midmark™

# Midmark Multiparameter Monitor
# Veterinary Vital Signs Monitor

**For Models:**

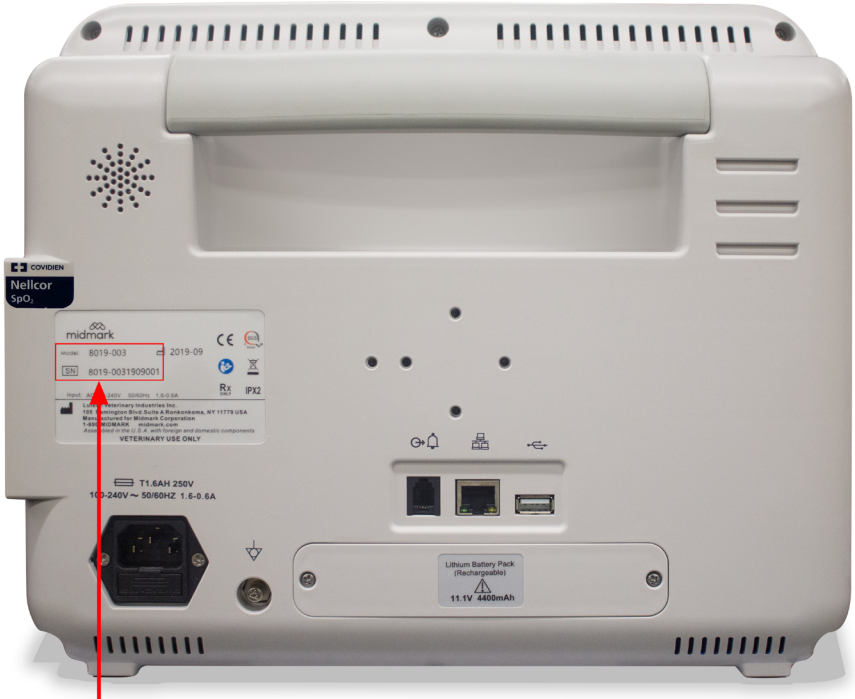
8019-001
8019-002
8019-003


# User's Guide


**003-10271-00 Rev. AA2 (05/26/2020)**
**Software Version V2.00**

# Product Information

| | |
|---|---|
| ***Dealer:*** | ***Date of Purchase:*** |
| ***Model / Serial Number:*** | ***Midmark Authorized Service Company:*** |




**Model/Serial Number Location**

## Product Registration

To register your product, go to www.midmark.com

# Table of Contents

# SECTION 1 - PREFACE

## 1.1 General

Welcome and thank you for choosing the portable Midmark Multiparameter Monitor. The Midmark Multiparameter Monitor continuously monitors and displays the following physiological parameters: ECG waveforms and heart rate, peripheral capillary oxygen saturation, an estimate of the amount of oxygen in the blood, SpO2 is an estimate of arterial oxygen saturation and pulse rate, respiration rate, systolic (SYS), diastolic (DIA) and mean arterial pressure (MAP), and temperature. Available options for this monitor include Invasive Blood Pressure and a built in printer.

This Midmark Multiparameter Monitor can be upgraded to offer CO2 or Multi-gas monitoring at any time. With the addition of a Respironics Capnostat® 5 mainstream sensor or Respironics LoFlo™ sidestream analyzer, one can measure end-tidal CO2 as well as inspired CO2. Alternatively, one can use Masimo IRMA™ Mainstream CO2 probe or NomoLine® ISA™ CO2 Sidestream gas analyzer for measuring the same. Masimo IRMA™ AX+ Mainstream multi-gas probe or ISA™ AX+Sidestream multi-gas analyzer can be used to measure N2O as well as five anesthetic agents (HAL, ENF, ISO, SEV, DES) in addition to CO2.

This User's Guide is an integral part of the product and contains detailed information about the performance specifications, operation, and maintenance of the Midmark Multiparameter Monitor and its intended use. Observance of this User's Guide is a prerequisite for proper product performance and correct operation and ensures patient and operator safety. It should always be kept close to the equipment.

## 1.2 Compliance

The manufacturer's quality management system complies with the international standards ISO 13485:2016 and has the certificate issued by TUV. Additional quality compliance certification includes IEC 60601-1, IEC 60601-1-2: 2014, IEC 60601-2-27: 2011, IEC 60601-2-25: 2011, IEC 80601-2-30: 2009, IEC60601-2-34:2011, IEC 60601-2-49: 2011, ISO 80601-2-56: 2009, ISO 80601-2-61: 2011, IEC 62133, RoHS Directive 2011/65/EU, CE, IPX2 and NRTL (USA and Canada).

# SECTION 2 - SAFETY

## 2.1 Safety Notice

### 2.1.1 Intended Use

The Midmark Multiparameter Monitor is a portable multi-parameter monitoring device for animals intended to monitor basic physiological parameters of one patient at a time within an animal health environment and make that monitored data available to be interpreted by licensed veterinarians or veterinary technicians.

### 2.1.2 Application Environment

This device is for use by trained veterinary personnel in veterinary centers. The device is to be used on one patient at a time.

| **Transport and Storage Conditions** | |
|---|---|
| Temperature: | -4°F (-20°C) to 140°F (60°C) |
| Humidity: | 30%-93% (non-condensing) |
| Atmospheric Pressure: | 700-1060mbar (hPa) |

| **Working Conditions** | |
|---|---|
| Temperature: | 41°F (5°C) to 104°F (40°C) |
| Humidity: | 30%-85% (non-condensing) |
| Atmospheric Pressure: | 700-1060mbar (hPa) |

### 2.1.3 Operator Requirements

Only qualified veterinary personnel who have read the User's Guide should use this monitor. The monitor is intended only as an adjunct in patient assessment. It must be used in conjunction with clinical signs and symptoms. United States Federal Law restricts this device to sale, distribution and use by or on the order of a veterinarian.

### 2.1.4 Terminology

The terms **NOTE**, **CAUTION**, and **WARNING** are used throughout this User's Guide to point out hazards and to designate a degree or level of seriousness. Familiarize yourself with their definitions and significance.

***NOTE***
*Provides application tips or other useful information to assure that you get the most from your equipment.*

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

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

### 2.1.5 Monitor Safety

The safety statements presented in this chapter refer to the equipment in general and in most cases, apply to all aspects of the monitor. There are additional safety statements in the parameter chapters, which are specific to that monitored parameter.

The order in which safety statements are presented in no way implies order of importance.

## *2.2 Safety Requirements*

The following warnings and cautions must be read and understood before operating the veterinary monitor.

### 2.2.1 WARNING:

- This monitor is intended for use by trained and qualified veterinary personnel only.
- The Midmark Multiparameter Monitor veterinary monitor is not intended to be used as an apnea monitor.
- The Midmark Multiparameter Monitor veterinary monitor is not intended to be used during MRI or CT scan.
- When a defibrillator is used, make sure the patient does not make contact with the ground, metal objects, or other conductors or devices. During defibrillation, never touch the patient, table or the device.
- Please do not rely on the alarm functions of the veterinary monitor. The alarm limits may have been improperly set or the alarm may have been disabled.
- Alarm functions of the veterinary monitor must be checked regularly.
- Before putting the system into operation, visually inspect all connecting cables for signs of damage. Damaged cables and connectors must be replaced immediately.
- When several devices are used on the same patient, leakage current may increase and become a danger to the patient. Before using, please consult a professional to do a leakage current test to make sure the leakage current is within safety limits.
- Before using on another patient, make sure the previous monitoring data is cleared.
- Use properly grounded power sockets and ensure adequate grounding. If there is any doubt about the grounding, please use battery operation.
- Do not use the monitor in a location where flammable gases such as anesthetics are not properly contained and treated to prevent explosion or fire.
- The Monitor should only be used on one patient at a time.

### 2.2.2 CAUTION:

- Check accessories on a regular basis and discard damaged accessories properly.
- To ensure patient’s safety and performance of the product, use only the manufacturer recommended accessories.
- Service parts must be in conformity with IEC 60601 standards. The system configuration of the monitor must be in conformity with IEC 60601-1-1 medical electric standard; otherwise, it will reduce the safety of the monitor.
- Even while not being used, the battery may still discharge. Check battery level every month.
- The ECG cable socket is for connecting ECG lead wires only. Please do not connect it to any other signal source. Pay attention to the color label and marks of ECG lead wires.
- Ensure that the conductive parts of electrodes and associated connectors, including neutral electrodes, do not come in contact with earth or any other conducting objects.
- Please clean the monitor and accessories according to instructions. Always unplug the power cord before cleaning.
- Electromagnetic Interference - This product is designed and built to minimize electromagnetic interference with other devices. However, if interference is noticed between another device and this monitor:
    - Remove interfering device from room.
    - Plug monitor into an isolated circuit.
    - Increase separation between Midmark product and interfering device.
    - Contact Midmark if interference persists.

- For continual safe use of this equipment, it is necessary to follow the instructions. However, instructions listed in this User's Guide in no way supersede established medical practices concerning patient care.
- In the event of interrupted data or loss of data, please keep patient under close observation until the device returns to normal.
- Other devices connecting to the device should meet IEC standards (for example, data processing device should meet IEC 950, and medical device should meet IEC60601-1) and the whole system should meet the latest version of IEC60601-1-1 standards.
- Plastic bags and other packaging materials should be disposed of in accordance with related regulations.
- At the end of product life, the monitor, accessories, battery, and other consumable goods may become contaminated from normal use. Consult local codes and ordinances for proper disposal of equipment and other consumable goods.
- Do not open the enclosure of the monitor to avoid the risk of electrical shock.

