the user can open the **Titration** on the **Drug Dose** interface.

The user can change the following items in the titration table:

- Basic
- Step
- Dose Type

The data in the trend table will vary with the changes above. And the user can perform the following:

- Scroll up and down the screen by selecting and pressing the symbol  and  displayed on the trend graph.
- Record the data displayed in the current window by selecting **Record**.

## 19.2 Hemodynamic Calculation

### 19.2.1 Calculation Procedure

1. The hemodynamic calculation interface is displayed by selecting **Menu > Common Function > Calculation > Hemodynamics**.
2. Manually enter the values required on this interface. You can also directly obtain the values of HR, PA MAP and CVP if they are available from the monitor by selecting **Get Info**.
3. Select **Calculate** to output parameter value.

### 19.2.2 Input Parameters

Items	English Full Name/Description
CVP	Central venous pressure
HR	Heart rate
LV_D	Left Ventricular Diameter
AP MAP	Mean Artery Pressure
PA MAP	Pulmonary artery mean pressure
Height	/
Weight	/

### 19.2.3 Output Parameters

Items	English Full Name/Description
CI	Cardiac index
BSA	Body surface area
SV	Stroke volume
SVI	Stroke volume index
SVR	Systemic vascular resistance
SVRI	Systemic vascular resistance index
PVR	Pulmonary vascular resistance
PVRI	Pulmonary vascular resistance index
LCW	Left cardiac work
LCWI	Left cardiac work index
RCW	Right cardiac work
RCWI	Right cardiac work index
LVSW	Left ventricular stroke work

Items	English Full Name/Description
LVSWI	Left ventricular stroke work index
RVSW	Right ventricular stroke work
RVSWI	Right ventricular stroke work index
EF	Ejection fraction

## 19.3 Oxygenation Calculation

### 19.3.1 Calculation Procedure

1. Select **Menu > Common Function > Calculation > Oxygenation**.
2. Manually enter the values required on this interface. You can also directly obtain the values of patient height, patient weight and FiO<sub>2</sub> if they are available from the monitor by selecting **Get Info**.
3. Select **Calculate** to output parameter value.

### 19.3.2 Input Parameters

Items	English Full Name/Description
FiO <sub>2</sub>	Percentage fraction of inspired oxygen
PaO <sub>2</sub>	Partial pressure of oxygen in the arteries
PaCO <sub>2</sub>	Partial pressure of carbon dioxide in the arteries
SaO <sub>2</sub>	Arterial oxygen saturation
PvO <sub>2</sub>	Partial pressure of oxygen in venous blood
SvO <sub>2</sub>	Venous oxygen saturation
Hb	Hemoglobin
CaO <sub>2</sub>	Arterial oxygen content
CvO <sub>2</sub>	Venous oxygen content
VO <sub>2</sub>	Oxygen consumption
RQ	Respiratory quotient
ATMP	Atmospheric pressure
Height	/
Weight	/

### 19.3.3 Output Parameters

Items	English Full Name/Description
BSA	Body surface area
VO <sub>2</sub> calc	Calculated oxygen consumption
C (a-v) O <sub>2</sub>	Arterial venous oxygen content difference
O <sub>2</sub> ER	Oxygen extraction ratio
DO <sub>2</sub>	Oxygen transport
PAO <sub>2</sub>	Partial pressure of oxygen in the alveoli
AaDO <sub>2</sub>	Alveolar-arterial oxygen difference
CcO <sub>2</sub>	Capillary oxygen content
Qs/Qt	Venous admixture
PaO <sub>2</sub> /FiO <sub>2</sub>	PaO <sub>2</sub> /FiO <sub>2</sub>
PaO <sub>2</sub> /PAO <sub>2</sub>	PaO <sub>2</sub> /PAO <sub>2</sub>
AaDO <sub>2</sub> /PaO <sub>2</sub>	AaDO <sub>2</sub> /PaO <sub>2</sub>
DO <sub>2</sub> I	Oxygen delivery index
VO <sub>2</sub> I	Oxygen consumption index
CaO <sub>2</sub> calc	Calculated arterial oxygen content
CvO <sub>2</sub> calc	Calculated venous oxygen content

## 19.4 Ventilation Calculation

### 19.4.1 Calculation Procedure

1. Select **Menu > Common Function > Calculation > Ventilation**.
2. Manually enter the values required on this interface. You can also directly obtain the values of FiO<sub>2</sub>, RR, PIP and PEEP if they are available from the monitor by selecting **Get Info**.
3. Select **Calculate** to output parameter value.

### 19.4.2 Input Parameters

Items	English Full Name/Description
FiO <sub>2</sub>	Percentage fraction of inspired oxygen
RR	Respiration rate
PeCO <sub>2</sub>	Partial pressure of mixed expiratory CO <sub>2</sub>
PaCO <sub>2</sub>	Partial pressure of carbon dioxide in the arteries
PaO <sub>2</sub>	Partial pressure of oxygen in the arteries

Items	English Full Name/Description
VT	Tidal volume
RQ	Respiratory quotient
ATMP	Atmospheric pressure
PIP	Peak inspiratory pressure
PEEP	Positive end-expiratory pressure

### 19.4.3 Output Parameters

Items	English Full Name/Description
PAO <sub>2</sub>	Partial pressure of oxygen in the alveoli
AaDO <sub>2</sub>	Alveolar-arterial oxygen difference
PaO <sub>2</sub> /FiO <sub>2</sub>	PaO <sub>2</sub> /FiO <sub>2</sub>
PaO <sub>2</sub> /PAO <sub>2</sub>	PaO <sub>2</sub> /PAO <sub>2</sub>
AaDO <sub>2</sub> /PaO <sub>2</sub>	AaDO <sub>2</sub> /PaO <sub>2</sub>
MV	Minute volume
VD	Volume of physiological dead space
VD/VT	Physiological dead space in percent of tidal volume
VA	Alveolar volume
Cdyn	Compliance dynamic

## 19.5 Renal Function Calculation

### 19.5.1 Calculation Procedure

1. Select **Menu > Common Function > Calculation > Renal Function**.
2. Manually enter the values required on this interface.
3. Select **Calculate** to output parameter value.

### 19.5.2 Input Parameters

Items	English Full Name/Description
URK	Urine potassium
URNa	Urinary sodium
Urine	Urine
Posm	Plasm osmolality
Uosm	Urine osmolality
SerNa	Serum sodium

<b>Items</b>	<b>English Full Name/Description</b>
SCr	Serum creatinine
UCr	Urine creatinine
BUN	Blood urea nitrogen
UUN	Urine urea nitrogen

### 19.5.3 Output Parameters

<b>Items</b>	<b>English Full Name/Description</b>
URNaEx	Urine sodium excretion
URKEx	Urine potassium excretion
Na/K	Sodium potassium ratio
CNa	Clearance of sodium
CCr	Creatinine clearance rate
CUUN	Urine urea nitrogen clearance rate
FENa	Fractional excretion of sodium
FEUr	Fractional Excretion of Urea
Cosm	Osmolar clearance
CH <sub>2</sub> O	Free water clearance
U/P osm	Urine to plasma osmolality ratio
BUN/SCr	Blood urea nitrogen creatinine ratio
U/SCr	Urine-serum creatinine ratio

## Chapter 20 Recording

A thermal dot matrix recorder is used for the monitor and can support many recording types and output patient information, measurement data, review data waveform and so forth.



1	Recording indicator
2	Paper feeding key: press this key to start or stop feeding recording paper without outputting anything on the paper
3	Paper outlet
4	Recorder door

### 20.1 Performance of the Recorder

- Waveform record is printed at the rate of 12.5mm/s, 25 mm/s or 50 mm/s.
- 48mm wide printout paper.
- It can record up to three waveforms.
- User-selectable real-time recording time and waveform.
- Auto recording interval is set by the user, and the waveform is in accordance with the real time recording.

#### NOTE:

It is suggested that the user should not use the recorder when the low battery displays, or the monitor may be turned off automatically.

### 20.2 Starting and Stopping Recording

The monitor provides several types of stripe recording. You can start recording following the procedure below:



<b>Recording Type</b>	<b>Description/ Procedure</b>
Continual real-time recording	Select at least one Rec waveform in <b>Recorder Setup</b> (A maximum of three waveforms can be selected), select <b>Continual</b> in R-T Rec Time. Press the Record button on the front panel to start the recording. Press the button again to stop recording.
8-second real-time recording	Select at least one Rec waveform in Recorder Setup (A maximum of three waveforms can be selected), select 8 s in R-T Rec Time, set <b>Record Interval</b> as needed, press the <b>Record</b> button on the front panel to start the recording. Press the button again to stop recording or when R-T Rec time ends, the monitor stops recording automatically. The runtime for each wave is 8 seconds. The record Interval can be set as: <b>Off, 10 min, 20 min, 30 min, 40 min, 50 min, 1 h, 2 h, 3 h, 4 h.</b>
Trend graph recording	Select <b>Menu &gt; Review &gt; Trend Graph</b> , click <b>Record</b> to start recording.
Trend table recording	Select <b>Menu &gt; Review &gt; Trend Table</b> , click <b>Record</b> to start recording.
NIBP review recording	Select <b>Menu &gt; Review &gt; NIBP Review</b> , click <b>Record</b> to start recording.
Arrhythmia review recording	Select <b>Menu &gt; Review &gt; ARR Review</b> , select one arrhythmia alarm and click <b>Record</b> to start recording.
Alarm review recording	Select <b>Menu &gt; Review &gt; Alarm Review</b> , select one alarm and click <b>Record</b> to start recording.
Drug calculation titration recording	Select <b>Menu &gt; Common Function &gt; Drug Dose &gt; Titration</b> , click <b>Record</b> to start recording.
Hemodynamic Calculation result recording	Select <b>Menu &gt; Common Function &gt; Hemodynamics</b> , click <b>Record</b> to start recording.
Frozen waveform recording	In the <b>Freeze</b> window, click <b>Record</b> to start recording.

To manually stop recording, click **Record** again in the related windows.

The recorder will stop recording in the following situations:

- The recording task is finished.
- No paper in the recorder.
- Malfunction stops the recorder from running properly.

**NOTE:**

You can also use the button  on the front panel to manually start or stop recording.

## 20.3 Recorder Operations and Status Messages

### 20.3.1 Record Paper Requirement

Only standard thermosensitive record paper can be used: otherwise the recorder may not function, the recording quality may be poor, and the thermosensitive printhead may be damaged.

### 20.3.2 Proper Operation

- When the recorder is working, the record paper goes out steadily. Do not pull the paper outward with force: otherwise the recorder may be damaged.
- Do not operate the recorder without record paper.

### 20.3.3 Paper Out

When the **Recorder Out OF Paper** alarm is displayed, the recorder cannot start. Please insert record paper properly.

### 20.3.4 Replacing Paper

1. Pull outwards the upper arc part of the recorder casing to release the casing, shown in the following figure.



2. Insert a new roll of paper into the paper cassette, printing side facing upwards.



3. Ensure proper position and tidy margin.



4. Pull about 2cm of the paper out, and close the recorder casing.

**NOTE:**

Be careful when inserting papers. Avoid damaging the thermo-sensitive print head. Unless when inserting papers or shooting troubles, do not leave the recorder catch open.

### 20.3.5 Removing Paper Jam

When the recorder functions or sounds improperly, you should open the recorder casing to check for a paper jam. Remove the paper jam in the following way:

- Cut the record paper from the feeding edge.
- Open the recorder casing.
- Re-insert the paper.

**NOTE:**

1. If the monitor is not installed with a recorder, it will indicate **RECORDER SETUP NEEDED** after pressing the **Record** button.
2. Do not touch the thermo-sensitive print head when performing continuous recording.

## Chapter 21 Other Functions

### 21.1 Nurse Call

The monitor provides dedicated nurse call port which is connected to nurse call system through the nurse call cable to perform the nurse call function. You should activate the function following the steps below:

1. Select **Menu > Maintenance > User Maintain**, and input the password **ABC**;
2. Select **Other Setups > Aux Output**;
3. Choose **On** in the **Nurse Call** list.

#### **NOTE:**

Before using nurse call function, please check whether it is normal.

### 21.2 Analog Output and Defibrillator Synchronization

The monitor provides analog output signals to accessory equipment. Also, if a defibrillator is connected to the monitor, a defibrillator synchronization pulse can be output. You should activate the function following the steps below:

1. Select **Menu > Maintenance > User Maintain**, and input the password **ABC**;
2. Select **Other Setups > Aux Output**;
3. Choose **Analog Output** or **Defibrillation** in the **Aux Output** list.

### 21.3 Wi-Fi

Wi-Fi modules are optional to be configured in the monitors. And you should configure the settings on the monitor following the steps below before connecting the monitor to a wireless network:

1. Select **Menu > Maintenance > User Maintain**, and input the password **ABC**.
2. In the **User Maintain** menu, select **Network Maintain**.
3. In the **Network Maintain** menu, select **Wi-Fi** from the **Network Type** list. And click **Config** to open the **Wi-Fi Setup** window. The available networks will be listed in this window.
4. Choose a network from the window. You will be prompted to enter the password of that network if a password is required.