**2.2.3 NOTE:**

- Install the monitor in a location that is easy for observation, operation and maintenance.
- Keep the User's Guide near the monitor for easy reference.

**2.2.4 WARNING - Li-ion Battery**

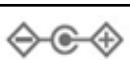
- Improper operation may cause the internal li-ion battery (hereinafter called battery) to become heated or to ignite or explode. It may also lead to a decrease in battery capacity. Please read the Operator's Manual carefully and thoroughly before operating the monitor.
- Do not reverse the anode and the cathode when installing the battery as it may cause an explosion.
- Do not use the battery near a fire or in an environment where the temperature exceeds 140°F (60°C).
- Do not heat the battery or throw it into fire.
- Do not splash the battery or throw it into water.
- Do not destroy the battery. Do not pierce, hit, step on, throw, drop, shock, or physically damage the battery in any way.
- Do not disassemble or modify the battery as it could lead to overheating, smoking, deformation, burning, or other dangerous results.
- If leakage or foul smell is found, stop using the battery immediately. If your skin or clothes come into contact with the leakage liquid, cleanse it with clean water at once. If the leakage liquid splashes into your eyes, do not wipe them. Irrigate them with clean water first and go see a doctor immediately.
- Only qualified service engineers authorized by the manufacturer can open the battery compartment and replace the battery.
- Only use batteries made specifically for this monitor.
- Properly dispose of or recycle the depleted battery according to local rules and regulations.

**2.2.5 WARNING - Cleaning and Maintenance**

- Turn off the power before cleaning and disinfecting. The mains power supply must be switched off if it is used, and the power cord and any patient cables must be removed.
- Do not allow any detergent to seep into the monitor.
- Never immerse the monitor and patient cables in liquid.
- Do not clean the monitor and accessories with abrasive fabric and avoid scratching the electrodes.
- Any remainder of detergent should be removed from the unit and the patient cable after cleaning.
- Do not use high-temperature, high-pressure vapor or ionizing radiation as disinfection methods. Do not use chloric disinfectant such as chloride, sodium hypochlorite etc.

## 2.3 Safety Symbols

***NOTE***
*Some symbols may not appear on all equipment.*

| Symbol | Definition |
|---|---|
|  | Type BF Applied Part: F-type, defibrillation proof applied part (floating/insulated) complying with the specified requirements of IEC 60601-1 Medical Standards to provide a higher degree of protection against electric shock than that provided by Type B applied parts. There are six BF type defibrillation proof applied parts (NIBP, TEMP1, TEMP2, Nellcor SpO2, Masimo AG, Masimo or Respironics CO2) and following exposure to a defibrillation event, the parameters will resume normal operation after 10 seconds. |
|  | Type CF Applied Part: F-type, defibrillation proof applied part (floating/insulated) complying with the specified requirements of IEC 60601-1 Medical Standards to provide a higher degree of protection against electric shock than that provided by Type BF applied parts. There are three CF type defibrillation proof applied parts (ECG, IBP1, IBP2) and following exposure to a defibrillation event, the ECG parameter will resume normal operation after 5 seconds, while IBP will resume after 10 seconds. |
|  | Attention: Consult accompanying documents. |
|  | DC Power Supply |
|  | Fuse |
|  | Power Adapter |
|  | Equipotentiality |
|  | Power ON/OFF |
|  | Alternating |
|  | Current Earth Connector |
|  | Network Interface |
|  | USB Interface |
|   | Caution: U.S. federal law restricts this device to sale by or on the order of a veterinarian. |
|   | Liquid Protection Class |
|  | Waste electrical and electronic equipment directive |
|  | Notified Body Code |

| | |
|---|---|
|  | Production Date |
|   | Serial Number |
|  | Manufacturer Info |

## *2.4 Packaging Symbols*

These symbols are used on the packaging material for the Midmark Multiparameter Monitor:

| Symbol | Definition |
|---|---|
|  | Keep Upright |
|  | Fragile, Handle with Care |
|   | Maximum Stacking |
|  | Keep Dry |
|   | Temperature Range Requirement |
|   | Humidity Range Requirement |
|   | Pressure Range Requirement |

# SECTION 3 - CONTROLS & CONNECTORS

## 3.1 Installation and Connection

### 3.1.1 Environment Requirements

To ensure electric installation safety, the environment should be reasonably dust free, without corrosive or combustible gas, or extreme temperature or humidity.

Keep a space for the veterinary monitor at least 5cm from the wall to ensure good air ventilation.

Extreme temperature can affect the accuracy of the monitor and damage accessories or circuits.

Please ensure that water does not condense in the veterinary monitor when using the device. For instance, when the monitor is transferred between buildings, there is a risk of condensation because of exposure to humidity combined with a difference in temperature.

***WARNING***
***Never use the veterinary monitor in an environment with combustible anesthetic gases.***

### 3.1.2 Power Supply Requirements

| | |
|---|---|
| Rated Input Voltage: | AC100V-240V |
| Rated Frequency: | 50Hz/60Hz |
| Rated Input Power: | 160VA |
| Fuses: | T1.6AH, 250V* |
| Rated Battery Voltage: | d.c. 11.1V |
| Battery Capacity: | 4400mAh |
| ** Note: T1.6AL fuse can also be used* | |

### 3.1.3 Shock Protection

The Midmark Multiparameter Monitor veterinary monitor is a Class I device, in conformity with IEC60601/EN60601 requirements, with protective grounding (through three pin power plug).

***WARNING***
***To turn off the AC power, please unplug the power cord from power socket or unplug the power cord from the AC power receptacle on the monitor.***

The On/Off button will not turn off the AC power of the veterinary monitor.

### 3.1.4 Patient Grounding

During heart or head check, in order to eliminate the potential difference between different equipment, the monitor has a special cable to connect to the grounding system. The grounding cable should be used when using high electrical output equipment such as a defibrillator or electric cautery, or any equipment that may cause interference with the monitor.

Connect the small end of the grounding cable to the grounding (equipotentiality) connector on the monitor as shown in Fig. 3-2, Item 6. The large end (which may be a clamp-like object) of the grounding cable should be connected to any metal surface or copper pipes.

### 3.1.5 Combination of Equipment

Both medical and non-medical equipment must comply with IEC60601-1-1 standard.

***CAUTION***
*The use of several machines together can increase the current leakage which risks injury to patient and medical personnel.*

#### 3.1.6 Unpacking

After confirming the outside packing is intact, please open the box and inspect the contents:

- Midmark Multiparameter Monitor
- Component Package

If any damage is found during shipping, please keep the package and contact Midmark immediately.

## *3.2 Before Monitoring*

Before monitoring the patient, please check the following:

- Check if there is any mechanical damage.
- Check the external connections.
- Check if the veterinary monitor is in good working condition.

***WARNING***
***If any abnormalities are found or mechanical damage is suspected, please do not use the monitor and contact Midmark as soon as possible.***

**Step 1:** Turn the monitor on. The monitor will begin a sequence of self-diagnostic tests. If the tests are successful, you can start monitoring the patient. If changes need to be made to the operation or settings of the monitor, see the User's Guide.

**Step 2:** Make sure the monitor is connected to the patient with the appropriate accessories.

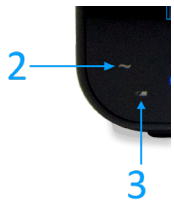
**Step 3:** After connections are in place, there should be waveforms or data on the screen, otherwise:

- Check the connections to the patient.
- Check the connections to the monitor.

## *3.3 Front Panel*

The front panel of the Midmark Multiparameter Monitor is as shown in Fig.3-1:

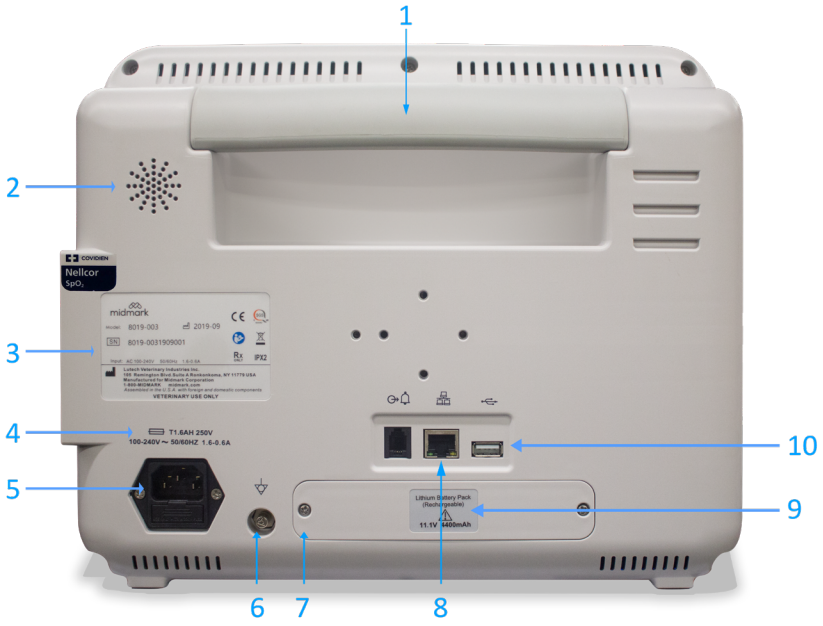

*The Midmark Multiparameter Monitor front enclosure (Fig.3-1)*

| | | |
|---|---|---|
|  | 1. | Power Switch: When the monitor is connected to the wall socket or there is enough battery power, press this button and the veterinary monitor will turn on or off. After the veterinary monitor is turned off, the battery continues to charge if the monitor is connected to AC power. |
|  | 2. | Power Indicator: AC power indicator. When the monitor is on and connected to AC power, the green LED will be on. If the monitor is not connected to AC power or if the monitor is not on, the LED will be off. |
| | 3. | Battery Indicator: This is the battery power indicator. When the monitor is on and connected to AC power, the green LED will be on if the battery is properly installed. The battery will automatically charge when connected to AC power. When disconnected from AC, a blinking green LED will be on. The LED will be off it the battery is not installed or if the monitor is off. |
|  | 4. | Alarm Reset: This will silence the audible alarm of physiological alarms and latching alarms that no longer exist. |
|  | 5. | Alarm Pause: This will pause the audible alarm for an interval designated by the user. |
|  | 6. | Freeze/Restore: When the waveform is sweeping across the screen, press this button to freeze the waveform. Press the button again to unfreeze the waveform sweep. The screen will remain frozen until the Freeze button is pressed again. |
|  | 7. | Start/Stop BP: Press this button to start blood pressure measurement; press it again to stop blood pressure measurement. If this button is not pressed to stop blood pressure measurement, the monitor will stop automatically when the measurement is completed. |
|  | 8. | Start/Stop Printing: Press this button to start printing. Press it again to stop printing. If this button is not pressed to stop printing, the monitor will stop printing automatically after printing out 8 seconds worth of data/waveform. The monitor may also be set to print at user selected intervals. |
|  | 9. | Settings: This opens the settings menu where the user may set preferences for various parameters and access major functions of the monitor. |