If the monitor is successfully connected to the selected network, it will be indicated by the message **Connected**, and the local IP address of the monitor will be displayed in the **Wi-Fi Setup** window. Also, a symbol indicating the networking state will be displayed on the lower portion of the main screen. The meanings of the networking state symbols are explained below:



Wi-Fi signal intensity: Level 4



Wi-Fi signal intensity: Level 3



Wi-Fi signal intensity: Level 2



Wi-Fi signal intensity: Level 1

**NOTE:**

- 1 Be aware that some network-based functions may be limited for monitors on wireless networks in comparison with those on wired networks.
- 2 The obstacle may interfere with data transmission and even cause data loss.
- 3 If the monitor fails to connect to any wireless network or no available wireless network is in the **Wi-Fi Setup** window, switch the **Network Type** from **Wi-Fi** to **Wired** and then to **Wi-Fi** again. Then retry to connect to a wireless network. If the wireless network still fails to be connected, please try to restart the monitor and connect again.
- 4 Use the wireless device recommended by EDAN, otherwise some exceptional situations such as frequent network disconnection may occur on the monitor.
- 5 The wireless driver is compatible with channels 1-11 only.

## 21.4 Storing Data in the Storage Device

### 21.4.1 Data Stored in the Storage Device

A single piece of patient data maximally contains the following information:

Patient information	MRN, name, date of birth, date of admission, gender, type, height, weight, blood type, pace, doctor, bed No., department
Trend graph and trend table	240 hours, resolution: 1 min
NIBP measurement review	1200 sets
Alarm review	200 sets
Arrhythmia event	200 sets
Full disclosure waveforms	48 hours

When the single patient data reach the maximum, you can choose to **Keep Storing** or **Stop Storing** by selecting **Menu > Common Function > Data Store > if one patient data full**.

If you choose **Keep Storing**, as soon as the single patient data is full, the earliest data will be replaced by the latest one.

If you choose **Stop Storing**, the monitor will stop data storing and the latest data cannot be stored when the single patient data reach the maximum. For instance, if all the patient data (such as the trend graph, trend table, NIBP measurements, arrhythmia event and alarm event) except waveforms reach the maximum, the monitor will stop storing, while only the waveforms keep storing until they are full.

**NOTE:**

- 1 The storage time varies according to the patient's parameter data volume. When the single patient data store reaches 240 hours, the monitor will automatically create a new folder for continuous data store.
- 2 When the storage space is insufficient, the monitor will stop storing data no matter the user selects **Keep Storing** or **Stop Storing**.

The following storage capacity for 1G extended space is for reference:

Continuous parameter data	90 hours, resolution: 1 s
NIBP data	At least 68000 sets
Physiological alarm event	At least 4500 sets
Arrhythmia event	At least 4500 sets
Full disclosure waveforms	90 hours, resolution: 1 s

### 21.4.2 Activating/ Deactivating Data Storing

To activate/ deactivate the data storing function, select **Menu > Maintenance > User Maintain > Other Setups**, and set **Data Store** to **On** or **Off**.



The monitor will stop storing data in the storage device under the following circumstances:

- No storage devices are selected.
- There is no enough space in the storage device for storing data.
- The removable device is read-only.
- The data storing function is deactivated.
- The monitor is switched off.
- The power supply is off.

### 21.4.3 Selecting a Storage Device

To configure the storage device, select **Menu > Common Function > Data Store > Storage Medium**, and choose the storage medium from the pop-up list as desired. **Internal Storage Device** and **Removable Device** can be selected.

When you choose **Internal Storage Device** as the storage medium, if configured, the storage device name will automatically become **Internal Storage Device**. You may plug several removable devices into the monitor at the same time, but only one is operative. You can select a removable device as a working one among the plugging devices by selecting **Menu > Common Function > Data Store > Storage Device** and choosing the device name from the list. By default, the first plugged removable device is the working one.

After you configure the appropriate storage device, click exit. If the storage device is successfully starting data storing, the monitor will be indicated by the symbol . If there is no enough space in storage device, or the storage device is read-only/damaged, the symbol  will be displayed.

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**CAUTION**

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- 1 Not all the removable devices are compatible with the monitor, Use the removable devices recommended by EDAN.
  - 2 DO not set the read-only switch on the removable device to on when the removable device is inserted in the monitor.
  - 3 It is recommended to format the USB flash drive to the FAT file type via PC prior to use.
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#### 21.4.4 Reviewing Data Stored in the Storage Device

To review data stored in the storage device, select **Menu > Review > History Patient**. You can choose to review the storage device as desired from the pop-up list. Choose a patient from the list to review the data including patient information, trend graph, trend table, NIBP measurements, arrhythmia event, alarm event and waveform.

#### 21.4.5 Deleting Data Stored in the Storage Device

To delete data of one patient, choose the patient from the list after selecting **Menu > Review > History Patient**, and then click **Delete data** on the **Review** menu. Further confirmation of deletion is required.

To delete data of all patients, select **Menu > Review > History Patient** and click **Delete all data** on the **History Patient Review** menu. Further confirmation is required.

#### 21.4.6 Exporting Data Stored in the Internal Storage Device

To export data of one patient from the internal storage device to the removable device, choose the patient from the list after selecting **Menu > Review > History Patient**, and then click **Export Current Data** on the **Review** menu.

To export data of all patients, select **Menu > Review > History Patient** and click **Export all data** on the **History Patient Review** menu.

#### 21.4.7 Formatting the Internal Storage Device

To format the internal storage device, select **Menu > Maintenance > User Maintain > Other Setups > Format internal storage device**. Further confirmation is required.

**NOTE:**

- 1 As soon as the internal storage device is formatted, all the data will be cleared.
- 2 You have no need to restart the monitor after formatting is successful. The internal storage device can be identified and loaded automatically.
- 3 If formatting is failed, try again. Restart the monitor and retry the formatting, or contact the service personnel of the manufacturer if formatting is failed repeatedly.

### 21.4.8 Ejecting a Removable Device

Before unplugging a removable device from the monitor, you need to select **Menu > Removable device** and click **Eject** to uninstall the removable device. In this menu, you can also check the remaining capacity of the storage device.

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#### **CAUTION**

Do not remove the removable device without ejecting it during data storing, or the removable device might be damaged.

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## Chapter 22 Using Battery

This monitor can run on battery power, which ensures its uninterrupted operation even when AC power supply is interrupted. The battery recharges whenever the monitor is connected to the AC power source. During monitoring, if the AC power is interrupted, the monitor will take power from the internal battery. If the monitor is powered by battery, the monitor will switch off automatically before the battery is completely depleted.

### 22.1 Battery Safety Information

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#### **WARNING**

- 1 Before using the rechargeable lithium-ion battery (hereinafter called battery), be sure to read the user manual and safety precautions thoroughly.
  - 2 The service life of the battery depends on the service frequency and time. The service life of the battery is about three years if the battery is well maintained and stored. The service life of the battery may shorten if it is used inappropriately.
  - 3 Periodic checks on the battery performance are required. Change the battery if necessary.
  - 4 Do not connect the positive (+) and negative (-) terminals with metal objects, and do not put the battery together with metal objects, which can result in short circuits.
  - 5 Do not unplug the battery when the monitor is working.
  - 6 Do not heat or throw the battery into a fire.
  - 7 Do not use, leave the battery close to fire or other places where temperature may be above 60°C.
  - 8 Do not immerse, throw, or wet the battery in water/seawater.
  - 9 Do not destroy the battery: do not pierce the battery with a sharp object such as a needle; do not hit with a hammer, step on or throw or drop to cause strong shock; do not disassemble or modify the battery.
  - 10 The recommended battery can only be used for this monitor.
  - 11 Do not solder the leading wire and the battery terminal directly.
  - 12 If liquid leaking from the battery gets into your eyes, do not rub your eyes. Wash them well with clean water and go to see a doctor immediately. If liquid leaks of the battery splash onto your skin or clothes, wash well with fresh water immediately.
  - 13 Keep away from fire immediately when leakage or foul odor is detected.
  - 14 Stop using the battery if abnormal heat, odor, discoloration, deformation or abnormal condition is detected during use, charge, or storage. Keep it away from the monitor.
  - 15 Do not use a battery with serious scratch or deformation.
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**WARNING**

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- 16 Use the battery with similar performance, which can extend the service life of the battery.
  - 17 When the monitor is running on battery power, do not replace the battery during monitoring patients; or the monitor will be powered off, which may result in patient injury.
  - 18 Do not place battery in the monitor with the (+) and (-) in the wrong way.
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## 22.2 Battery Power Indicator

The indicator labeled Battery on the front panel of the monitor illuminates in green when the monitor is battery powered and illuminates in yellow when battery is being charged. The indicator is not illuminated when the monitor is not powered or when AC power is applied.

## 22.3 Battery Status on the Main Screen

Battery status symbols show the status of each battery detected and the combined battery power remaining.

-  Remaining battery power: 100%.
-  Remaining battery power: 75%
-  Remaining battery power: 50%
-  Remaining battery power: 25%
-  Batteries are almost depleted and need to recharge immediately.
-  No battery is installed.

## 22.4 Checking Battery Performance

The performance of rechargeable batteries may deteriorate over time. Battery maintenance as recommended here can help to slow down this process.

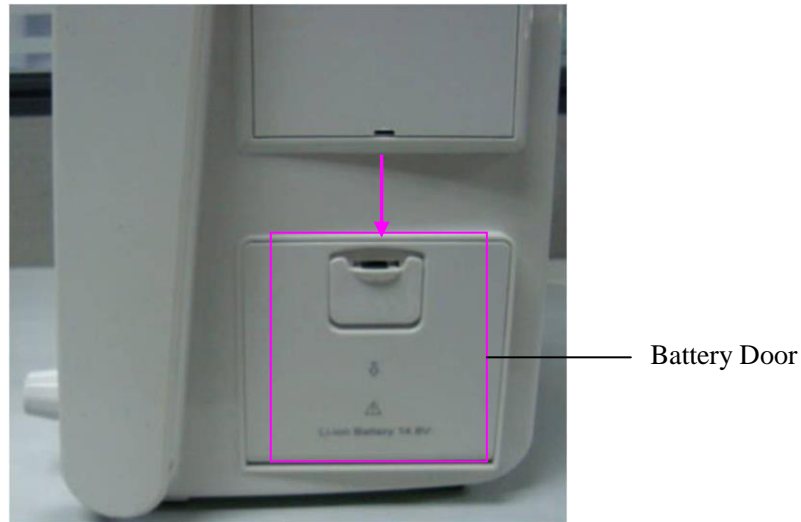
1. Disconnect the patient from the monitor and stop all monitoring and measurement.
2. Switch the monitor power on and charge the battery for more than 6 hours continuously.
3. Disconnect monitor from mains power and let the monitor run until there is no battery power left and the monitor shuts off.

4. The running time of the battery reflects the battery performance.

If the running time is obviously less than the specified time in the specification, please change the battery or contact the service personnel.

## 22.5 Replacing the Battery

To install or replace the battery, please follow the procedure:



1. Pull the battery door according to indication on it to open it.
2. Pull the plastic retainer until the battery can be removed.
3. Insert the new battery into the battery compartment.
4. Pull the metal retainer downward to fix the battery and close the battery door.

## 22.6 Recycling the Battery

When the battery no longer holds a charge, it should be replaced. Remove the old battery from the monitor and recycle it properly.

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### **WARNING**

Do not disassemble batteries, put them into fire or cause them to short circuit. They may ignite, explode or leak, causing injury to users and patients.

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## 22.7 Maintaining the Battery

Batteries should be conditioned regularly to maintain their useful life.

Remove the batteries from the monitor if they are not used for a longer period of time. And recharge the batteries at a minimum of every 6 months when they are stored.

Discharge the battery completely once every month.

## Chapter 23 Care and Cleaning

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

EDAN Instruments has validated the cleaning and disinfection instructions included in this User Manual. It is the responsibility of the healthcare professional to ensure that the instructions are followed so as to ensure adequate cleaning and disinfection.

### 23.1 General Points

Keep your monitor, cables and accessories free of dust and dirt. To prevent the device from damage, please follow the procedure:

- Use only recommended cleaning substances and disinfectants listed in this manual. Others may cause damage (not covered by warranty), reduce product lifetime or cause safety hazards.
- Always dilute according to the manufacturer's instructions.
- Unless otherwise specified, do not immerse any part of the equipment or any accessories in liquid.
- Do not pour liquid onto the system.
- Do not allow liquid to enter the case.
- Never use abrasive material (such as steel wool or silver polish).
- Inspect the monitor and reusable accessories after they are cleaned and disinfected.

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**CAUTION**

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If you spill liquid on the equipment, battery, or accessories, or they are accidentally immersed in liquid, contact your service personnel or EDAN service engineer.

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### 23.2 Cleaning

If the device or accessory has been in contact with the patient, then cleaning and disinfection is required after every use. If there has been no patient contact and there is no visible contamination then daily cleaning and disinfection is appropriate.

The validated cleaning agents for cleaning the monitor and reusable accessories are:

- Mild near neutral detergent
- Ethanol (75%)
- Isopropanol (70%)

Cleaning agents should be applied and removed using a clean, soft, non-abrasive cloth or paper towel.

## 23.2.1 Cleaning the Monitor

### **WARNING**

Before cleaning the monitor, make sure that the monitor is switched off and disconnected from the power line.

To surface-clean the monitor, follow these steps:

1. Switch off the monitor and disconnect it from the power line.
2. Wipe the entire exterior surface, including the screen, of the equipment using a soft cloth dampened with the cleaning solution thoroughly until no visible contaminants remain..
3. After cleaning, wipe off the cleaning solution with a fresh cloth or towel dampened with tap water until no visible cleaning agent remains.
4. Dry the monitor in a ventilated and cool place.