| | | |
|---|---|---|
|  | 10. | Brightness Sensor: This is the sensor for the auto brightness setting. It will detect ambient light conditions and automatically adjust the brightness of the screen. |
|  | 11. | Alarm Indicator: Dual-color (red/yellow alarm indicator). This lights up whenever there is an alarm.<br><br>For physiological alarms, it is dependent on the alarm level for each parameter. Red LED flashes if the parameter alarm level is set to High. Yellow LED flashes if the parameter alarm level is set to Med. Yellow LED stays on without flashing if the parameter alarm level is set to Low.<br><br>For technical alarms, the user is not able to adjust alarm levels. Therefore, it will also be a Yellow LED light, no flashing. |

## 3.4 Rear Panel

The rear panel of the Midmark Multiparameter Monitor veterinary monitor is as shown in Fig.3-2:



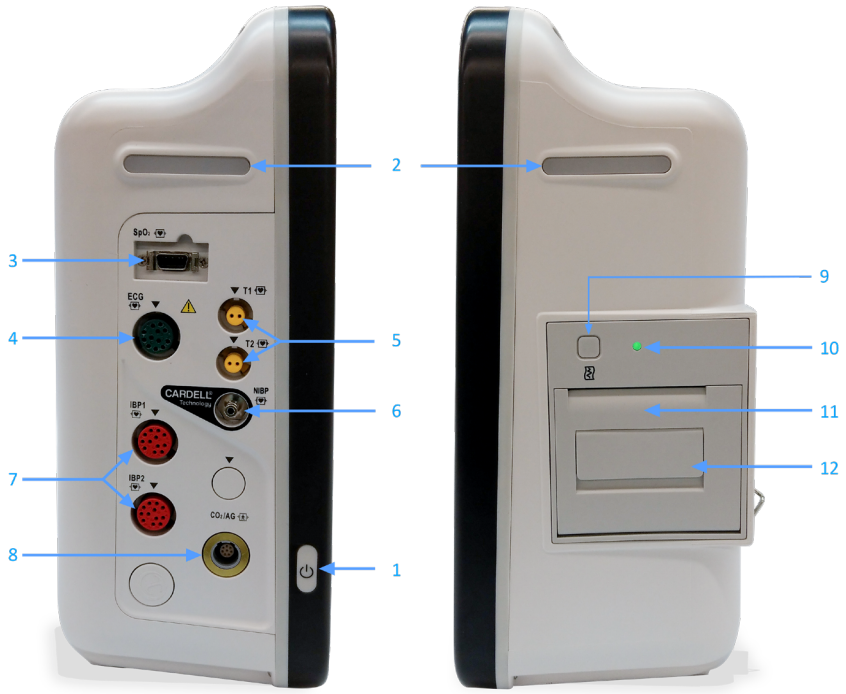

*The Midmark Multiparameter Monitor rear panel (Fig.3-2)*

| | | | |
|---|---|---|---|
| 1. | Handle | 7. | Battery Compartment |
| 2. | Speaker | 8. | Network Connection Port |
| 3. | Label | 9. | Battery Label |
| 4. | Fuse Info | 10. | USB Port |
| 5. | AC Power Connector | | |
| 6. | Grounding (Equipotentiality) Port | | |

***WARNING***
***Other equipment connected to the device should be certified according to IEC standards (i.e. IEC 950 for data-processing equipment, IEC 60601-1 for medical equipment and IEC 60601-1-1 for whole system).***

## 3.5 Side Panels

The side panel of the Midmark Multiparameter Monitor veterinary monitor is as shown in Fig. 3-3:




*The Midmark Multiparameter Monitor side panel (Fig.3-3)*

| | |
|---|---|
| 1. | Power Switch: When the monitor is connected to the wall socket or there is enough battery power, press this button and the veterinary monitor will turn on or off. After the veterinary monitor is turned off, the battery continues to charge if the monitor is connected to AC power. |
| 2. | Alarm Indicator: Dual-color (red/yellow alarm indicator). This lights up whenever there is an alarm.<br><br>For physiological alarms, it is dependent on the alarm level for each parameter. Red LED flashes if the parameter alarm level is set to High. Yellow LED flashes if the parameter alarm level is set to Med. Yellow LED stays on without flashing if the parameter alarm level is set to Low.<br><br>For technical alarms, the user is not able to adjust alarm levels. Therefore, it will also be a Yellow LED light, no flashing. |
| 3. | SpO2: Receptacle for SpO2 extension cable. |
| 4. | ECG: Receptacle for ECG cable. |
| 5. | Temperature 1/2: Receptacles for temperature probes. |
| 6. | NIBP: Receptacle for NIBP inflation hose. |
| 7. | IBP 1/2: Receptacles for IBP cables. (Optional) |
| 8. | CO2 /AG: Receptacle for Mainstream or Sidestream CO2 or AG module accessories. (Optional) |
| 9. | Print Button: push this button to print the current data/waveform. Push it again to stop printing. |
| 10. | Printer indicator light. |
| 11. | Printer: Internal built in printer. (Optional) |
| 12. | Printer door latch. Use latch to open the printer door and access the internal printer paper compartment. |

***NOTE***
*The monitor you receive may differ from the image above depending on the parameters ordered.*

## 3.6 Power

### 3.6.1 AC Power

When AC power is used, the Midmark Multiparameter Monitor may be turned on at any time. Before plugging it into AC power, compare the resident power output with the requirements of the device. On the rear panel, you can see the power supply requirements.

After confirming all cables are properly connected, press the power button located on connector side panel as shown below.

*The Midmark Multiparameter Monitor power button. (Fig.3-4)*

The system will start a self-diagnostic test which lasts about 2-3 seconds. If the tests are successful, the monitor will display the main screen. The device can then be used for vital signs monitoring, communication, and battery charging.

When the device is plugged into AC power and turned off, the power indicator on the front panel continues to be lit, indicating the monitor is in standby mode and the battery is being charged.

### 3.6.2 Battery Power

When AC power is shut off, the Midmark Multiparameter Monitor can still work using the internal battery. The internal battery is pre-installed inside the monitor. It should only be removed or exchanged by properly trained personnel. Before use, the battery must be charged. Whenever the device is plugged into AC power, the battery will automatically be charging. The battery needs to be charged for at least 5 hours before a full charge is achieved. To ensure the battery is fully charged, it is recommended that the device be plugged into AC power even when the device is not in use.

A fully charged battery can support a working device continuously for approximately 2-4 hours, depending on the parameters in use. The frequency of NIBP measurements and printing may accelerate the consumption of battery power. As the battery power depletes the battery icon in the top right hand corner of the monitor changes from four to three green bars to two yellow bars and finally to one red bar. When the battery power is almost depleted, the alarm indicator light in the upper left hand corner of the monitor will flash red and a flashing red warning signal with 60 second countdown appears in the Status Bar. This alerts the user to plug the device into AC power as soon as possible or the unit will shutdown in 60 seconds.

***WARNING***

- ***Even when the device is off, the battery power will be discharged slowly.***
- ***When the device is being stored for a long time, remove the battery prior to storage.***
- ***Check the battery status and recharge at least once a month.***

## 3.7 Software Version

**Follow the steps below to determine the software version of your monitor:**

**Step 1:** Press the “Settings” Quick Access Button or Icon.

**Step 2:** Press the “Monitor Info” button.

The Monitor Information menu will open. The software version as well as relevant manufacturing information is stored within this menu. To exit this menu, press the X in the upper right corner of the screen or press anywhere outside of the menu. Please refer to this User’s Guide for operation instructions of your Midmark Multiparameter Monitor.

## 3.8 Navigation Options

### 3.8.1 Color TFT Touch Screen

The Midmark Multiparameter Monitor features a color touch screen for ease of navigation. Use your finger and press on the screen to access menus and input data.

### 3.8.2 Quick Access Buttons

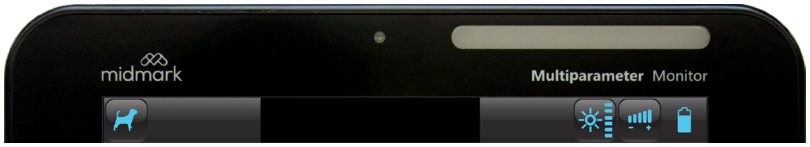
The Midmark Multiparameter Monitor has 6 quick access buttons on the front of the monitor.


Please refer to Chapter 3.3 Front Panel for more details.

### 3.8.3 Touch Screen Quick Access Icons

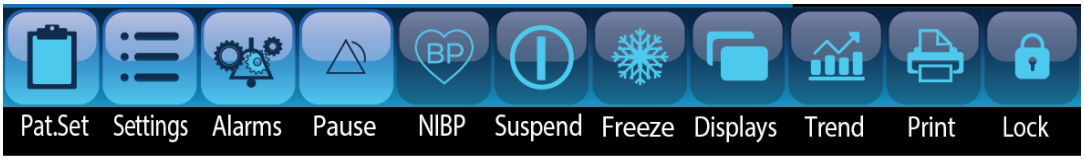
These Quick Access Icons will appear when the monitor is turned on. They are located at the top and bottom of the screen and allow quick access to frequently used menus and functions.

The following are the 4 quick access icons that appear at the top of the screen:




| Icon | Definition |
|---|---|
|  | Patient Info: Press this icon to open the Patient Information menu. |
|  | Brightness: Press this icon to toggle through the 6 brightness levels and the auto brightness feature. |
|  | Volume: Press this icon to open the Volume Setup Menu. This is where the user can set the volume for Alarm Volume, HR Beat Volume, Pulse Volume, Touch Volume. |
|  | Battery: This is not an active icon. It cannot be changed by the user but rather indicates the battery status. |

The following are the 11 quick access icons that appear at the bottom of the screen:




| Icon | Definition |
|---|---|
|  | Pat. Set: This is the patient setup icon. Press this icon to open the Patient Setup Menu. The user may admit or discharge a patient and enter various patient data. |

| Icon | Definition |
|---|---|
|  | Settings: Press this icon to open the Settings Menu where the user may set preferences for various parameters and access major functions of the monitor. |
|  | Alarms: Press this icon to open the Alarm Setup Menu where the user may set alarm limits for the parameters within the monitor. |
|  | Alarm Pause: Press this icon to temporarily pause the audio portion of the current alarms. The visual portion of the alarm will still be active. This includes flashing lights and the display of the alarm message. Depending on the user presets, the alarm will return to normal after a predetermined time range. |
|  | NIBP: Press this icon to manually start the NIBP measurement. The NIBP measurement process will automatically stop once completed. Press this button again before completing the NIBP measurement process to stop it immediately. Press and hold the button to access the screening mode. |
|  | Suspend: Press this icon and confirm. The monitor will stop all the waveform and parameter testing. |
|  | Freeze: Press this icon to stop the movement of the waveform across the screen so that the user may analyze the current waveform more carefully. Press this again to restart the movement. Screen will remain frozen until the Freeze button is pressed again. |
|  | Displays: Press this icon to toggle through all the different display modes offered by the monitor: Normal, Enlarged Display, 7-lead ECG with numerical data, IBP, and Multigas (when the module is activated). |
|  | Trend: Press this icon to open the Trend Menu to review Graphic, Tabular or NIBP trends. |
|  | Print: Press this icon to print current patient information. The printer will print up to a preset amount of minutes. Press this button again to stop printing before the preset time. |
|  | Screen Lock: Press this icon to lock up the touch screen function of the monitor to prevent accidental changes to settings. The Lock icon will change to an Unlock icon once it is pressed. Press the Unlock icon to unlock the touch screen function. The Unlock icon will then revert to the Lock icon. |

## *3.9 Display Screen*

### 3.9.1 Main Screen Display


*Main Screen Display (Fig. 3-5)*

| | |
|---|---|
| 1. | Top Quick Access Icons: Displays patient information and provides quick access to certain menu items. |
| 2. | Status Bar Area: Displays alarms and messages. |
| 3. | Waveform and Trend Area: Displays waveform for ECG, SpO2, RESP and CO2. |
| 4. | Numerical Data Area: Displays parameter values for ECG HR, Temperature, SpO2 %, SpO2 Pulse Rate, RESP/CO2 and NIBP. |
| 5. | Bottom Quick Access Icons: Provides quick access to certain menu items. |
| 6. | Historical data display as well as Catalog display when this option is turned on. |
| 7. | Date and time |

***NOTE***
*Main Screen Display may vary from monitor to monitor depending on the number of parameters available on the monitor. Monitors with only standard parameters will not display optional parameter information.*

The Main Screen Display is defaulted to the one shown above in Fig. 3-1. However, the user may change the default to any of the available Display Modes.

**Follow the steps below to select a different Main Screen Display for your monitor:**

**Step 1:** Select the “SETTINGS” Touch Screen Quick Access Icon.

**Step 2:** Select the “USER MAINTENANCE” Touch Screen Button and enter the password: 2013. Press “OK”

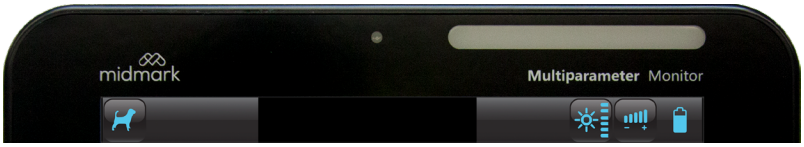
**Step 3:** Select “Screen Setup”.

**Step 4:** Use the drop down arrow to select the screen you would like the monitor to default to at start up.

**Step 5:** Press “X” to exit the menu. When you exit to the main menu, the monitor will already display your preferred display mode. This screen will now be the default screen that loads upon restart.

Additionally, there is a small status bar at the bottom right corner of the screen. The date and time may be found in this location.

### 3.9.2 Status Bar




*Main Screen Status Bar (Fig.3-6)*

The Status Bar is located at the very top of the Main Screen. The Status Bar provides the following information: Patient Information, Technical Alarm Messages, Demo Mode Status/Message Prompts, Physiological Alarm Messages, Silence Mode Status, Sound Level, Brightness Level, and Battery Power Status/Battery Charging Status. Besides the Battery and Silence Mode icons, all other icons may be pressed to access the menu related to that feature.

1. Patient Information: This area displays the patient species in picture format and the patient name. Pressing the screen in this area will open up the Patient Setup Menu. The only species available for display in picture format are cats, dogs, and horses. If “Other” is chosen, no picture will be displayed.

2. Technical Alarm Messages: The technical alarm messages are displayed in the technical alarm area at the top of the screen. A technical alarm is also known as a system error message. These alarms are caused by improper operation or system failure which may result in system malfunction or distorted monitoring results. If multiple alarm events are occurring simultaneously, this area will rotate through all alarm event messages.


3. Demo Mode Status/Message Prompts: Strictly speaking, the message prompts are not alarms. The monitor will display some information associated with system status in addition to the physiological and technical alarms. Generally, such information does not involve the patient’s vital signs. These messages generally appear in the technical alarm area as well as the numerical parameters area. When the monitor is in Demo Mode, the Demo Mode Status will be displayed here as well. If messages are occurring simultaneously, this area will rotate through all messages.


4. Physiological Alarm Messages: The physiological alarm messages are displayed in the physiological alarm area at the top of the screen under the technical alarm message area. A physiological alarm is usually triggered when a physiological parameter of the patient exceeds the alarm limit or the patient has physiological abnormalities. If multiple alarm events are occurring simultaneously, this area will rotate through all alarm event messages.


5. Alarm Pause Status: To pause the alarm, select the Alarm Pause Button or Quick Access Icon. The following icon will appear on the upper right corner to indicate that the alarm sounds have been temporarily paused. The visual alarms are still active. A countdown for the pause will initiate and be displayed at the bottom of the Alarm Pause Quick Access Icon. The time for the countdown is defaulted to 120s but can be changed by the user. Once the countdown is complete, the alarm sounds will return

.

6. Alarm Silence Status: To silence the alarm, change the Alarm Volume to 0 using the Quick Access Volume Icon. The following icon will appear on the upper right corner to indicate that alarm sounds have been disabled.

***WARNING***
***Silencing the alarms completely is not recommended. Please make sure the patient is actively monitored by qualified and trained personnel at all times regardless of the Alarm Silence setting.***

7. This will silence the audible alarm of physiological alarms and latching alarms that no longer exist.

8. Sound Level: This area contains the icon for the volume settings. Pressing the icon will allow you access to the volume control menu, which will allow you to set the following volumes: Alarm Volume, HR Beat Volume, Pulse Volume, Touch Volume. Volume ranges from 0 to 9, with 9 being the loudest.

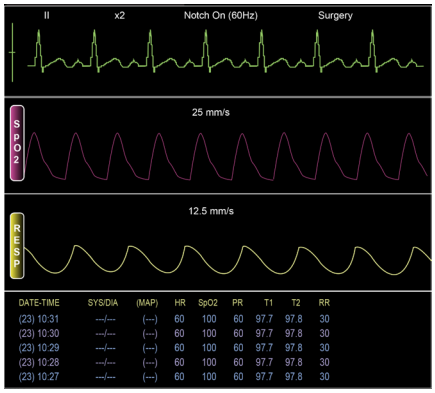
9. Brightness Level: This area contains the icon for the brightness settings. Pressing this icon will allow you to toggle through the brightness levels available. There are 6 different brightness levels denoted by the horizontal bars next to the brightness symbol. The more bars there are, the higher the brightness level. There is also an auto brightness level. Toggle through the levels until you see the auto brightness icon. When this option is chosen, the Brightness Sensor at the top of the monitor will register ambient light conditions and adjust brightness levels automatically.