## 23.2.2 Cleaning the Reusable Accessories

### 23.2.2.1 Cleaning the ECG Cable Assembly

1. Wipe the cable assembly with a soft cloth dampened with the cleaning solution until no visible contaminants remain.
2. After cleaning, wipe off the cleaning solution with a fresh cloth or towel dampened with tap water until no visible cleaning agent remains.
3. Wipe off residual moisture with a dry cloth.
4. Leave the cable assembly to air dry.

### 23.2.2.2 Cleaning the Blood Pressure Cuff

#### **Cleaning the Cuff:**

1. Take out the air bladder before cleaning.
2. Hand wash the cuff with the cleaning solution; clean the air bladder with a soft cloth dampened with the cleaning solution. until no visible contaminants remain
3. Rinse the cuff and after cleaning, wipe off the cleaning solution with a fresh cloth or towel dampened with tap water until no visible cleaning agent remains.
4. Wipe off with a dry cloth to remove residual moisture
5. Air dry the cuff thoroughly after cleaning.

#### **Replacing the Air Bladder:**

After cleaning, replace the air bladder into the cuff following the steps below:

1. Roll the bladder lengthwise and insert it into the cuff from the large opening at one end of the cuff.

2. Thread the hose from within the cuff and out through the small hole at the top of the cuff.
3. Adjust the bladder until it is in position.

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

1. Wipe the surfaces of the sensor and cable using a soft cloth dampened with the cleaning solution until no visible contaminants remain.
2. Wipe the patient contact area of the sensor with the cotton swab dampened with the cleaning solution. until no visible contaminants remain
3. Wipe off the cleaning solution with a fresh cloth or towel, dampened with tap water after cleaning until no visible cleaning agent remains.
4. Wipe off residual moisture with a dry cloth.
5. Leave the sensor to air dry.

### 23.2.2.4 Cleaning the IBP Cables

1. Wipe the cables with a soft cloth dampened with the cleaning solution until no visible contaminants remain.
2. Wipe off the cleaning solution with a fresh cloth or towel, dampened with tap water after cleaning until no visible cleaning agent remains.
3. Wipe off residual moisture with a dry cloth.
4. Leave the cables to air dry.

### 23.2.2.5 Cleaning the TEMP Sensor Probe

1. Wipe the patient contact area with a soft cloth dampened with the cleaning solution until no visible contaminants remain.
2. Wipe off the cleaning solution with a fresh cloth or towel, dampened with tap water after cleaning until no visible cleaning agent remains.
3. Wipe off residual moisture with a dry cloth.
4. Leave the sensor/probe to air dry.

## 23.3 Disinfection

For devices or accessories that have been in contact mucosal surface, High Level disinfection must occur, for all other accessories, low level disinfection is appropriate. Clean the monitor and reusable accessories before they are disinfected. The validated disinfectants for cleaning the monitor and reusable accessories are:

- Ethanol (75%)
- Isopropanol (70%)
- Cidex OPA (High level disinfection of intracavitary temperature probe only)

If Ethanol or Isopropanol is used for both cleaning and disinfecting, then a new cloth is required to be used for the disinfection step.

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**WARNING**

The monitor and reusable accessories shall be disinfected to avoid patient cross infection.

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### 23.3.1 Disinfecting the Monitor

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**WARNING**

Before disinfecting the monitor, make sure that the monitor is switched off and disconnected from the power line.

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To disinfect the monitor, follow these steps:

1. Switch off the monitor and disconnect it from the power line.
2. Wipe the display screen using a soft, clean cloth dampened with the disinfectant solution.
3. Wipe the exterior surface of the equipment using a soft cloth dampened with the disinfectant solution.
4. Wipe off the disinfectant solution with a dry cloth after disinfection if necessary.
5. Dry the monitor for at least 30 minutes in a ventilated and cool place.

### 23.3.2 Disinfecting the Reusable Accessories

#### 23.3.2.1 Disinfecting the ECG Cable Assembly

1. Wipe the cable assembly with a soft cloth dampened with the disinfectant solution.
2. Wipe off the disinfectant solution with a dry cloth after disinfection.
3. Leave the cable assembly to air dry for at least 30 minutes.

#### 23.3.2.2 Disinfecting the Blood Pressure Cuff

**Disinfecting the Cuff:**

1. Take out the air bladder before disinfection.
2. Wipe the cuff and the air bladder with a soft cloth dampened with the disinfectant solution.
3. Leave the cuff and air bladder to air dry for at least 30 minutes.

**Replacing the Air Bladder:**

After disinfection, replace the air bladder into the cuff. Refer to Section 23.2.2.2 for more information.

**NOTE:**

Prolonged use of disinfectant may cause discoloration of the cuff.

### 23.3.2.3 Disinfecting the SpO<sub>2</sub> Sensor

1. Wipe the surfaces of the sensor and cable using a soft cloth dampened with the disinfection solution.
2. Wipe the patient contact area of the sensor with the cotton swab dampened with the disinfection solution.
3. Wipe off the disinfection solution with a dry cloth after disinfection.
4. Leave the sensor to air dry for at least 30 minutes.

### 23.3.2.4 Disinfecting the IBP Cables

1. Wipe the cables with a soft cloth dampened with the disinfectant solution.
2. Wipe off the disinfectant solution with a dry cloth after disinfection.
3. Leave the cables to air dry for at least 30 minutes.

### 23.3.2.5 Disinfecting the TEMP sensor

The intracavitary TEMP sensors should be reprocessed by high-level disinfection before and after use on each new patient. Cidex OPA is the validated agent for high level disinfection. Refer to the instructions of the disinfectant for the methods of disinfection. High level disinfection has been validated with a 12 minute soak. Rinse and dry according to the labeled instructions of Cidex OPA. Do not dampen the sensor connector.

For the skin TEMP sensors, disinfect them as follows using ethanol or isopropanol only:

1. Wipe the patient contact area with a soft cloth dampened with the disinfectant solution (ethanol or isopropanol).
2. Wipe off the disinfectant solution with a dry cloth after disinfection.
3. Leave the sensor to air dry.

## 23.4 Cleaning and Disinfecting Other Accessories

For cleaning and disinfecting other accessories, refer to the instructions delivered with the accessories. If the accessories are not accompanied by instructions, refer to this manual for the methods of cleaning and disinfecting the monitor.



## Chapter 24 Maintenance

### **WARNING**

- 1 Failure on the part of the responsible individual hospital or institution employing the use of this equipment to implement a satisfactory maintenance schedule may cause undue equipment failure and possible health hazards.
- 2 If you discover a problem with any of the equipment, contact your service personnel, or your authorized supplier.

### 24.1 Inspecting

The overall check of the monitor, including the safety check, should be performed only by qualified personnel every 24 months, and each time after fix up.

The following items should be checked:

- If the environment condition and power supply meet requirement.
- If the power supply cord has damage and insulativity meets requirement.
- If the device and accessories have damage.
- Specified accessories.
- If the alarm system can work properly.
- If the recorder can work properly and the paper meets the requirement.
- Battery performance
- If all monitoring functions are in good conditions.
- If the grounding resistance and leakage current meet requirement.

If any damage or abnormality is found, please don't use the monitor and contact local Customer Service Center.

### 24.2 Maintenance Task and Test Schedule

Maintenance shall be carried out at least once every two years, or as specified by local regulations. The following tasks are for EDAN-qualified service professionals only. Contact an EDAN-qualified service provider if your monitor needs a safety or performance test. Clean and disinfect equipment to decontaminate it before testing or maintaining it.

Maintenance and Test Schedule	Frequency
Safety checks. Selected tests on the basis of IEC60601-1	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.
Check all monitoring functions and measuring functions	At least once every two years, or as needed.

## Chapter 25 Warranty and Service

### 25.1 Warranty

EDAN warrants that EDAN's products meet the labeled specifications of the products and will be free from defects in materials and workmanship that occur within warranty period.

The warranty is void in cases of:

- a) damage caused by mishandling during shipping.
- b) subsequent damage caused by improper use or maintenance.
- c) damage caused by alteration or repair by anyone not authorized by EDAN.
- d) damage caused by accidents.
- e) replacement or removal of serial number label and manufacture label.

If a product covered by this warranty is determined to be defective because of defective materials, components, or workmanship, and the warranty claim is made within the warranty period, EDAN will, at its discretion, repair or replace the defective part(s) free of charge. EDAN will not provide a substitute product for use when the defective product is being repaired.

### 25.2 Contact information

If you have any question about maintenance, technical specifications or malfunctions of devices, contact your local distributor.

Alternatively, you can send an email to EDAN service department at: [support@edan.com.cn](mailto:support@edan.com.cn).

## Chapter 26 Accessories

You can order accessories from EDAN supplies at [www.edan.com.cn](http://www.edan.com.cn) or consult your local EDAN representative for details.

### **WARNING**

- 1 Never reuse disposable transducers, sensors, accessories and so forth that are intended for single use, or single patient use only. Reuse may compromise device functionality and system performance and cause a potential hazard.
- 2 Use only EDAN-approved accessories. Using non-EDAN-approved accessories may compromise device functionality and system performance and cause a potential hazard.
- 3 IBP sterilized accessories are already sterilized, refer to the package labeling for detailed method. Do not use a sterilized accessory if its packaging is damaged.

### **NOTE:**

Transducers and sensors have a limited shelf life. Refer to the package labeling.

The following cables may not all be available in all countries. Please check availability with your local EDAN supplier.

### 26.1 ECG Accessories

Part Number	Accessories
01.57.471381	3-lead, 6-pin, Defib-proof, IEC, Clip
01.57.471382	3-lead, 6-pin, Defib-proof, AHA, Clip
01.57.471383	3-lead, 6-pin, Defib-proof, IEC, Snap
01.57.471384	3-lead, 6-pin, Defib-proof, AHA, Snap
01.57.471389	3-lead, 6-pin, ESU-proof, IEC, Clip
01.57.471390	3-lead, 6-pin, ESU-proof, AHA, Clip
01.57.471391	3-lead, 6-pin, ESU-proof, IEC, Snap
01.57.471392	3-lead, 6-pin, ESU-proof, AHA, Snap
01.57.471477	5-lead, 6-pin, ESU-proof, Clip, IEC, 3.4m, Reusable
01.57.471478	5-lead, 6-pin, ESU-proof, Clip, AHA, 3.4m, Reusable
01.57.471479	5-lead, 6-pin, ESU-proof, Snap, IEC, 3.4m, Reusable
01.57.471480	5-lead, 6-pin, ESU-proof, Snap, AHA, 3.4m, Reusable
01.57.471193	3-lead, 6-pin, Defib-proof

<b>Part Number</b>	<b>Accessories</b>
01.57.471195	3-lead, Snap, IEC
01.57.471196	3-lead, Snap, AHA
01.57.471197	3-lead, Clip, IEC
01.57.471198	3-lead, Clip, AHA
01.57.471230	5-lead, 6-pin, ESU-proof, 2.7 m
01.57.471231	5-lead, 6-pin, ESU-proof, Extended, 5.0 m
01.57.471232	5-lead, 6-pin, Defib-proof, 2.7 m
01.57.471233	5-lead, 6-pin, Defib-proof, Extended, 5.0 m
01.13.036620	5-lead, Clip, AHA, Extended, 1.6 m
01.13.036621	5-lead, Clip, AHA, 1.0 m
01.13.036622	5-lead, Snap, AHA, Extended, 1.6 m
01.13.036623	5-lead, Snap, AHA, 1.0 m
01.13.036624	5-lead, Clip, IEC, Extended, 1.6 m
01.13.036625	5-lead, Clip, IEC, 1.0 m
01.13.036626	5-lead, Snap, IEC, Extended, 1.6 m
01.13.036627	5-lead, Snap, IEC, 1.0 m
01.57.471469	5-Lead, 6pin, Defib-proof, clip, IEC, 3.4 m, reusable
01.57.471472	5-Lead,6pin, Defib-proof, snap, AHA,3.4m, reusable
01.57.471471	5-Lead, 6 pin, Defib-proof, snap, IEC, 3.4 m, reusable
01.57.471470	5-lead, 6 pin, Defib-proof, clip, AHA, 3.4 m, reusable
01.57.471041	Multi-Function Clamp For VET

## 26.2 SpO<sub>2</sub> Accessories

<b>Part Number</b>	<b>Accessories</b>
02.01.110498	VE-SH7 Veterinary SpO <sub>2</sub> sensor
01.15.040433	Nellcor Veterinary SpO <sub>2</sub> sensor(-YS)

## 26.3 NIBP Accessories

Part Number	Accessories
<b>For EDAN Module</b>	
01.57.471326	NIBP Cuff, E5, 10-15 cm, reusable
01.57.471327	NIBP Cuff, E6, 13-17cm, reusable
01.57.471328	NIBP Cuff, E7, 16-21.5 cm, reusable
01.57.471329	NIBP Cuff, E8, 20.5-28 cm, reusable
01.57.471330	NIBP Cuff, E9, 27-35 cm, reusable
01.57.471331	NIBP Cuff, E10, 34-43 cm, reusable
01.57.471005	NIBP Hose, Quick Connect to Quick Connect
01.57.471323	NIBP Cuff, 10 cm-15 cm, reusable
01.57.471324	NIBP Cuff, 6 cm-11 cm, reusable
01.57.471021	NIBP Tube for cuff, 3 m
01.57.471303	NIBP Tube, 3 m
01.57.471291	NIBP Tube, 3 m
<b>For SunTech Module</b>	
01.57.471157	NIBP Cuff, #1, 3-6 cm, disposable
01.57.471158	NIBP Cuff, #2, 4-8 cm, disposable
01.57.471159	NIBP Cuff, #3, 6-11 cm, disposable
01.57.471160	NIBP Cuff, #4, 7-13 cm, disposable
01.57.471161	NIBP Cuff, #5, 8-15 cm, disposable
01.57.471201	Single-patient NIBP Cuff #1, 3-6 cm
01.57.471202	Single-patient NIBP Cuff #2, 4-8 cm
01.57.471203	Single-patient NIBP Cuff #3, 6-11 cm
01.57.471204	Single-patient NIBP Cuff #4, 7-13 cm
01.57.471205	Single-patient NIBP Cuff #5, 8-15 cm

Part Number	Accessories
01.57.471495	APC Cuff, (Royal Blue), Range: 17 – 25 cm
01.57.471496	APC Cuff, (Navy Blue), Range: 23 – 33 cm

**NOTE:**

For SunTech module, #1, #2, #3 is relatively corresponding to SunTech small cuff, #5, #4 and APC is corresponding to big cuff.