Battery Power Status/Battery Charging Status: This area displays the battery icon matches the battery status at that time. This is not a button and cannot be pressed.

| Icon | Definition |
|---|---|
|  | Battery is full. The blue color indicates that the monitor is not connected to AC power. |

| | |
|---|---|
|  | Battery status is indicated by the blue bar inside the battery. The lower it goes, the less battery power it has. The blue color indicates that the monitor is not connected to AC power. |
|  | Battery is full. The lightning icon indicates that auto charge is on. The green color indicates that the monitor is connected to AC power. |
|  | Battery is being charged when the green bar moves continuously upward in a cyclical pattern. This only occurs when the monitor is connected to AC power and the battery is not full. |
|  | Battery is critically low. Please connect the monitor to AC power immediately or the monitor may shut down. |
|  | Battery is not detected. Either the battery is not installed or it is not working. |

### 3.9.3 Waveform Area



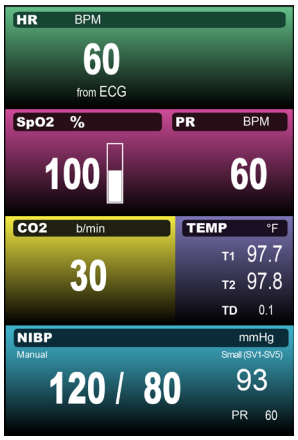

*Main Screen Waveform Area (Fig.3-7)*

The Waveform Area displays real-time waveform data for ECG, SpO2, Respiration, CO2, IBP, and AG depending on monitor settings. Press on a waveform to access the menu associated with that waveform parameter.

**Waveforms include the following:**

- ECG 3-Leads: I, II, III
- ECG 5-Leads: I, II, III, V, avL, avR, avF
- SpO2
- Respiration Leads: RA-LA, RA-LL, LA-RL, LL-RL
- CO2
- IBP1: ART1, PA1, CVP1, AO1, RA1, ICP1, FA1
- IBP2: ART2, PA2, CVP2, AO2, RA2, ICP2, FA2
- AG: CO2, N2O, ISO, DES, HAL, ENF, SEV

### 3.9.4 Parameter Box




*Main Screen Parameter Box (Fig. 3-8)*

The Parameter Box is located on the right side of the Main Screen and displays numerically the following parameter values in real-time: HR/PR, SpO2%, DIA/SYS/MAP NIBP, EtCO2, InCO2, RR, TEMP1, TEMP2, IBP, CO2, AA and Temperature Difference. Press on a displayed parameter to access that parameter's setup menu.

> ***NOTE***
> *Main Screen Display may vary from monitor to monitor depending on the number of parameters available on the monitor. Monitors with only standard parameters will not display optional parameter information.*

### 3.9.5 Touch Screen Menu

The Touch Screen offers easy access to parameter menus by attaching them to each displayed waveform within the Waveform Area and each displayed parameter within the Parameter Box. To configure the displayed parameters, press on a parameter (waveform or numeric) to access the setup menu associated with that parameter. The Quick Access Icons also allow quick access to some of these menus.

# SECTION 4 - ALARM SETUP

## 4.1 General Information

Alarms are designed to give an alert when the monitoring results are abnormal. These alerts are given via audible sounds, visual LED indicators, and flashing alarm messages. Alarms have three levels: High (Emergency) (2 sets of 5 beeps every 5-10 seconds with continuous red flashing visual alarm), Medium: (3 beeps every 25 seconds with yellow flashing visual alarm) and Low (Warning) (1 beep every 25 seconds with yellow solid visual alarm).

- Emergency Alarms: Example: Asystole, Parameter values exceed set limits when Alarm Level is defaulted to “High”, SYS-DIA is too low, Apnea Alarm, Low Battery Alarm
- Medium alarms: Example: Parameter values exceed set limits when Alarm Level is defaulted to Medium.
- Warning Alarms: Example: Equipment Alarms or when parameter values exceed set limits when Alarm Level is defaulted to Low.

**Typical warning alarms for equipment conditions are as follows:**

- ECG Lead Off
- SpO2 Sensor Off
- Cuff Leak
- Cuff Loose
- No Cuff
- NIBP Over Pressure

Other alarm messages will appear depending on the parameter in use.

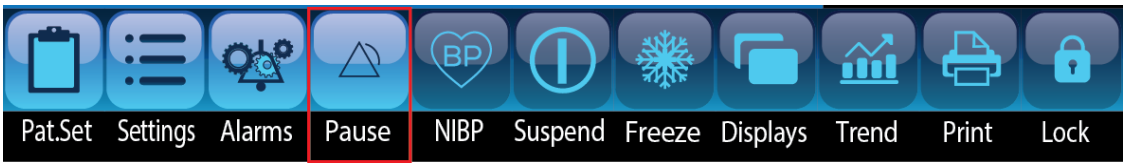
When sensors are unplugged, the screen will display “No Sensor Connected”. When probes are not connected to a patient, the screen will display “Sensor Off”.

> ***NOTE***
> *When “Asystole” is displayed on the screen, please check patient first, then the ECG gain of the relative channel to see if it is too low to detect heart rate. If so, the user can adjust ECG gain, switch the ECG lead, or change the ECG filtering mode.*

Different aspects of the alarm function such as Alarm Level (which will change the tone alarm) may be adjusted within the setup menu of each individual parameter.

## 4.2 Alarm Pause

To silence the alarm for a pre-determined amount of time, press the Alarm Pause Button  located on the Quick Access Button panel on the front enclosure or press the icon located on the Quick Access Icon panel.




*Touch Screen Quick Access Silence Button (Fig.4-1)*

To end the silence timer before the pre-determined time frame has elapsed, press the button again. The alarm will also resume normal alarm functions when the pre-determined alarm silence period expires.

The default Alarm Pause time frame is 120 seconds.

**The Alarm Pause duration can be changed by accessing the Alarm Param (Parameter) Menu as described in Section 4.3.1**

**below.**

**Step 1:** The Alarm Pause Time option is located in the middle of the Alarm Param Menu. The user may choose one of the following options: 1min, 2min, 3min, 4min, 5min, 10min, 15min, 20min or Permanent.

When the alarm is silenced using the Alarm Pause button, the occurrence of a new technical alarm, such as probe off, will cancel the silence feature. This will end the silence function before the silence timer runs out and sound the new alarm as well as the old alarms.

**Alarm Reset:** This will silence the audible alarm of physiological alarms and latching alarms that no longer exist.

Alarm Reset can be disabled by pressing Alarm Pause. The Alarm Pause will begin to countdown and audible alarms will trigger again if the condition is still present.

***WARNING***
***New technical alarms, such as leads off, as well as new physiological alarms, such as exceeding upper limits, will cancel the silence feature.***

***WARNING***
***The Low Battery Power Alarm may be silenced by the Silence Button. Please plug the monitor into AC power as soon as you see and hear the Low Battery Power Alarm***

***WARNING***
***When the alarm sound is silenced using the Silence Button, the user should pay close attention to the patient and the monitor screen for visual cues to ensure the safety of the patient.***

## *4.3 Alarm Param (Parameter) Setup*

#### 4.3.1 Alarm Param (Parameter) Menu

**Using the Quick Access Buttons or the Quick Access Icons, press the Settings button/icon. Then follow the steps below to access the Alarm Param Menu:**

**Step 1:** Select the “SETTINGS” Touch Screen Quick Access Icon.

**Step 2:** Select the “USER MAINTENANCE” Touch Screen Button and enter the password: 2013. Press “OK”

**Step 3:** Select the “ALARM PARAM” Touch Screen Button.

**Alarm Setup Param Menu Options:**

| | |
|---|---|
| **ALARM** | You may turn the ALARM feature ON or OFF. |
| **ALARM VOLUME** | ALARM VOLUME may be changed from 0 to 9, 9 being the loudest and 0 being silent. By default, the alarm volume is set to 4. |
| **LATCHING ALARM** | The user may choose the Latching or No-Latching option for the physiological alarms only. By default, the alarm system is set to No-Latching, which means that as soon as the physiological alarm is cleared, the system will no longer prompt the physiological alarm. |
| **ALARM PAUSE TIME** | ALARM PAUSE TIME is the setting used for the Alarm Silence feature. The alarm silence period can be set to 1min, 2min, 3min, 4min, 5min, 10min, 15min, 20min or Permanent. By default, it is set to 2min. |
| **ALARM DELAY** | ALARM DELAY allows the user to delay alarms. The user can set this to OFF, 5s, 10s, 15s, 20s or 25s. If turned on, an alarm event will not trigger an alarm until the set time has passed. If the alarm resolves before the set time has passed, no audio or visual alarms will sound at all. By default, it is set to Off. |
| **ALARM REMINDER SIGNAL** | When the alarm is silenced, the user may choose to turn the ALARM REMINDER SIGNAL ON or OFF. The Alarm Reminder Signal works for paused Alarm and 0 volume alarms but not alarms that have been silenced with Alarm Reset. |
| **ALARM REMINDER INTERVAL** | The user may set the ALARM REMINDER INTERVAL to 1min, 2min or 3min. |

| | |
|---|---|
| **ALARM LIMIT** | The user may turn the ALARM LIMIT ON or OFF.<br><br>Turning the ALARM LIMIT on will display the preset upper and lower limits of each parameter next to the actual parameter values from the patient within the Main Screen Parameter Box. |

#### 4.3.2 Alarm Setup Menu

Alarm limits include upper and lower limits that are user adjustable. All parameter limits are available within this menu on the Midmark Multiparameter Monitor.

**Accessing the Alarm Setup Menu using the Quick Access Icon:**

**Step 1:** Select the “ALARMS” Touch Screen Quick Access Icon.

**Step 2:** Select the alarm limits to be adjusted. The following parameter alarm limits are available by default: ECG, SpO2, NIBP, RESP, Temp (1 and 2). Alarm Setup for optional parameters will become available once those parameter modules are activated. Optional parameters include IBP (1 and 2), CO2 and Multigas.

**Changing Alarm Limits through the Alarm Setup Menu:**

**Step 1:** Once inside the Alarm Setup Menu, press on the parameter you would like to set up. This will open the menu for that specific parameter. Make sure to press the title of the parameter such as ECG, TEMP…etc.

**Step 2:** The default number will be displayed. Press on the default number to display a number pad.

**Step 3:** Enter the new number using the number pad and press “ENTER” to save. If you entered the wrong number, press “BACK” to delete the numbers one at a time. Press the “X” button on the upper right corner of the number pad to leave without entering any new numbers. Once a new number has been entered and the “ENTER” button has been pressed, the user will be returned to the setup menu for that specific parameter. The new number is now saved. Press the “X” button on the upper right corner to exit the menu.

**Changing Alarm Limits through the Waveform Area:**

**Step 1:** Press on any waveform within the Waveform Area to access the menu for that particular parameter.

**Step 2:** Press “ALARM SETUP” to open the Alarm Setup Menu for that specific parameter.

**Changing Alarm Limits through the Parameter Box:**

**Step 1:** Press on any data within the Parameter Box to access the menu for that particular parameter.

**Step 2:** Press “ALARM SETUP” to open the Alarm Setup Menu for that specific parameter.

#### 4.3.3 Current and Custom Alarm Settings

There are four total alarm setting accounts available within the User Alarm Setup Menu: Current, User 1, User 2, and User 3. The monitor will come with factory default settings within the User Alarm Setup Menu. When the user first enters the User Alarm Setup Menu, the “Current/DEFAULT” account is open.

**Users may change the limits as required and save up to 3 customer accounts using the steps below:**

**Step 1:** Set the desired alarm limits for each parameter.

**Step 2:** Select the “Settings” Quick Access Icon to display the settings menu.

**Setp 3:** Select the “User Alarm Setup” button to display the User Alarm Setup menu.

**Step 4:** Using the dropdown arrow, select the user number you would like to set. There are a total of 3 spots. Then select the field next to it to enter a label for this setting. The label can be up to 8 characters long.

**Step 5:** Press the “Show Current” button to load the current limits in the system. Check to make sure that all alarm limits are set as desired.

**Step 6:** Press “Save Current” at the bottom right corner to save the current settings under the current label. Repeat the process for any additional users for a total of 3 custom user accounts.

**Step 7:** Press the “X” on the upper right corner to exit.

### 4.3.4 Loading Saved User Accounts

**Load saved user accounts using the steps below:**

**Step 1:** Select the “Settings” Quick Access Icon to display the settings menu.

**Step 2:** Select the “User Alarm Setup” button to display the User Alarm Setup menu.

**Step 3:** Using the dropdown arrow, select the user you would like to use. There screen will load the settings for this user. Confirm that these are the settings you would like to use.

**Step 4:** Press “Load (User Label Name)” to load the settings into the monitor. The User Label Name is the label you have saved the settings under.

**Step 5:** Press the “X” on the upper right corner to exit.

### 4.3.5 Changes Made to Custom Alarm Settings

> ***CAUTION***
> *It is recommended that before using the monitor on a patient, the desired User Alarm Setup Account is re-loaded onto the monitor using the steps described in Section 4.3.4.*

The alarm parameter settings may be changed by different users throughout the day. To ensure that the proper setting is being used, always reload the Alarm Parameter Setting Account associated with the current patient before using the monitor.

### 4.3.6 Alarm Volume and Sound Setup

**Volume Setup Menu**

Press the VOLUME Quick Access Icon  located on the upper right corner of the screen to access the following volume options.

| | |
|---|---|
| **ALARM VOLUME** | Choose from 0-9, 9 being the loudest. If ALARM VOLUME is set to 0, there will not be any audio alarms for either the physiological or technical alarms. However, the visual alarms will still be active. |
| **HR BEAT VOLUME** | Choose from 0-9, 9 being the loudest and 0 being silent. |
| **PULSE VOLUME** | Choose from 0-9, 9 being the loudest and 0 being silent. |
| **TOUCH SOUND** | Choose from 0-9, 9 being the loudest and 0 being silent. |

**To set the volume options, follow the steps below:**

**Step 1:** Select the VOLUME Quick Access Icon  .

**Step 2:** Select the number located next to the option you wish to change to display the up and down arrows.

**Step 3:** Use the arrows to rotate between 0-9, where 0 is silent and 9 is the loudest. Stop at the level you wish to use. Tap the number again to confirm your choice. The arrows will disappear and the number will turn yellow. Now the selection has been saved. Select the “x” on the upper right corner to exit the menu.

> ***NOTE***
> *All volume settings listed above will remain the way it is set after restart except for Alarm Volume. Alarm Volume will remain the same as it was set unless it was set to 0. If set to 0, upon restart, the Alarm Volume will be changed to 1.*

### 4.3.7 Default Alarm Limit

The Midmark Multiparameter Monitor includes default alarm limits recommended by members of the American College of Veterinary Anesthesia for general veterinary practice. The user may return to the default alarm settings for each parameter by entering the Alarm Setup menu for each specific parameter.

The user may also revert the monitor settings to factory default by using the User or Factory Maintenance menus. However, using these menus will default everything within the monitor, not just the parameter alarm settings.

***NOTE***

*There are 4 animal categories to choose from: Cat, Dog, Horse, and Other. Each has their own default settings for each parameter. Resetting the default for one animal category does not mean that the parameter is reset for all the other animal categories. For example, resetting the default ECG upper limit for the Dog category does not mean the ECG upper limit is reset for the Cat, Horse or Other category.*

**Step 1:** Select the animal category you would like to default.

**Step 2:** Select the "ALARMS" Touch Screen Quick Access Icon to display the Alarm Setup Menu.

**Step 3:** Select the parameter you wish to reset at the top of this menu.

**Step 4:** Select the "DEFAULT" within that parameter menu. A pop up warning will be displayed letting you know that should you continue, all current settings for this particular parameter will be lost. Press "OK" to proceed or "CANCEL" to stay with the current settings.

**Step 5:** Repeat steps 2 and 3 until all the parameters you wish to reset to default has been completed.

**Step 6:** Select the "X" on the upper right of the menu to exit when done.

The following default alarm limits were set in the factory before delivery for each animal category:

| **Parameter** | **Cat** | | **Dog** | | **Horse** | | **Other** | |
|---|---|---|---|---|---|---|---|---|
| | Low | High | Low | High | Low | High | Low | High |
| HR/PR (bpm) | 90 | 180 | 50 | 180 | 24 | 50 | 50 | 180 |
| SpO2 (%) | 95 | 100 | 95 | 100 | 95 | 100 | 95 | 100 |
| NIBP SYS (mmHg) | 70 | 160 | 70 | 160 | 70 | 160 | 70 | 160 |
| NIBP DIA (mmHg) | 40 | 100 | 40 | 100 | 40 | 100 | 40 | 100 |
| NIBP MAP (mmHg) | 70 | 140 | 70 | 140 | 70 | 140 | 70 | 140 |
| Resp. (rpm) | 5 | 55 | 5 | 55 | 5 | 55 | 5 | 55 |
| Temp. (°F) | 96.8 | 104 | 96.8 | 104 | 96.8 | 104 | 96.8 | 104 |
| AwRR (rpm) | 5 | 55 | 5 | 55 | 5 | 55 | 5 | 55 |
| Et CO2 (mmHg) | 20 | 60 | 20 | 60 | 20 | 60 | 20 | 60 |
| In CO2 (mmHg) | 0 | 10 | 0 | 10 | 0 | 10 | 0 | 10 |
| IBP SYS (mmHg) – ART1, ART2, AO, RA, FA | 100 | 160 | 100 | 160 | 100 | 130 | 100 | 160 |
| IBP DIA (mmHg) – ART1, ART2, AO, RA, FA | 50 | 90 | 50 | 90 | 50 | 80 | 50 | 90 |
| IBP MAP (mmHg) – ART1, ART2, AO, RA, FA | 60 | 120 | 70 | 130 | 60 | 100 | 70 | 130 |
| IBP SYS (mmHg) – PA | 5 | 38 | 5 | 38 | 5 | 38 | 5 | 38 |
| IBP DIA (mmHg) – PA | -4 | 4 | -4 | 4 | 0 | 16 | -4 | 4 |
| IBP MAP (mmHg) – PA | 12 | 16 | 12 | 16 | 8 | 25 | 12 | 16 |
| IBP MAP (mmHg) – CVP | 0 | 7 | 0 | 7 | 0 | 23 | 0 | 7 |
| IBP MAP (mmHg) – ICP | 0 | 4 | 0 | 4 | 0 | 10 | 0 | 4 |
| AG: Et CO2 (mmHg) | 20 | 60 | 20 | 60 | 20 | 60 | 20 | 60 |
| AG: Fi CO2 (mmHg) | 0 | 10 | 0 | 10 | 0 | 10 | 0 | 10 |
| AG: AwRR (rpm) | 5 | 55 | 5 | 55 | 5 | 55 | 5 | 55 |
| AG: Et N2O (%) | 40 | 70 | 40 | 70 | 40 | 70 | 40 | 70 |
| AG: Fi N2O (%) | 40 | 70 | 40 | 70 | 40 | 70 | 40 | 70 |
| AG: Et HAL (%) | 1.0 | 3.0 | 1.0 | 3.0 | 2.0 | 4.0 | 1.0 | 3.0 |
| AG: Fi HAL (%) | 1.0 | 3.0 | 1.0 | 3.0 | 2.0 | 4.0 | 1.0 | 3.0 |
| AG: Et ENF (%) | 2.0 | 5.0 | 2.0 | 5.0 | 2.0 | 5.0 | 2.0 | 5.0 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| AG: Fi ENF (%) | 2.0 | 5.0 | 2.0 | 5.0 | 2.0 | 5.0 | 2.0 | 5.0 |
| AG: Et ISO (%) | 1.5 | 3.0 | 1.0 | 3.0 | 1.5 | 3.5 | 1.0 | 3.0 |
| AG: Fi ISO (%) | 1.5 | 3.0 | 1.0 | 3.0 | 1.5 | 3.5 | 1.0 | 3.0 |
| AG: Et DES (%) | 9.0 | 14 | 7.0 | 14 | 7.0 | 15 | 7.0 | 14 |
| AG: Fi DES (%) | 9.0 | 14 | 7.0 | 14 | 7.0 | 15 | 7.0 | 14 |
| AG: Et SEV (%) | 2.5 | 5.0 | 2.0 | 5.0 | 2.5 | 6.0 | 2.0 | 5.0 |
| AG: Fi SEV (%) | 2.5 | 5.0 | 2.0 | 5.0 | 2.5 | 6.0 | 2.0 | 5.0 |

# SECTION 5 - SETTING UP THE MONITOR

## 5.1 Display Setup

### 5.1.1 Waveform Display

The waveform display of each parameter can be changed by pressing on the waveform. This will open the selected waveform's Setup menu. Depending on the parameter, the user may be able to change the Wave Speed and Wave Mode of the waveform.