## 26.4 Temp Accessories

Part Number	Accessories
01.15.040257	Temperature Probe, Skin, 6.3mm plug (2.252K/25 °C)
01.15.040258	Temperature Probe, rectal/oral, 6.3mm plug (2.252K/25 °C)
01.15.040422	Temperature Probe, Skin, 6.3mm plug (10K/25 °C)
01.15.040423	Temperature Probe, rectal/oral, 6.3mm plug (10K/25 °C)
01.15.040185	Temperature Probe, skin, 3 m, reusable
01.15.040420	Temperature Probe, Skin, 6.3 mm plug (10K/25 °C)
01.15.040184	Temperature Probe, rectal/oral, 6.3 mm plug (2.252K/25 °C)
01.15.040421	Temperature Probe, rectal/oral, 6.3 mm plug (10K/25 °C)

## 26.5 IBP Accessories

Part Number	Accessories
02.57.471280	ICP transfer cable
01.57.471014	Pressure transducer interface cable, BD
01.57.471013	Pressure transducer interface cable, EDWARD
01.57.471027	Pressure transducer interface cable, Hospira
01.57.471028	Pressure transducer interface cable, Utah
01.57.40121	IBP Pressure transducer kit, BD, disposable(BD DT-4812)
01.57.471664	Disposable Pressure transducer PT161103, compatible with BD

Part Number	Accessories
01.57.471665	Disposable Pressure transducer PT151103, compatible with Edward
01.57.471666	Disposable Pressure transducer PT141103, compatible with Abbott
01.57.471880	Reusable pressure transducer
01.57.471881	Disposable dome

## 26.6 CO<sub>2</sub> Accessories

Part Number	Accessories
<b>For EDAN Module</b>	
02.01.210520	Dewatering Cup(Single Patient Use, 10 ml)
01.57.471275	CO <sub>2</sub> Sampling Line with Male Luer Lock, 2.0 m
01.57.471282	All Purpose Sampling Cannula without filter (Non Sterile). Size: 10-14mm
01.57.471283	All Purpose Sampling Cannula without filter (Non Sterile). Size: 9-13mm
01.57.471284	All Purpose Sampling Cannula without filter (Non Sterile). Size: 6.5-9.5mm
01.57.471285	Duo Flow O <sub>2</sub> +CO <sub>2</sub> Sampling Cannula (Non Sterile). Size: 10-14mm
01.57.471286	Duo Flow O <sub>2</sub> +CO <sub>2</sub> Sampling Cannula (Non Sterile). Size: 9-13mm
01.57.471287	Capnomask O <sub>2</sub> +CO <sub>2</sub> Sampling Cannula (Non Sterile). Size: 67*134mm
01.57.471288	Capnomask O <sub>2</sub> +CO <sub>2</sub> Sampling Cannula (Non Sterile). Size: 53.5*101mm
<b>For Respironics Module</b>	
02.08.078137	Respironics EtCO <sub>2</sub> module/(Side-stream) 1022054
01.15.040143	Respironics CAPNOSTAT 5 EtCO <sub>2</sub> (Main-stream) Module 1015928
02.08.078166	LoFlo™ Module Mounting Bracket (Respironics 1027730)
01.57.078139	Disposable CO <sub>2</sub> Nasal Cannula - (Respironics 3468ADU-00)
01.57.078151	Airway adapter kit with dehumidification tubing (Respironics 3473ADU-00)
01.57.078154	Disposable Sampling Line Kit with Dehumidification Tubing (Respironics 3475-00)
01.57.471019	Reusable Airway Adapter (7007-01), big
01.57.471020	Reusable Airway Adapter (7053-01), small
01.59.078156	CO <sub>2</sub> Airway Adapter, (6312-00)

Part Number	Accessories
01.57.078141	Disposable CO <sub>2</sub> Nasal Cannula (Respironics 3468INF-00)
01.57.078152	Airway adapter kit with dehumidification tubing (Respironics 3473INF-00)

## 26.7 AG Accessories\*

Part Number	Accessories
01.57.471043	Nomoline with Luer Lock connector, Box of 25, CAT.NO. 108210
01.57.471042	IRMA Airway Adapter, Box of 25, CAT.NO. 106220
01.57.471189	Nomoline Adapter
01.57.471190	Nomoline Airway Adapter Set
01.57.471191	Nomo Extension
01.57.471192	T-adapter

\* Only applicable to iM70 VET.

## 26.8 Other Accessories

Part Number	Accessories
01.21.064142	Rechargeable Lithium-Ion Battery/TWSLB-002
01.21.064143	Rechargeable Lithium-Ion Battery/TWSLB-003
02.01.210217	EPRT-48mm recorder, Serial/parallel port
02.01.19084	Thermal printer
02.01.109592	Pole clamp, 1 set /package
02.01.109636	Pole clamp, 4 sets/package
01.57.78035	Recorder paper
01.18.052245	Netac USB flash disk (U208, 4G, USB2.0)
01.23.068023	USB barcode scanner
01.18.078205	Security lock
01.13.01950	Three flat power cable, length 3 m
01.13.36014	Power cable, length 1.8 m, VDE
01.13.36015	Power cable, length 1.8 m, American standard
01.13.036106	Power cable, length 1.8 m, American standard, medical grade
01.13.114214	Ground Cable
02.01.210633	Recorder



<b>Part Number</b>	<b>Accessories</b>
01.18.052307	Sandisk SD Card (CLASS 4, 8G)
02.04.241688	Patient monitor mounting arm assembly kit
83.60.261083	MT-206 Trolley (iM60&iM70), metal caster
83.60.261118	MT-206 Trolley (iM60&iM70), plastic caster

**NOTE:**

The part name may vary depending on context, but the part number is constant.

## A Product Specification

### NOTE:

The performance of the equipment with ☆ mark is determined to be essential performance.

### A.1 Classification

Anti-electroshock type	Class I equipment and internal powered equipment
Anti-electroshock degree	ECG (RESP), TEMP, IBP ☆ CF SpO <sub>2</sub> , NIBP, CO <sub>2</sub> , AG ☆ BF
Ingress Protection	IPX1
Disinfection/sterilization method	Refer to Chapter Care and Cleaning for details.
Working system	Continuous operation equipment
Compliant with Standards	IEC60601-2-49: 2011; IEC 60601-1: 2005+A1 :2012; IEC 60601-1-2: 2007; EN 60601-1: 2006+A1 :2013; EN 60601-1-2: 2007;

### A.2 Physical Specifications

#### A.2.1 Size and Weight

Product	Size	Weight (standard configuration, including battery)
iM60 VET	303±2 mm (W) * 254±2 mm (H) * 161±2 mm (D)	< 4.5 kg
iM70 VET	328±2 mm (W) × 285±2 mm (H) × 158±2 mm (D)	< 5.5 kg

#### A.2.2 Function Configuration

Model	Standard Configuration	Optional Configuration
iM60 VET	ECG(3/5-lead), RESP, SpO <sub>2</sub> (EDAN), NIBP(EDAN), TEMP	SpO <sub>2</sub> (Nellcor), NIBP (SunTech), CO <sub>2</sub> , IBP
iM70 VET	ECG(3/5-lead), RESP, SpO <sub>2</sub> (EDAN), NIBP(EDAN), TEMP	SpO <sub>2</sub> (Nellcor), NIBP(SunTech), CO <sub>2</sub> , IBP, AG

#### A.2.3 Environment Specification

The monitor may not meet the performance specifications given here if stored or used outside the specified temperature and humidity ranges.

When the monitor and related products have differing environmental specifications, the effective range for the combined products is that range which is common to the specifications for all products.

Temperature	
Working	+0 °C to +40 °C (32 °F ~104 °F)
Transport and Storage	-20 °C to +55 °C (-4 °F ~131 °F)
Humidity	
Working	15%RH ~ 95%RH (non-condensing)
Transport and Storage	15%RH ~ 95%RH (non-condensing)
Altitude	
Working	86 kPa ~ 106 kPa
Transport and Storage	70 kPa ~ 106 kPa
Power Supply	100 V-240 V~, 50 Hz/60 Hz
	Current=1.4 A-0.7 A; Fuse: T3.15 AH, 250 VP

## A.2.4 Display

Product	Display	Messages
iM60 VET	Display screen: 10.4 inch color TFT, supporting touch screen Resolution: 800×600	A maximum of 11 waveforms One power LED Two alarm LED One charge LED
iM70 VET	Display screen: 12.1 inch color TFT, supporting touch screen Resolution: 800×600	A maximum of 11 waveforms One power LED Two alarm LED One charge LED

## A.2.5 Battery

Operating Time	2500 mAh	≥ 3.5 h
	5000 mAh	≥ 7 h
Condition	At 25±2 °C, with standard configuration and (a) new fully charged battery/batteries, continuous SpO <sub>2</sub> measurement and NIBP automatic measurement mode at interval of 15 minutes, ECG/TEMP module connected, recording at interval of 10 minutes, brightness set to “1”.	
Charge Time	2500 mAh	≤ 3.5 h

	5000 mAh	≤6.5 h
Condition	Monitor is on or in standby mode.	

### A.2.6 Recorder

Record Width	48 mm
Paper Speed	12.5 mm/s, 25 mm/s, 50 mm/s
Trace	3
Recording types	Continuous real-time recording 8 seconds real-time recording Time recording Alarm recording Trend graph recording Trend table recording NIBP review recording Arrhythmia review recording Alarm review recording Drug calculation titration recording Hemodynamic Calculation result recording

### A.3 Wi-Fi

IEEE	802.11b/g/n
Frequency Band	2.4 GHz ISM band
Modulation	OFDM with BPSK, QPSK, 16-QAM, and 64-QAM 802.11b with CCK and DSSS
Typical Transmit Power ( $\pm 2$ dBm)	17 dBm for 802.11b DSSS 17 dBm for 802.11b CCK 15 dBm for 802.11g/n OFDM

### A.4 ECG

Complies with IEC 60601-2-27: 2011.

Lead Mode	3-Lead: I, II, III 5-Lead: I, II, III, aVR, aVL, aVF, V
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Lead Naming Style	AHA, IEC
☆ Display Sensitivity (Gain Selection)	1.25 mm/mV ( $\times 0.125$ ), 2.5 mm/mV ( $\times 0.25$ ), 5 mm/mV ( $\times 0.5$ ), 10 mm/mV ( $\times 1$ ), 20 mm/mV ( $\times 2$ ), AUTO gain
☆ Sweep	6.25 mm/s, 12.5 mm/s, 25 mm/s, 50 mm/s
Bandwidth (-3dB)	Weak: 0.05 Hz to 150 Hz Middle: 0.5 Hz to 40 Hz Strong: 1 Hz to 20 Hz
☆ CMRR (Common Mode Rejection Ratio)	Weak: > 95 dB Middle: > 105 dB Strong: > 105 dB
Notch	In diagnosis, monitor and surgery modes: 50 Hz/60 Hz (Notch filter can be turned on or off manually)
☆ Differential Input Impedance	> 5 M $\Omega$
☆ Input Signal Range	$\pm 10$ mV PP
☆ Accuracy of Signal Reproduction	An error of $\leq \pm 20\%$ of the nominal value of the output or $\pm 100$ $\mu$ V, whichever is greater. The total error and frequency response comply with IEC 60601-2-27: 2011, Sect. 201.12.1.101.1.
☆ Electrode Offset Potential Tolerance	$\pm 500$ mV
Auxiliary Current (Leads off detection)	Active electrode: < 100 nA Reference electrode: < 900 nA
☆ Recovery Time After Defibrillation	< 5 s (measured without electrodes as IEC60601-2-27:2011, Sect. 201.8.5.5.1 requires.)
Leakage Current of Patient	< 10 $\mu$ A
Scale Signal	1 mV PP, accuracy is $\pm 5\%$
☆ System Noise	< 30 $\mu$ VPP
☆ Multichannel Crosstalk	$\leq 5\%$ of the input signal Complied with IEC 60601-2-27: 2011, Sect. 201.12.1.101.5.