Wave Speed is the speed the waveform travels across the screen. This value is in mm/sec.

Wave Mode is the option to show the waveform in Scan or Fill. Scan is a single line while Fill will make the underside of the waveform solid. This option is not available for ECG or Multi-gas waveforms.

### 5.1.2 Display Modes

By default, the Parameter Trend Screen is chosen. Select the "DISPLAYS" Quick Access Icon to rotate through all the screen options available based on the monitor's current setup. Certain screens are only available when the specific module related to the parameter is turned ON in the module setup menu. For example, the Anesthesia Screen is only available when the AG module has been turned ON.

| | |
|---|---|
| **Parameter Trend Screen** | The Parameter Trend Screen is set by default. It consists of 3 waveforms, numerical parameter data for HR, SpO2, RESP, TEMP, CO2 and NIBP, and a historical data table. |
| **ECG Catalog Screen** | The ECG Catalog Screen consists of everything the Parameter Trend Screen contains except for the historical data table. |
| **Numerical Screen** | The Numerical Screen is used when observing the screen from a long distance. It will only show numerical values for HR, SpO2, NIBP and RESP. If CO2 is in use, the CO2 numerical values will replace the RESP values. |
| **Anesthesia Screen** | The Anesthesia Screen is only added into the rotation with the "DISPLAYS" Quick Access Icon when the AG module have been turned ON. This display mode will be available regardless of whether the AG sensor is plugged in or not. |
| **IBP Screen** | The IBP Screen is only added into the rotation with the "DISPLAYS" Quick Access Icon when the IBP module has been turned ON. This display mode will be available regardless of whether the IBP sensor is plugged in or not. |
| **7 ECG Wave Screen** | The 7 ECG Wave Screen shows 7 ECG waveforms on one screen. It also consists of numerical parameter data for HR, NIBP, SPO2, RESP, Temp |
| **3 Lead Screen** | The 3 Lead Screen consists of 3 waveforms but no historical data table. |

## 5.2 Demo Mode

For the purpose of training, the Midmark Multiparameter Monitor provides a Demo Mode function.

> ***CAUTION***
> *Never attempt to use the Demo Mode while monitoring patients or while the monitor is connected in any way to the patient.*

**Follow the steps below to enter Demo Mode:**

**Step 1:** Press the "SETTINGS" Touch Screen Quick Access Icon.

**Step 2:** Press "DEMO MODE" to bring up the password dialogue box for Demo Mode.

**Step 3:** Press the empty field next to Enter Password. A keypad will pop up. Input "5555" and press "ENTER". This will bring you back to the password screen. Press "OK" to confirm.

To show that the monitor is in Demo Mode, the word "Demo Mode" will be displayed at the top of the Waveform Area in yellow.


**Follow the steps below to exit Demo Mode:**

**Step 1:** Press the “SETTINGS” Touch Screen Quick Access Icon.

**Step 2:** Press “EXIT DEMO”. A pop up warning box will be displayed: “To exit Demo Mode, the monitor will need to shut down. Would you like to continue?”. Press “OK” to proceed.

**Step 3:** The monitor will automatically shut down. Press the power button to turn it back on in standard mode, ready to monitor.

## *5.3 Trend Display*

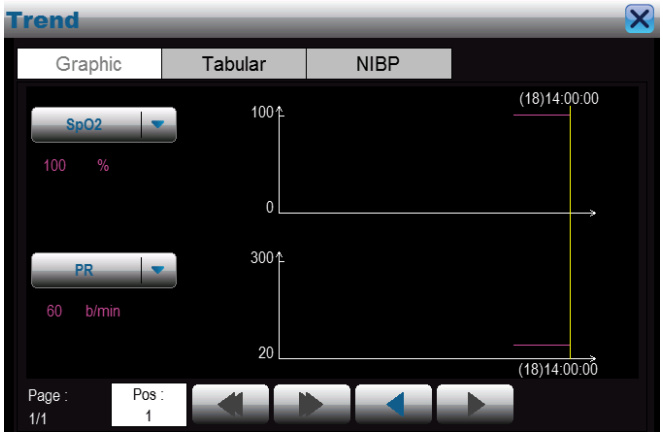
### 5.3.1 Displaying Trend Graph

**Follow the steps below to enter the Trend Graph Screen:**

**Step 1:** Press the “TREND” Touch Screen Quick Access Icon.

**Step 2:** Press the “GRAPHIC” Touch Screen Quick Access Icon.

**Step 3:** Using the drop buttons, select the parameter graph you wish to see. The screen can show two graphs at a time. Choose from HR, SpO2, PR, NIBP-SYS, NIBP-DIA, NIBP-MAP, NIBP-PR, T1, T2, TD, and RESP. If the optional modules are turned on such as IBP, CO2 or AG, these options will also be added to the dropdown list and will be available for review.




*Graphical trend display (Fig. 5-1)*

**Step 4:** Use the Single Left Arrow  and Single Right Arrow  to move the trend cursor line. The time corresponding to the cursor position is displayed at the top of the cursor. Wherever the cursor lands, the parameter value at that time will be displayed to the left. The parameter value will automatically update as the cursor moves within the timeline.

**Step 5:** Use the Double Left Arrow  and Double Right Arrow  to move forwards and backwards through the trend information timeline.

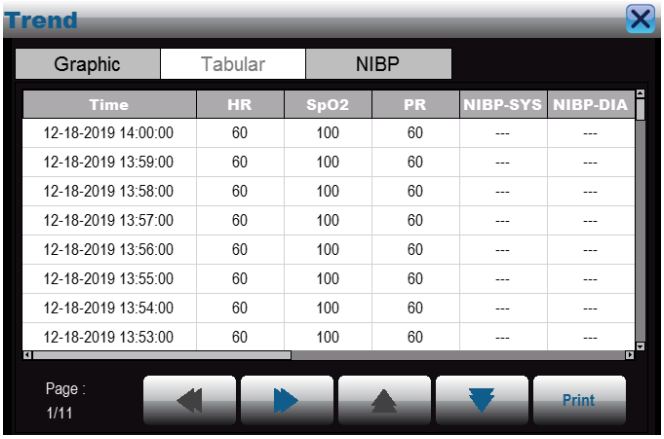
### 5.3.2 Displaying Trend Table

**Follow the steps below to enter the Trend Table Screen:**

**Step 1:** Press the “TREND” Touch Screen Quick Access Icon.

**Step 2:** Press the “TABULAR” Touch Screen Quick Access Icon.

**Step 3:** The Trend Table will display the following parameters: HR, SPO2, PR, NIBP-SYS, NIBP-DIA, NIBP-MAP, NIBP-PR, T1, T2, TD, RESP, AG-EtCO2, AG-InCO2, AG-RR, ART1-SYS, ART1-DIA, ART1-MAP, RR, EtCO2, InCO2 CVP2-SYS, CVP2-DIA, CVP2-MAP, RR, EtCO2 and InCO2.




*Tabular trend display (Fig. 5-2)*

> ***NOTE***
> *IBP, CO2 and AG trend data are only available when the modules for these specific options are turned on.*

> ***NOTE***
> *IBP data source will change depending on the IBP label selected. For example, if ART1 is selected, the following options will become available: ART1-SYS, ART1-DIA, ART1-MAP. If ART2 is selected, the following options will become available: ART2-SYS, ART2-DIA, ART2-MAP. Only one set of data can be viewed at a time.*

**Step 4:** Select the “PRINT” button to print all parameter data available that is currently within the time range displayed on the screen.