☆Frequency and Impulse Response	<p>Frequency response:  Input a 5 Hz, 1 mV sine wave signal, and the output signal amplitude remains within the range of 71% to 110% at 0.67 Hz and 40 Hz.  Input a 1 Hz, 1.5 mV 200 ms triangular wave input signal, and the output shall be within 11.25 mm~15 mm.  Impulse response:  Displacement value: <math>\leq 0.1</math> mV  Slope: <math>\leq 0.3</math> mV/s following the end of the pulse.  Complied with IEC 60601-2-27: 2011, Sect. 201.12.1.101.8.</p>
Sampling Frequency	1000 Hz
Sampling Channel Switch Time	$< 80 \mu\text{S}$
A/D Precision	24 Bits (Minimum resolution: 0.077uV/LSB)
☆ESU Protection	<p>Cut mode: 300 W  Coagulation mode: 100 W  Restore time: <math>\leq 10</math> s</p>
Electrosurgical Interference Suppression	<p>Test according to ANSI/AAMI EC13:2002, Sect. 5.2.9.14.  Complied with ANSI/AAMI EC13:2002, Sect. 4.2.9.14.</p>
Minimum Input Slew Rate (Lead II)	$> 2.5$ V/s
☆Baseline Reset Time	$< 3$ s
Pace Pulse	
☆Pulse Indicator	<p>Pulse is marked if the requirements of IEC 60601-2-27: 2011, Sect. 201.12.1.101.12 are met:  Amplitude: <math>\pm 2</math> mV to <math>\pm 700</math> mV  Width: 0.1 ms to 2.0 ms  Ascending time: 10 <math>\mu\text{s}</math> to 100 <math>\mu\text{s}</math></p>
☆Pulse Rejection	<p>Pulse is rejected if the requirements of IEC 60601-2-27: 2011, Sect. 201.12.1.101.13 are met:  Amplitude: <math>\pm 2</math> mV to <math>\pm 700</math> mV  Width: 0.1 ms to 2.0 ms  Ascending time: 10 <math>\mu\text{s}</math> to 100 <math>\mu\text{s}</math></p>
Pace Pulse Detecting Lead: one among I, II, III, AVR, AVL, AVF, V1, V2, V3, V4, V5, V6	

Heart Rate	
HR Calculation	
☆Range	15 bpm to 350 bpm
☆Accuracy	±1% or 1 bpm, whichever is greater
Resolution	1 bpm
Sensitivity	≥300 μVPP
☆QRS Detection Range	Width: 40 ms ~ 120 ms. Amplitude: 0.5 mv~5 mv
PVC	
Range	0 to 350 PVCs/ min
Resolution	1 PVCs/min
ST value	
Range	-2.0 mV to +2.0 mV
Accuracy	-0.8 mV to +0.8 mV: ±0.02 mV or 10%, whichever is greater. Beyond this range: not specified.
Resolution	0.01 mV
HR Averaging Method	
Method 1	Heart rate is computed by excluding the minimum and maximum values from the 12 most recent RR intervals and averaging the residual 10 RR intervals.
Method 2	If each of three consecutive RR intervals is greater than 1200 ms, then the four most recent RR intervals are averaged to compute the HR.
Range of Sinus and SV Rhythm	
Tachy	RR interval for 5 consecutive QRS complex ≤ 0.375 s.
Normal	0.375s < RR interval for 5 consecutive QRS complex < 1 s.
Brady	RR interval for 5 consecutive QRS complex ≥ 1 s.
Range of Ventricular Rhythm	
Ventricular Tachycardia	The interval of 5 consecutive ventricular beats is less than 600 ms
Ventricular Rhythm	The interval of 5 consecutive ventricular beats ranges from 600 ms to 1000 ms
Ventricular Bradycardia	The interval of 5 consecutive ventricular beats is more than 1000 ms

Maximum Start-up Alarm Time for Tachycardia			
Ventricular Tachycardia 1 mV 206bpm	Gain 0.5: 10 s		
	Gain 1.0: 10 s		
	Gain 2.0: 10 s		
Ventricular Tachycardia 2 mV 195bpm	Gain 0.5: 10 s		
	Gain 1.0: 10 s		
	Gain 2.0: 10 s		
Response Time of Heart Rate Meter to Change in HR	HR range: 80 bpm to 120 bpm		
	Range : Within 11 s		
	HR range: 80bpm to 40bpm		
☆Tall T-wave Rejection	HR range: 80bpm to 40bpm		
	Range : Within 11 s		
☆Tall T-wave Rejection	Complied with IEC 60601-2-27: 2011, Sect. 201.12.1.101.17 minimum recommended 1.2 mV T-Wave amplitude		
Accuracy of Heart Rate Meter and Response to Irregular Rhythm	Complied with IEC 60601-2-27: 2011, Sect. 201.7.9.2.9.101 b) 4), the HR value after 20 seconds of stabilization is displayed as follows:  Ventricular bigeminy: 80 bpm $\pm$ 1 bpm Slow alternating ventricular bigeminy: 60 bpm $\pm$ 1 bpm Rapid alternating ventricular bigeminy: 120 bpm $\pm$ 1 bpm Bidirectional systoles: 91 bpm $\pm$ 1 bpm		
Time to Alarm for Heart Rate alarm conditions	Asystole alarm: $\leq$ 10 s HR low alarm: $\leq$ 10 s HR high alarm: $\leq$ 10 s		
Arrhythmia analyses	ASYSTOLE	VFIB/VTAC	COUPLET
	VT > 2	BIGEMINY	TRIGEMINY
	VENT	R on T	PVC
	TACHY	BRADY	MISSED BEATS
	IRR	VBRADY	PNC
	PNP		

## A.5 RESP

Method	Impedance between RA-LL, RA-LA
Measurement lead	Options are lead I and II. The default is lead II.



Calculation Type	Manual, Automatic
Baseline Impedance Range	200 $\Omega$ to 2500 $\Omega$ (with ECG cables of 1 K $\Omega$ resistance)
Measuring Sensitivity	Within the baseline impedance range: 0.3 $\Omega$
Waveform Bandwidth	0.2 Hz to 2.5 Hz (-3 dB)
Respiration Excitation Waveform	Sinusoid, 62.8 kHz ( $\pm$ 10%), < 500 $\mu$ A
☆RR Measuring Range	0 rpm to 150 rpm
Resolution	1 rpm
☆Accuracy	6 rpm to 150 rpm: $\pm$ 2 rpm
	0 rpm to 5 rpm: not specified
☆Gain Selection	$\times$ 0.25, $\times$ 0.5, $\times$ 1, $\times$ 2, $\times$ 3, $\times$ 4, $\times$ 5
☆Sweep	6.25 mm/s, 12.5 mm/s, 25 mm/s, 50 mm/s
☆Apnea Alarm Time Setup	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s; default value is 20 s.

## A.6 NIBP

Complies with IEC 80601-2-30: 2009.

### EDAN Module

Technique	Oscillometry
Mode	Manual, Auto, Continuous
Measuring Interval in AUTO Mode	1/2/3/4/5/10/15/30/60/90/120/240/480 min
Continuous	5 min, interval is 5 s
Measuring Type	SYS, DIA, MAP, PR
☆Measuring Range	
☆Big Cuff Mode	SYS: 40 mmHg to 270 mmHg
	DIA: 10 mmHg to 215 mmHg
	MAP: 20 mmHg to 235 mmHg
☆Middle Cuff Mode	SYS: 40 mmHg to 230 mmHg
	DIA: 10 mmHg to 180 mmHg
	MAP: 20 mmHg to 195 mmHg

☆Small Cuff Mode	SYS: 40 mmHg to 135 mmHg DIA: 10 mmHg to 100 mmHg MAP: 20 mmHg to 110 mmHg
☆Alarm Type	SYS, DIA, MAP
☆ Cuff Pressure Measuring Range	0 mmHg to 300 mmHg
Pressure Resolution	1 mmHg
☆Maximum Mean Error	±5 mmHg
☆Maximum Standard Deviation	8 mmHg
Maximum Measuring Period	
Big/Middle Cuff	120 s
Small Cuff	90 s
Typical Measuring Period	20 s to 35 s (depend on HR/motion disturbance)
Dual Independent Channel Overpressure Protection	
Big Cuff	(297±3) mmHg
Middle Cuff	(245±3) mmHg
Small Cuff	(147±3) mmHg
PR	
☆Measuring Range	40 bpm to 240 bpm
☆Accuracy	±3 bpm or 3.5%, whichever is greater
Pre-inflation Pressure	
Big cuff mode	Default: 160 mmHg Range: 80/100/120/140/150/160/180/200/220/240 mmHg
Middle cuff mode	Default: 140 mmHg Range: 80/100/120/140/150/160/180/200 mmHg
Small cuff mode	Default: 100 mmHg Range: 60/70/80/100/120 mmHg

### SunTech Module

Method	Oscillometric
Mode	Manual, Auto, Continuous

Measuring Interval in AUTO Mode (unit: minutes)	1/2/3/4/5/10/15/30/60/90/120/240/480
Continuous	5 min, interval is 5 s
Max Single Measuring Time	120 s
Measuring Type	SYS, DIA, MAP
Measuring Range	
SYS	40 mmHg ~265mmHg
DIA	20 mmHg ~200 mmHg
MAP	27 mmHg ~222 mmHg
☆PR Range	
Measuring Range	25 bpm ~ 300 bpm
Accuracy	± 2% or ± 3 bpm, whichever is greater
Pre-inflation Pressure	
Big cuff Mode	Default: 160 mmHg Range: 120/140/150/160/180/200/220/240/260/280 mmHg
Small Cuff Mode	Default: 160 mmHg Range: 60/80/100/120/140/160/180/200/240/280 mmHg
Overpressure Protection	300 mmHg±10 mmHg

## A.7 SpO<sub>2</sub>

Complies with ISO 80601-2-61: 2011.

### EDAN Module

Measuring Range	0% to 100%
Resolution	1%
☆Data Update Period	1 s
☆Accuracy	±3% (70% to 100% SpO <sub>2</sub> )
	Undefined (0% to 69% SpO <sub>2</sub> )
Pulse Rate	
Measuring Range	25 bpm to 350 bpm
Resolution	1 bpm
☆Accuracy	±2 bpm
Sensor	

Red Light	(660±3) nm
Infrared Light	(905±10) nm
Emitted Light Energy	<15 mW
PI	
Measuring Range	0-10, invalid PI value is 0.
Resolution	1

### Nellcor Module

Measuring Range	1% to 100%
Resolution	1%
☆Data Update Period	1 s
☆Accuracy	±4% (70% to 100% SpO <sub>2</sub> ) Undefined (0% to 69% SpO <sub>2</sub> )
Pulse Rate	
Measuring Range	20 bpm to 300 bpm
Resolution	1 bpm
☆Accuracy	±3 bpm (20 bpm to 250 bpm) Undefined (250 bpm ~300bpm)
Sensor	Wave length: approximately 660 nm and 900 nm
	Emitted light energy: <15 mW

### NOTE:

The information about wavelength range can be especially useful to clinicians (for instance, when photodynamic therapy is performed).

## A.8 TEMP

Complies with ISO 80601-2-56: 2009.

Technique	Thermal resistance
Position	Skin, oral cavity, rectum
Measure Parameter	T1, T2, TD (the absolute value of T2 minus T1)
Channel	2
Sensor Type	YSI-10K and YSI-2.252K
Unit	°C, °F

Measuring Range	0 °C to 50 °C (32 °F to 122 °F)
Resolution	0.1 °C (0.1 °F)
☆Accuracy <sup>1</sup>	±0.3 °C
Refresh Time	Every 1 s to 2 s
Temperature Calibration	At an interval of 5 to 10 minutes
Measuring Mode	Direct Mode
Transient Response Time	≤ 30 s

Note 1: The accuracy consists of two parts, as following:

- Accuracy (not including sensor): ±0.1 °C
- Sensor accuracy: ≤ ±0.2 °C

## A.9 IBP

Complies with IEC 60601-2-34: 2011.

Technique		Direct invasive measurement	
Channel		2 channels	
IBP Measure	☆Measuring Range	Art	(0 to +300) mmHg
		PA	(-6 to +120) mmHg
		CVP/RAP/LAP/ICP	(-10 to +40) mmHg
		P1/P2	(-50 to +300) mmHg
	Resolution		1 mmHg
☆Accuracy (not including sensor)		± 2% or ±1 mmHg, whichever is greater ICP: 0 mmHg to 40 mmHg: ±2% or ±1 mmHg, whichever is greater; -10 mmHg to 0 mmHg: undefined	
PR Measure	☆Measuring Range		20 bpm to 300 bpm
	Resolution		1 bpm
	☆Accuracy		30 bpm to 300 bpm: ±2 bpm or ±2%, whichever is greater; 20 bpm to 29 bpm: undefined
Pressure Unit		kPa, mmHg, cmH <sub>2</sub> O	
Pressure sensor			
Sensitivity		5 μV/V/mmHg	

Impedance Range		300 Ω to 3000 Ω
Filter		DC~ 12.5 Hz; DC~ 40 Hz
Zero		Range: ±200 mmHg
Pressure Calibration Range	IBP (excluding ICP)	80 mmHg to 300 mmHg
	ICP	10 mmHg to 40 mmHg
Volume Displacement		7.4x10 <sup>4</sup> mm <sup>3</sup> /100 mmHg

## A.10 CO<sub>2</sub>

Complies with ISO 80601-2-55: 2011.

### EDAN Module

Intended Patient	Patients whose tidal volume is more than 200 ml			
Measure Parameters	EtCO <sub>2</sub> , FiCO <sub>2</sub> , AwRR			
Unit	mmHg, %, kPa			
☆ Measuring Range	CO <sub>2</sub>	0 mmHg to 150 mmHg (0% to 20%)		
	AwRR	2 rpm to 150 rpm		
Resolution	EtCO <sub>2</sub>	1 mmHg		
	FiCO <sub>2</sub>	1 mmHg		
	AwRR	1 rpm		
☆ Accuracy	EtCO <sub>2</sub>	±2 mmHg, 0 mmHg to 40 mmHg	Respiratory rate ≤60 rpm	Typical conditions: Ambient temperature: (25±3) °C Barometric pressure: (760±10) mmHg Balance gas: N <sub>2</sub> Sample gas flowrate: 100 ml/min
		±5% of reading, 41 mmHg to 70 mmHg		
		±8% of reading, 71 mmHg to 100 mmHg		
		±10% of reading, 101 mmHg to 150 mmHg		
		± 12% of reading or ± 4 mmHg, whichever is greater	Respiratory rate > 60 rpm	All conditions
	AwRR	±1 rpm		

Drift of Measure Accuracy	Meets the requirements of the measure accuracy	
Sample Gas Flowrate	70 ml/min or 100 ml/min, optional (accuracy: $\pm 15$ ml/min)	
Warm-up Time	Display reading within 20 s; reach to the designed accuracy within 2 minutes.	
Rise Time	< 400 ms (with 2 m gas sampling tube, sample gas flowrate: 100 ml/min)	
	< 500 ms (with 2 m gas sampling tube, sample gas flowrate: 70 ml/min)	
Response Time	< 4 s (with 2 m gas sampling tube, sample gas flowrate: 100 ml/min)	
	< 4 s (with 2 m gas sampling tube, sample gas flowrate: 70 ml/min)	
Work Mode	Standby, measure	
O <sub>2</sub> Compensation	Range: 0% to 100% Resolution: 1% Default: 16%	
N <sub>2</sub> O Compensation	Range: 0% to 100% Resolution: 1% Default: 0%	
AG Compensation	Range: 0% to 20% Resolution: 0.1% Default: 0%	
Humidity Compensation Method	ATPD(default), BTPS	
Barometric Pressure Compensation	Automatic (The change of barometric pressure will not add additional errors to the measurement values.)	
Zero Calibration	Support	
Calibration	Support	
☆ Alarm	EtCO <sub>2</sub> , FiCO <sub>2</sub> , AwRR	
☆ Apnea Alarm Delay	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s, 60 s; default value is 20 s.	
Data Sample Rate	100 Hz	
EtCO <sub>2</sub> Change <sup>1</sup>	AwRR $\leq$ 80rpm, meet the accuracy mentioned above; AwRR > 80 rpm, EtCO <sub>2</sub> descends 8%; AwRR > 120 rpm, EtCO <sub>2</sub> descends 10%	with 2 m gas sampling tube, sample gas flowrate: 100 ml/min)

	AwRR ≤ 60rpm, meet the accuracy mentioned above; AwRR > 60 rpm, EtCO <sub>2</sub> descends 8%; AwRR > 90 rpm, EtCO <sub>2</sub> descends 10%; AwRR > 120rpm, EtCO <sub>2</sub> descends 15%;	with 2 m gas sampling tube, sample gas flowrate: 70 ml/min)
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Note 1: Use a test device equivalent to EN ISO 80601-2-55 fig 201.101 to measure at 1:2 I/E ratio. Respiration rate accuracy is determined by frequency of device, and ET READING change refers to the nominal value.

**Interfering Gas Effects:**

Gas	Gas Level (%)	Quantitative Effect/Comments
Nitrous oxide	60	The interfering gas will have no effect on the measurement value if compensation of O <sub>2</sub> , N <sub>2</sub> O, anesthetic agents has been correctly set.
Halothane	4	
Enflurane	5	
Isoflurane	5	
Sevoflurane	5	
Desflurane	15	

**Respironics Module**

Applicable Patient Type	Patients whose tidal volume is more than 100 ml	
Technique	Infra-red Absorption Technique	
Measure Parameters	EtCO <sub>2</sub> , FiCO <sub>2</sub> , AwRR	
Unit	mmHg, %, Kpa	
☆Measuring Range		
☆EtCO <sub>2</sub>	0 mmHg to 150 mmHg	
☆FiCO <sub>2</sub>	3 mmHg to 50 mmHg	
☆AwRR	0 rpm to 150 rpm (Mainstream) 2 rpm to 150 rpm (Sidestream)	
Resolution	EtCO <sub>2</sub>	1 mmHg
	FiCO <sub>2</sub>	1 mmHg
	AwRR	1 rpm
☆EtCO <sub>2</sub> Accuracy	±2 mmHg, (0 to 40) mmHg	
	±5% of reading, (41 to 70) mmHg	
	±8% of reading, (71 to 100) mmHg	



	±10% of reading, (101 to 150) mmHg
	±12% of reading, RR is over 80 rpm (sidestream) There will be no degradation in performance due to Respiration Rate. (mainstream)
☆AwRR Accuracy	±1 rpm
Operation Mode	Measure, standby
Sample Gas Flowrate (sidestream)	(50 ±10) ml/min
O <sub>2</sub> Compensation	
Range	0% to 100%
Resolution	1%
Default	16%
Barometric Compensation Pressure	User setup
Anesthetic Gas Compensation	
Range	0% to 20%
Resolution	0.1%
Default	0.0%
Balance Gas Compensation	Room air, N <sub>2</sub> O, helium
Stability	
Short Term Drift	Drift over 4 hours < 0.8 mmHg
Long Term Drift	120 hours
Zero Calibration	Support
☆Alarm Type	EtCO <sub>2</sub> , FiCO <sub>2</sub> , AwRR
☆Apnea Alarm Delay	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s; default value is 20 s.
Data Sample Rate	100 Hz
CO <sub>2</sub> Rise Time/Response Time (mainstream)	Less than 60 ms
Sensor Response Time (sidestream)	< 3 seconds, including transport time and rise time

Interfering Gas and Vapor Effects on EtCO<sub>2</sub> Measurement Values:

Gas or Vapor	Gas Level (%)	Quantitative Effect/Comments
Nitrous oxide	60	Dry and Saturated Gas
Halothane	4	(0 ~ 40) mmHg: ± 1 mmHg additional error
Enflurane	5	(41 ~ 70) mmHg: ± 2.5% additional error
Isoflurane	5	(71 ~ 100) mmHg: ± 4% additional error
Sevoflurane	5	(101 ~ 150) mmHg: ± 5% additional error
Xenon	80	*Additional worst case error when compensation for P <sub>B</sub> , O <sub>2</sub> , N <sub>2</sub> O, anesthetic agents, or helium is correctly selected for the actual fractional gas constituents present.
Helium	50	
Desflurane	15	Desflurane: The presence of desflurane in the exhaled breath at concentrations greater than 5% will positively bias Carbon Dioxide values by up to an additional 3 mmHg at 38 mmHg.  Xenon: The presence of Xenon in the exhaled breath will negatively bias Carbon Dioxide values by up to an additional 5 mmHg at 38 mmHg.

Barometric Pressure on EtCO<sub>2</sub> Measurement Values:

Quantitative Effect
Ambient Barometric, Operational
(0 ~ 40) mmHg: ± 1 mmHg additional error
(41 ~ 70) mmHg: ± 2.5% additional error
(71 ~ 100) mmHg: ± 4% additional error
(101 ~ 150) mmHg: ± 5% additional error
*Additional worst case error when compensation for P <sub>B</sub> , O <sub>2</sub> , N <sub>2</sub> O, anesthetic agents, or helium is correctly selected for the actual fractional gas constituents present.

**NOTE:**

Respiration Rate accuracy was verified by using a solenoid test setup to deliver a square wave of known CO<sub>2</sub> concentration to the device. 5% and 10% CO<sub>2</sub> concentrations were used. Respiration rate was varied over the range of the device. Pass/Fail criteria was comparison of the respiratory rate output from the sensor to the frequency of the square wave.

## A.11 AG

Complies with ISO 80601-2-55: 2011.

### A.11.1 Sidestream

#### ISA analyzer

Module Type	ISA AX+	Displaying the concentration of CO <sub>2</sub> , N <sub>2</sub> O, and two anaesthesia agent and identifying the anaesthesia agent automatically (built-in module)
	ISA OR+	Displaying the concentration of CO <sub>2</sub> , O <sub>2</sub> , N <sub>2</sub> O, and two anaesthesia agent and identifying the anaesthesia agent automatically (built-in module)
Measurement Parameters	CO <sub>2</sub> , N <sub>2</sub> O , O <sub>2</sub> , Halothane (HAL), Isoflurane (ISO), Enflurane (ENF), Sevoflurane (SEV) , Desflurane (DES), awRR, MAC	
Measurement Principle	CO <sub>2</sub> , N <sub>2</sub> O, Anaesthesia Agent: infra-red absorption characteristic; O <sub>2</sub> : Paramagnetic method	
Sampling Flow Rate	(50±10) ml/min	
Work Mode	Measure	
Compensations	Automatic compensation for pressure, temperature and broadening effects on CO <sub>2</sub> .	
Warm-up Time	< 20 s	
Rise Time at 50 ml/min sample flow	CO <sub>2</sub> ≤ 300 ms N <sub>2</sub> O, O <sub>2</sub> , ENF, ISO , SEV, DES ≤ 400 ms HAL ≤ 500 ms	
Primary Anaesthesia Agent Threshold	≤ 0.15 vol%	
Second Anaesthesia Agent Threshold	0.2 vol% + 10%	
Agent Identification Time	< 20 seconds (typically <10 seconds)	
Total System Response Time	< 4 seconds (with 2 m Nomoline Airway Adapter Set sampling line)	

Data Update Period	1 s		
Data Sample Rate	20 data frames, 420 bytes, per second		
Respiration Rate	0 to 150 ± 1 breaths/min		
Fi and ET	<p>Fi and ET are displayed after one breath and have a continuously updated breath average.                      ET will typically decrease below nominal value (ET<sub>nom</sub>) when respiration rate (RR) exceeds the RR threshold (RR<sub>th</sub>) according to the following formulas:</p> <p>CO<sub>2</sub> <math>ET = ET_{nom} \times \sqrt{(70/RR)}</math> for RR<sub>th</sub> &gt; 70</p> <p>N<sub>2</sub>O, O<sub>2</sub>, DES, ENF, ISO, SEV <math>ET = ET_{nom} \times \sqrt{(50/RR)}</math> for RR<sub>th</sub> &gt; 50</p> <p>HAL <math>ET = ET_{nom} \times \sqrt{(35/RR)}</math> for RR<sub>th</sub> &gt; 35</p> <p>NOTE: Measured at I/E ratio 1:1 using breath simulator according to EN ISO 80601-2-55 fig. 201.101</p>		
Measurement Range	<p>CO<sub>2</sub>: 0 to 25 vol%</p> <p>O<sub>2</sub>: 0 to 100 vol%</p> <p>N<sub>2</sub>O: 0 to 100 vol%</p> <p>HAL, ENF, ISO, SEV, DES: 0-25 vol%</p> <p>AwRR: (0 to 150) rpm</p>		
Resolution	<p>CO<sub>2</sub>: 0.1%</p> <p>HAL, ENF, ISO, SEV, DES: 0.1%</p> <p>N<sub>2</sub>O: 1%</p> <p>O<sub>2</sub>: 1%</p> <p>AwRR: 1 rpm</p>		
☆ Accuracy- Standard Conditions	Gas	Range	Accuracy
	CO <sub>2</sub>	0 to 15 vol%	±(0.2 vol% + 2% of reading)
		15 to 25 vol%	Unspecified
	N <sub>2</sub> O	0 to 100 vol%	±(2 vol% + 2% of reading)
	HAL, ENF, ISO	0 to 8 vol %	±(0.15 vol% + 5% of reading)
		8 to 25 vol %	Unspecified
SEV	0 to 10 vol %	±(0.15 vol% + 5% of reading)	
	10 to 25 vol %	Unspecified	
DES	0 to 22 vol %	±(0.15 vol% + 5% of reading)	
	22 to 25 vol %	Unspecified	

	O <sub>2</sub>	0 to 100 vol %	±(1 vol% + 2% of reading)
☆ Accuracy- All Conditions	Gas	Accuracy	
	CO <sub>2</sub>	±(0.3 kPa + 4% of reading)	
	N <sub>2</sub> O	±(2 kPa + 5% of reading)	
	Agents	±(0.2 kPa + 10% of reading)	
	O <sub>2</sub>	±(2 kPa + 2% of reading)	
☆AwRR Accuracy	±1 rpm		
☆Apnea Alarm Delay	20 s, 25 s, 30 s, 35 s, 40 s; default value is 20 s.		
☆Alarm	Providing alarms of EtCO <sub>2</sub> , FiCO <sub>2</sub> , EtO <sub>2</sub> , FiO <sub>2</sub> , EtN <sub>2</sub> O , FiN <sub>2</sub> O , EtAA , FiAA , AwRR		
Exhaust Emission	Interface for exhaust collection is available		
Support:			
<ul style="list-style-type: none"> <li>◆ Zero calibration</li> <li>◆ O<sub>2</sub> compensation</li> <li>◆ N<sub>2</sub>O compensation</li> </ul>			

Interfering Gas and Vapor Effects:

Gas or Vapour	Gas Level	CO <sub>2</sub>	Agents	N <sub>2</sub> O
		ISA AX+ ISA OR+		
N <sub>2</sub> O <sup>4)</sup>	60 vol%	- <sup>1)</sup>	- <sup>1)</sup>	- <sup>1)</sup>
HAL <sup>4)</sup>	4 vol%	- <sup>1)</sup>	- <sup>1)</sup>	- <sup>1)</sup>
ENF, ISO, SEV <sup>4)</sup>	5 vol%	- <sup>1)</sup>	- <sup>1)</sup>	- <sup>1)</sup>
DES <sup>4)</sup>	15 vol%	- <sup>1)</sup>	- <sup>1)</sup>	- <sup>1)</sup>
Xe(Xenon) <sup>4)</sup>	80 vol%	-10% of reading <sup>3)</sup>	- <sup>1)</sup>	- <sup>1)</sup>
He(Helium) <sup>4)</sup>	50 vol%	-6% of reading <sup>3)</sup>	- <sup>1)</sup>	- <sup>1)</sup>
Metered Dose Inhaler Propellants <sup>4)</sup>	Not for use with metered dose inhaler propellants			
C <sub>2</sub> H <sub>5</sub> OH(Ethanol) <sup>4)</sup>	0.3 vol%	- <sup>1)</sup>	- <sup>1)</sup>	- <sup>1)</sup>
C <sub>3</sub> H <sub>7</sub> OH (Isopropanol) <sup>4)</sup>	0.5 vol%	- <sup>1)</sup>	- <sup>1)</sup>	- <sup>1)</sup>
CH <sub>3</sub> COCH <sub>3</sub> (Acetone) <sup>4)</sup>	1 vol%	- <sup>1)</sup>	- <sup>1)</sup>	- <sup>1)</sup>

CH <sub>4</sub> (Methane) <sup>4)</sup>	3 vol%	- <sup>1)</sup>	- <sup>1)</sup>	- <sup>1)</sup>
CO(Carbon monoxide) <sup>5)</sup>	1 vol%	- <sup>1)</sup>	- <sup>1)</sup>	- <sup>1)</sup>
NO(Nitrogen monoxide)	0.02 vol%	- <sup>1)</sup>	- <sup>1)</sup>	- <sup>1)</sup>
O <sub>2</sub> <sup>5)</sup>	100 vol%	- <sup>2)</sup>	- <sup>1)</sup>	- <sup>1)</sup>

Note 1: Negligible interference, effect included in the specification “Accuracy, all conditions” above.

Note 2: Negligible interference with N<sub>2</sub>O / O<sub>2</sub> concentrations correctly set, effect included in the specification “Accuracy, all conditions” above.

Note 3: Interference at indicated gas level. For example, 50 vol% Helium typically decreases the CO<sub>2</sub> readings by 6%. This means that if measuring on a mixture containing 5.0vol% CO<sub>2</sub> and 50vol% Helium, the actual measured CO<sub>2</sub> concentration will typically be  $(1-0.06) * 5.0\text{vol}\% = 4.7\text{vol}\% \text{CO}_2$ .

Note 4: According to the EN ISO 80601-2-55:2011 standard.

Note 5: In addition to the EN ISO 80601-2-55:2011 standard.

## A.11.2 Mainstream

### IRMA module

Module Type	IRMA AX+	Displaying the concentration of CO <sub>2</sub> , N <sub>2</sub> O and two anaesthesia agent and indentifying two anaesthesia agent
Measurement Parameters	CO <sub>2</sub> , N <sub>2</sub> O, HAL, Isoflurane (ISO), Enflurane (ENF), Sevoflurane (SEV), Desflurane (DES), awRR, MAC	
Measurement Principle	CO <sub>2</sub> , N <sub>2</sub> O, anaesthesia agent: infra-red absorption characteristic	
Barometric Pressure Compensation	Automatic	
Data Sample Rate	20 data frames, 420 bytes, per second	
Warm-up Time	IRMA AX+: < 20 seconds (Concentrations reported, automatic agent identification enabled and full accuracy)	
Rise Time	CO <sub>2</sub> ≤ 90 ms N <sub>2</sub> O ≤ 300 ms HAL, ISO, ENF, SEV, DES ≤ 300 ms (Measured at 10 l/min with gas concentration steps corresponding to 30% of total measuring range for each gas.)	

Primary Agent Threshold	0.15 vol%. When an agent is identified, concentrations will be reported even below 0.15 vol% as long as apnea is not detected.		
Secondary Agent Threshold	0.2 vol% + 10% of total agent concentration		
Agent Identification Time	< 20 seconds (typically < 10 seconds)		
Total System Response Time	< 1 second (Measured at 10 l/min with gas concentrations according to table 201.103 in EN ISO 80601-2-55:2011.)		
Respiration Rate	(0-150) ± 1 bpm. The respiration rate is displayed after three breaths and the average value is updated every breath.		
Fi and ET	<p>IRMA AX+: CO<sub>2</sub>, N<sub>2</sub>O, primary and secondary agents (HAL, ENF, ISO, SEV, DES)</p> <p>Fi and ET are displayed after one breath and have a continually updated breath average.</p> <p>ET-values for anesthetic agents and N<sub>2</sub>O (IRMA AX+) will typically decrease below nominal value when respiration rate exceeds 80 bpm according to the formula <math>ET = 80 * ET_{nom} / RR</math> (tested at I/E ratio 1:1 using breath simulator according to EN ISO 80601-2-55 fig. 201.101).</p> <p>EtCO<sub>2</sub> will be within specification for all respiration rates up to 150 bpm (IRMA AX+).</p>		
Data Update Period	1 s		
Measurement Range	<p>CO<sub>2</sub>: 0 to 25 vol%</p> <p>N<sub>2</sub>O: 0 to 100 vol%</p> <p>HAL, ENF, ISO, SEV, DES: 0-25 vol%</p> <p>AwRR: (0 to 150) rpm</p>		
Resolution	<p>CO<sub>2</sub>: 0.1%</p> <p>HAL, ENF, ISO, SEV, DES: 0.1%</p> <p>N<sub>2</sub>O: 1%</p> <p>AwRR: 1 rpm</p>		
☆ Accuracy- Standard Conditions	Gas	Range	Accuracy
	CO <sub>2</sub>	0 to 15 vol%	±(0.2 vol% + 2% of reading)
	N <sub>2</sub> O	0 to 100 vol%	±(2 vol% + 2% of reading)
	HAL ISO ENF	0 to 8 vol%	±(0.15 vol% + 5% of reading)

	SEV	0 to 10 vol%	$\pm(0.15 \text{ vol\%} + 5\% \text{ of reading})$
	DES	0 to 22 vol%	$\pm(0.15 \text{ vol\%} + 5\% \text{ of reading})$
☆Accuracy- All Conditions	Gas	Accuracy	
	CO <sub>2</sub>	$\pm(0.3 \text{ kPa} + 4\% \text{ of reading})$	
	N <sub>2</sub> O	$\pm(2 \text{ kPa} + 5\% \text{ of reading})$	
	Agents	$\pm(0.2 \text{ kPa} + 10\% \text{ of reading})$	
☆AwRR Accuracy	±1 rpm		
☆Apnea Alarm Delay	20 s, 25 s, 30 s, 35 s, 40 s; default value is 20 s.		
Work Mode	Measure		
☆Alarm	Providing alarms of EtCO <sub>2</sub> , FiCO <sub>2</sub> , EtN <sub>2</sub> O, FiN <sub>2</sub> O, EtAA, FiAA, AwRR		
Support:			
<ul style="list-style-type: none"> <li>◆ Real-time gas concentration monitoring</li> <li>◆ Zero calibration</li> </ul>			

## Interfering Gas and Vapour Effects:

Gas or Vapour	Gas Level	CO <sub>2</sub>	Agents	N <sub>2</sub> O
		IRMA AX+		
N <sub>2</sub> O <sup>4)</sup>	60 vol%	-1&2)	-1)	-1)
HAL <sup>4)</sup>	4 vol%	-1)	-1)	-1)
ENF, ISO, SEV <sup>4)</sup>	5 vol%	-1)	-1)	-1)
DES <sup>4)</sup>	15 vol%	-1)	-1)	-1)
Xe(Xenon) <sup>4)</sup>	80 vol%	-10% of reading 3)	-1)	-1)
He(Helium) <sup>4)</sup>	50 vol%	-6% of reading 3)	-1)	-1)
Metered Dose Inhaler Propellants <sup>4)</sup>	Not for use with metered dose inhaler propellants			
C <sub>2</sub> H <sub>5</sub> OH(Ethanol) <sup>4)</sup>	0.3 vol%	-1)	-1)	-1)
C <sub>3</sub> H <sub>7</sub> OH (Isopropanol) <sup>4)</sup>	0.5 vol%	-1)	-1)	-1)
CH <sub>3</sub> COCH <sub>3</sub> (Acetone) <sup>4)</sup>	1 vol%	-1)	-1)	-1)
CH <sub>4</sub> (Methane) <sup>4)</sup>	3 vol%	-1)	-1)	-1)



CO(Carbon monoxide) 5)	1 vol%	- 1)	- 1)	- 1)
NO(Nitrogen monoxide) 5)	0.02 vol%	- 1)	- 1)	- 1)
O <sub>2</sub> 5)	100 vol%	- 1&2)	- 1)	- 1)

Note 1: Negligible interference, effect included in the specification “Accuracy, all conditions” above.

Note 2: IRMA AX+ does not measure O<sub>2</sub>.

Note 3: Interference at indicated gas level. For example, 50 vol% Helium typically decreases the CO<sub>2</sub> readings by 6%. This means that if measuring on a mixture containing 5.0vol% CO<sub>2</sub> and 50vol% Helium, the measured CO<sub>2</sub> concentration will typically be  $(1-0.06) * 5.0 \text{ vol\%} = 4.7\text{vol\% CO}_2$ .

Note 4: According to the EN ISO 80601-2-55:2011 standard.

Note 5: In addition to the EN ISO 80601-2-55:2011 standard.

## A.12 Interfaces

### A.12.1 Analog Output

Bandwidth (-3dB; reference frequency: 10Hz)	Diagnosis/Monitor: 0.5Hz to 40 Hz Surgery: 1 Hz to 20 Hz
Maximum Transmission Delay (Diagnosis Mode)	500 ms
Sensitivity	1 V/1 mV ±10%
PACE Rejection/ Enhancement	Not applicable.
Waveform Display	Consistent with the calculation leads.
Compliant with Standard and Directive	Complies with the requirements in terms of short circuit protection and leakage current in EN60601-1.
Output Impedance	<500 Ω
Interface Type	PS2 connector

#### NOTE:

While using analog output, set the calculation lead as following:

- 1) In 3-lead mode, set to Lead I, Lead II, or Lead III.
- 2) In 5-lead mode, set to Lead I, Lead II, Lead III or Lead V.

### A.12.2 Defibrillator Synchronization

Output Impedance	<500 $\Omega$
Maximum Time Delay	35 ms (R-wave peak to leading edge of pulse)
Waveform	Rectangular wave
Amplitude	High level: 3.5 V to 5.5 V, providing a maximum of 1 mA output current; Low level: <0.5 V, receiving a maximum of 5 mA input current
Minimum Required R-wave Amplitude	0.3 mV
Pulse Width	100 ms $\pm$ 10%
Limited Current	15 mA rating
Rising and Falling Time	<1 ms
Interface Type	PS2 connector

### A.12.3 Nurse Call

Drive Mode	Voltage output
Power Supply	$\leq$ 12.6 VDC, 200 mA Max.
Interface Signal	12 V power supply and PWM waveform
Interface Type	PS2 connector

### A.12.4 USB Interfaces

Number of USB Interfaces	Standard: 1
Drive Mode	HOST interface, USB1.0/2.0 protocol
Power Supply	5 VDC $\pm$ 5%, 500 mA Max.
Interface Type	USB A-type port

### A.12.5 VGA Interface

Number of VGA Interface	1
Horizontal Refreshing Rate	30-94 KHZ
Video Signal	0.7 Vpp @ 75 Ohm, HSYNC/VSYNC signal TTL
Interface Type	DB-15 female receptacle

### A.12.6 Network Interface

Bandwidth	10 Mbps
Interface Type	Standard RJ-45 network interface

### A.12.7 SD Card Interface

Interface Type	Standard SD card interface
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## B EMC Information

### - Guidance and Manufacture's Declaration

#### B.1 Electromagnetic Emissions


<b>Guidance and manufacture's declaration – electromagnetic emission</b>		
iM60 VET/ iM70 VET are intended for use in the electromagnetic environment specified below. The customer or the user of iM60 VET/ iM70 VET should assure that they are used in such an environment.		
<b>Emission test</b>	<b>Compliance</b>	<b>Electromagnetic environment – guidance</b>
RF emissions CISPR 11	Group 1	iM60 VET/ iM70 VET use RF energy only for their internal function. Therefore, their RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emission CISPR 11	Class A	iM60 VET/ iM70 VET are suitable for use in all establishments, other than domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC/EN 61000-3-2	Class A	
Voltage fluctuations/ flicker emissions IEC/EN 61000-3-3	Complies	

#### B.2 Electromagnetic Immunity

<b>Guidance and manufacture's declaration – electromagnetic immunity</b>			
iM60 VET/ iM70 VET is intended for use in the electromagnetic environment specified below. The customer or the user of iM60 VET/ iM70 VET should assure that they are used in such an environment.			
<b>Immunity test</b>	<b>IEC/EN 60601 test level</b>	<b>Compliance level</b>	<b>Electromagnetic environment - guidance</b>
Electrostatic discharge (ESD) IEC/EN 61000-4-2	±6 kV contact ±8 kV air	±6 kV contact ±8 kV air	Floors should be wood, concrete or ceramic tile. If floor are covered with synthetic material, the relative humidity should be at least 30%.

Electrical fast transient/burst IEC/EN 61000-4-4	$\pm 2$ kV for power supply lines	$\pm 2$ kV for power supply lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC/EN 61000-4-5	$\pm 1$ kV for line to line $\pm 2$ kV for line to ground	$\pm 1$ kV for line to line $\pm 2$ kV for line to ground	Mains power quality should be that of a typical commercial or hospital environment.
Power frequency (50 Hz /60 Hz) magnetic field IEC/EN 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC/EN 61000-4-11	$< 5\% U_T$ ( $> 95\%$ dip in $U_T$ ) for 0.5 cycle  $40\% U_T$ ( $60\%$ dip in $U_T$ ) for 5 cycles  $70\% U_T$ ( $30\%$ dip in $U_T$ ) for 25 cycles  $< 5\% U_T$ ( $> 95\%$ dip in $U_T$ ) for 5 sec	$< 5\% U_T$ ( $> 95\%$ dip in $U_T$ ) for 0.5 cycle  $40\% U_T$ ( $60\%$ dip in $U_T$ ) for 5 cycles  $70\% U_T$ ( $30\%$ dip in $U_T$ ) for 25 cycles  $< 5\% U_T$ ( $> 95\%$ dip in $U_T$ ) for 5 sec	Mains power quality should be that of a typical commercial or hospital environment. If the user of iM60/ iM70 VET requires continued operation during power mains interruptions, it is recommended that iM60/ iM70 VET be powered from an uninterruptible power supply or a battery.
<b>NOTE</b> $U_T$ is the a.c. mains voltage prior to application of the test level.			

### B.3 Electromagnetic Immunity

<b>Guidance and manufacture’s declaration – electromagnetic immunity</b>			
iM60 VET/ iM70 VET are intended for use in the electromagnetic environment specified below. The customer or the user of iM60 VET/ iM70 VET should assure that they are used in such an environment.			
<b>Immunity test</b>	<b>IEC/EN 60601 test level</b>	<b>Compliance level</b>	<b>Electromagnetic environment - guidance</b>
Conducted RF IEC/EN 61000-4-6	3 V <sub>rms</sub> 150 kHz to 80 MHz	3 V <sub>rms</sub>	<p>Portable and mobile RF communications equipment should be used no closer to any part of iM60 VET/ iM70 VET, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.</p> <p><b>Recommended separation distance</b></p> <p><math>d = 1.2\sqrt{P}</math> 150 kHz to 80 MHz</p>
Radiated RF IEC/EN 61000-4-3	3 V/m 80 MHz to 2.5 GHz	3 V/m	<p><math>d = 1.2\sqrt{P}</math> 80 MHz to 800 MHz</p> <p><math>d = 2.3\sqrt{P}</math> 800 MHz to 2.5 GHz</p> <p>Where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m).</p> <p>Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey,<sup>a</sup> should be less than the compliance level in each frequency range.<sup>b</sup></p> <p>Interference may occur in the vicinity of equipment marked with the following symbol:</p> 

**NOTE 1** At 80 MHz and 800 MHz, the higher frequency range applies.

**NOTE 2** These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

<sup>a</sup> Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which iM60 VET / iM70 VET is used exceeds the applicable RF compliance level above, iM60 VET / iM70 VET should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating iM60 VET / iM70 VET.

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

## B.4 Recommended Separation Distances

### Recommended separation distances between portable and mobile RF communications equipment and iM60 VET/ iM70 VET

iM60 VET/ iM70 VET are intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of iM60 VET/ iM70 VET can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and iM60 VET/ iM70 VET as recommended below, according to the maximum output power of the communications equipment.

Rated maximum output power of transmitter (W)	Separation distance according to frequency of transmitter(m)		
	150 kHz to 80 MHz $d = 1.2\sqrt{P}$	80 MHz to 800 MHz $d = 1.2\sqrt{P}$	800 MHz to 2.5 GHz $d = 2.3\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

For transmitters rated at a maximum output power not listed above, the recommended separation distance  $d$  in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where  $P$  is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

**NOTE 1** At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

**NOTE 2** These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

## C Default Settings

This appendix documents the most important default settings of your monitor as it is delivered from the factory.

Note: If your monitor has been ordered preconfigured to your requirements, the settings at delivery will be different from those listed here.

### C.1 Patient Information Default Settings

Patient Information Settings	
Patient Type	Feline
Cuff Type	Small
Pace	Off

### C.2 Alarm Default Settings

Alarm Settings	
Pause Time	120s
Sensor Off Alarm	Off
Alarm Latch	Off
Disconnect Alarm	Off

### C.3 ECG Default Settings

ECG Settings	
Alarm Switch	On
Alarm Record	Off
Alarm Level	Medium
Alarm High Limit	200
Alarm Low Limit	100
Pace	Off
Lead Type	5 Leads
Display	Normal
Filter	Middle
Smart Lead Off	Off
Heart Volume	3



ST Analysis			
ST Analysis	Off		
Alarm Switch	Off		
Alarm Level	Medium		
Alarm Record	Off		
Alarm High Limit (ST-X)	0.2		
Alarm Low Limit (ST-X)	-0.2		
X stands for I, II, III, aVR, aVL, aVF, V.			
ARR Analysis			
ARR Analysis	On		
PVCs Alarm Level	Medium		
PVCs Alarm Switch	Off		
PVCs Alarm Record	Off		
ARR Alarm Settings	Alarm Switch	Alarm Level	Alarm Record
ASYSTOLE	On	High	Off
VFIB/VTAC	On	High	Off
R ON T	On	Medium	Off
VT > 2	On	Medium	Off
COUPLET	On	Medium	Off
PVC	On	Medium	Off
BIGEMINY	On	Medium	Off
TRIGEMINY	On	Medium	Off
TACHY	On	Medium	Off
BRADY	On	Medium	Off
MISSEDBEATS	On	Medium	Off
IRR	On	Medium	Off
PNC	On	Medium	Off
PNP	On	Medium	Off
VBRADY	On	Medium	Off
VENT	On	Medium	Off

## C.4 RESP Default Settings

RESP Settings	
Alarm Switch	On
Alarm Record	Off
Alarm Level	Medium
Alarm High Limit	100
Alarm Low Limit	30
Apnea Time	20s
Calculation Type	Auto
RESP Type	II
Sweep	12.5mm/s
Amplitude	1

## C.5 SpO<sub>2</sub> Default Settings

SpO <sub>2</sub> Settings	
Alarm Switch	On
Alarm Record	Off
Alarm Level	Medium
Alarm High Limit	95
Alarm Low Limit	88
Pitch Tone	On
Sweep	12.5mm/s

## C.6 PR Default Settings

PR Settings	
PR Source	SpO <sub>2</sub>
Alarm Switch	On
Alarm Record	Off
Alarm Level	Medium
Alarm High Limit	200
Alarm Low Limit	100

Pulse Volume	3
Alarm Source	Auto

## C.7 NIBP Default Settings

NIBP Settings	Big Cuff	Middle Cuff	Small Cuff
Alarm Switch	On		
Alarm Record	Off		
Alarm Level	Medium		
Alarm High Limit (SYS)	160	120	90
Alarm Low Limit (SYS)	90	70	40
Alarm High Limit (Map)	110	90	70
Alarm Low Limit (Map)	60	50	30
Alarm High Limit (Dia)	90	70	60
Alarm Low Limit (Dia)	50	40	20
Inflation value	160	140	100
Unit	mmHg		
Inflation mode	Manual		

## C.8 TEMP Default Settings

TEMP Settings	
Alarm Switch	On
Alarm Record	Off
Alarm Level	Medium
Alarm High Limit (T1)	39.0
Alarm Low Limit (T1)	36.0
Alarm High Limit (T2)	39.0
Alarm Low Limit (T2)	36.0
Alarm High Limit (TD)	2.0
Unit	°C

## C.9 IBP Default Settings

IBP Settings			
Alarm Switch	On		
Alarm Record	Off		
Alarm Level	Medium		
Unit	mmHg		
Filter	12.5Hz		
	SYS	DIA	MAP
Alarm High Limit (ART, P1, P2)	90	60	70
Alarm Low Limit (ART, P1, P2)	55	20	35
Alarm High Limit (PA)	60	4	26
Alarm Low Limit (PA)	24	-4	12
	MAP		
Alarm High Limit (CVP, RAP, LAP, ICP)	4		
Alarm Low Limit (CVP, RAP, LAP, ICP)	0		

## C.10 CO<sub>2</sub> Default Settings

CO <sub>2</sub> Settings	
Alarm Switch	On
Alarm Record	Off
Alarm Level	Medium
Work Mode	Standby
Unit	mmHg
Apnea Time	20s
O <sub>2</sub> Compensate	16%
Anes Agent	0%
Alarm High Limit (EtCO <sub>2</sub> )	45
Alarm Low Limit (EtCO <sub>2</sub> )	30
Alarm High Limit (FiCO <sub>2</sub> )	4
Alarm High Limit (AWRR)	100

Alarm Low Limit (AWRR)	30
Sweep	6.25 mm/s
Amplitude	Low

## C.11 AG Default Settings

AG Settings	
Alarm Switch	On
Alarm Record	Off
Alarm Level	Medium
Work Mode	Measure
Apnea Time	20s
Unit	%
O <sub>2</sub> Compensate	OFF
Anes Agent	HAL
Alarm High Limit (EtAA)	8.0
Alarm Low Limit (EtAA)	0.0
Alarm High Limit (FiAA)	6.0
Alarm Low Limit (FiAA)	0.0
Alarm High Limit (EtN <sub>2</sub> O)	55
Alarm Low Limit (EtN <sub>2</sub> O)	0
Alarm High Limit (FiN <sub>2</sub> O)	53
Alarm Low Limit (FiN <sub>2</sub> O)	0
Alarm High Limit (EtO <sub>2</sub> )	90.0
Alarm Low Limit (EtO <sub>2</sub> )	18.0
Alarm High Limit (FiO <sub>2</sub> )	88.0
Alarm Low Limit (FiO <sub>2</sub> )	18.0
Sweep	6.25 mm/s
Amplitude	2

## D Abbreviations

Abbr	English Full Name/Description
AC	Alternating current
AG	Anaesthesia gas
Art	Arterial
aVF	Left foot augmented lead
aVL	Left arm augmented lead
aVR	Right arm augmented lead
awRR	Airway respiration rate
BP	Blood pressure
BTPS	Body temperature and pressure, saturated
CISPR	International Special Committee on Radio Interference
CO <sub>2</sub>	Carbon dioxide
COHb	Carboxyhemoglobin
CVP	Central venous pressure
DC	Direct current
Des	Desflurane
Dia	Diastolic
ECG	Electrocardiogram
EEC	European Economic Community
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
Enf	Enflurane
ESU	Electrosurgical unit
Et	End-tidal
EtCO <sub>2</sub>	End-tidal carbon dioxide
EtN <sub>2</sub> O	End-tidal nitrous oxide
Eto	Ethylene oxide
EtO <sub>2</sub>	End-tidal oxygen
FDA	Food and Drug Administration
Fi	Fraction of inspired

FiCO <sub>2</sub>	Fraction of inspired carbon dioxide
FiN <sub>2</sub> O	Fraction of inspired nitrous oxide
FiO <sub>2</sub>	Fraction of inspired oxygen
Hal	Halothane
Hb	Hemoglobin
Hb-CO	Carbon mono-xide hemoglobin
HR	Heart rate
IBP	Invasive blood pressure
ICP	Intracranial pressure
ICU	Intensive care unit
ID	Identification
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
Iso	Isoflurane
LA	Left arm
LAP	Left atrial pressure
LCD	Liquid crystal display
LED	Light emitting diode
LL	Left leg
MAP	Mean arterial pressure
MDD	Medical Device Directive
MetHb	Methemoglobin
MRI	Magnetic resonance imaging
N/A	Not applied
N <sub>2</sub>	Nitrogen
N <sub>2</sub> O	Nitrous oxide
NIBP	Non-invasive blood pressure
O <sub>2</sub>	Oxygen
oxyCRG	Oxygen cardio-respirogram
PA	Pulmonary artery
Pleth	Plethysmogram
PR	Pulse rate

PVC	Premature ventricular complex
R	Right
RA	Right arm
RAP	Right atrial pressure
RESP	Respiration
RHb	Reduced hemoglobin
RL	Right leg
RR	Respiration Rate
Sev	Sevoflurane
SYS	Systolic pressure
TB	Blood Temperature
TD	Temperature difference
TEMP	Temperature
USB	Universal serial bus



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