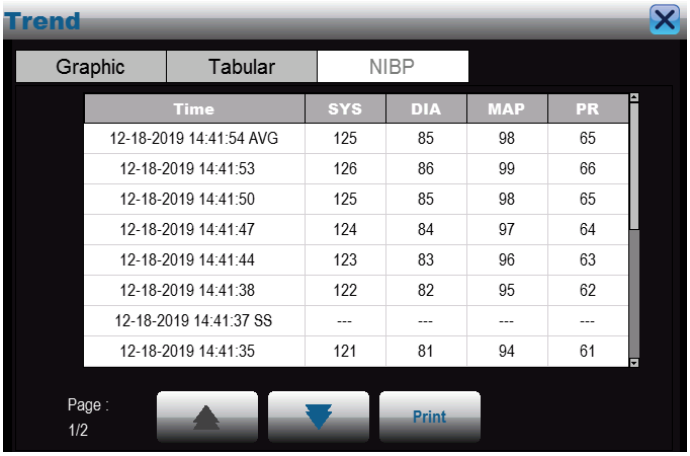
### 5.3.3 Displaying NIBP Trend Table

**Follow the steps below to enter the NIBP Trend Table Screen:**

**Step 1:** Press the “TREND” Touch Screen Quick Access Icon.

**Step 2:** Press the “NIBP” Touch Screen Quick Access Icon.

**Step 3:** The Trend Table will display the following parameters: Time, SYS, DIA, MAP and PR.




*NIBP trend display (Fig. 5-3)*

**Step 4:** Use the Double Up Arrow  and Double Down Arrow  to move forwards and backwards through the trend information timeline.

**Step 5:** Select the “PRINT” button to print all parameter data available that is currently within the time range displayed on the screen.

### 5.3.4 Deleting Trend Information

To delete the trend information, the user may clear that specific information source within the Patient Setup Menu. Alternatively, the user may discharge the patient within the Patient Setup Menu to clear all data associated with that patient all at once.

**Follow the steps below to clear the Trend information one by one from the Patient Setup Menu:**

**Step 1:** Press the “PAT.SET” Touch Screen Quick Access Icon.

**Step 2:** Press “CLEAR TABULAR TREND”. A pop up window will ask you to confirm that you wish to clear the Tabular Trend. Select “OK” to confirm your choice.

**Step 3:** Press “CLEAR NIBP TREND”. A pop up window will ask you to confirm that you wish to clear the NIBP Trend. Select “OK” to confirm your choice.

***CAUTION***
*The trend information cannot be retrieved once cleared. Please do not clear trend information until you are sure you do not require it anymore or you have created a backup for it.*

***CAUTION***
*Restarting the monitor will not clear Trend data. Please do not use restart as a method of changing patients.*

**Follow the steps below to clear all Trend information from the Patient Setup Menu all at once:**

**Step 1:** Press the “PAT.SET” Touch Screen Quick Access Icon.

**Step 2:** Press “DISCHARGE PATIENT”. A pop up window will ask you to confirm that you wish to discharge the current patient as all data relating to the patient will be purged. Select “OK” to confirm your choice. All trend information as well as alarms logged during the monitoring process for this patient will be purged.

## *5.4 Export Trend and ECG Data*

**To Export Trend and ECG Data, follow the steps below:**

**Step 1:** Plug the USB stick into the USB port at the back of the monitor.

**Step 2:** Press the “SETTINGS” Touch Screen Quick Access Button.

**Step 3:** Press “USB DATA EXPORT” to start exporting. An “Export Successful” message will be displayed when the export is finished. “Export Failed” will be displayed if the export was not successful.

One Excel file will be exported and placed onto the USB device under a folder named Trend. It will contain up to 7 days of Trend Data. The file name format is as shown below:

YearMonthDayHoursMinutesSeconds-Export

For example: 20200131171838-Export

***NOTE***
*Please note that the hours are counted in the 24 hour format. For example, 17:00 hour is 5:00pm.*

Saved files will not be deleted unless the user manually deletes it from the USB device. All new files will be saved onto the USB device until the USB device is full.

***NOTE***
*If data export is used frequently, please keep the USB storage device plugged into the monitor at all times. It is recommended that export be done after each case before discharge of patient.*

## 5.5 Midmark Visualizer Tool

The Midmark Multiparameter Monitor comes with a USB device preloaded with the Midmark Visualizer Tool. This tool will take the exported ECG data and map it into a waveform for easy reference. The parameter data will also populate each of the corresponding Trend Graphs for the user to view. This tool requires Microsoft Excel 2007, 2010, 2013, or 2016 to work.

### 5.5.1 Converting the Parameter Data using the Midmark Visualizer Tool

**To convert the parameter data using the Midmark visualizer tool, follow the steps below:**

**Step 1:** Connect the USB device that is included with your monitor to the computer.

**Step 2:** Double click the MidmarkVisualizer.exe file to install the software onto the computer. The Midmark Visualizer icon will appear on the desktop once installed.

**Step 3:** If you have not yet saved the parameter data file onto the USB stick, please refer to Section 5.4 Export Trend and ECG Data. If you already have the file saved on the USB stick, copy the exported data onto the computer.

**Step 4:** Double click on the Midmark Visualizer icon to open it.

**Step 5:** Once opened, the Start Menu will appear as shown below:


**Step 6:** Click on the “Select Data to Create Visualizer Record” button. Navigate to the parameter data excel file you just saved onto your computer and click “Open”.

**Step 7:** The exported file will now be converted by the visualizer into a new file with waveforms. The new converted file will automatically be saved in the same location as the original exported file. It will have the same file name but with a “M_” in the front.

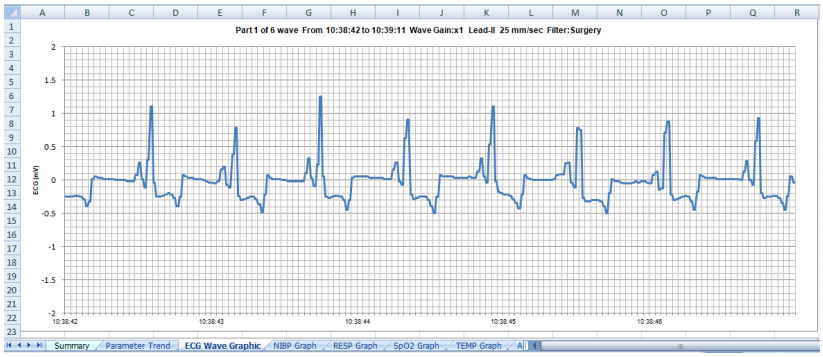
**Step 8:** Double click the new file to open for review. The new file will open using Excel.

### 5.5.2 Visualizer Data Tabs

The visualizer will look like an excel document. Depending on the monitor configuration, there will be at least 7 tabs for the standard parameters. There will be a maximum of 10 tabs if CO2 (or AA) and IBP are enabled.

| | |
|---|---|
| **Summary** | This worksheet displays the Patient Information, Anesthesia Record, and Trend graph. |
| **Parameter Trend** | This worksheet stores all parameter data according to date and time. |
| **ECG Wave Graphic** | This worksheet is where the ECG data will be displayed as a waveform. Please see Section 5.5.3 for a more detailed explanation. |
| **NIBP Graph** | This worksheet displays NIBP Graphical Trend data. |
| **RESP Graph** | This worksheet displays Respiration Graphical Trend data. |
| **SpO2 Graph** | This worksheet displays SpO2 and SpO2-PR Graphical Trend data. |
| **Temp Graph** | This worksheet displays T1, T2, and TD Graphical Trend data. |
| **CO2 Graph (if enabled)** | This worksheet displays EtCO2, InCO2, and RR Graphical Trend data. |
| **AA Graph (if enabled)** | This worksheet displays Et(HAL, ENF, ISO, SEV, DES), In(HAL, ENF, ISO, SEV, DES) and RR Graphical Trend data. |
| **IBP1 Graph (if enabled)** | This worksheet displays SYS, DIA, and MAP Graphical Trend data for IBP1. |
| **IBP 2 Graph (if enabled)** | This worksheet displays SYS, DIA, and MAP Graphical Trend data for IBP2. |

### 5.5.3 ECG Wave Graphic




The wave graphic includes the following information:

- Waveform Information. This includes Time, Wave Gain setting, Lead Type (Only Lead II can be viewed), Wave Speed and Filter setting.
- ECGmV
- ECG waveform interpreted from the imported data.
- Time of date point.

The ECG Wave Graphic will interpret up to 30 seconds of ECG data. However, this is not enough space on the screen to show all 30 seconds at the same time. Move the scroll bar up and down to show different ranges of time within the 30 seconds.

### 5.5.4 Printing Waveforms

**To print the waveforms from the visualizer, follow the steps below:**

**Step 1:** Select “File” located at the top left corner of the spreadsheet.

**Step 2:** Select “Print” to display the print menu.

**Step 3:** Configure your desired print options. Select “OK” to print.

> ***NOTE***
> *The visualizer prints to your currently selected (default) printer. If another printer (such as PDF) is desired, select File > Print from the Excel menu and select that specific printer.*

## *5.6 Printer Setup (Optional)*

**For monitors ordered with an internal printer option, follow the steps below to enter the Printer Setup Menu:**

**Step 1:** Press the “SETTINGS” Touch Screen Quick Access Icon.

**Step 2:** Select “PRINTER SETUP”.

**Printer Setup Menu Options:**

| | |
|---|---|
| **CHANNELS** | CHANNELS denote the number of slots given to waveform printing. The user may choose between 2 or 3. |
| **WAVE1** | WAVE1 is the first waveform on the printout. By default, it is set to ECG lead II. However, the user may choose from ECG lead I, ECG lead II, ECG lead III, SpO2 or RESP. if ECG is set to 5 Lead - in addition these appear: aVR, aVL, aVf, V. If Multigas is on, then CO2, AA, N2O appear. If IBP is on IBP1 and IBP2 appear. If just CO2 then CO2 appears. |
| **WAVE2** | WAVE2 is the second waveform on the printout. By default, it is set to ECG lead I. However, the user may choose from Off, ECG lead I, ECG lead II, ECG lead III, SpO2 or RESP. if ECG is set to 5 Lead - in addition these appear: aVR, aVL, aVf, V. If Multigas is on, then CO2, AA, N2O appear. If IBP is on IBP1 and IBP2 appear. If just CO2 then CO2 appears. If it is set to Off, more space will be allocated to WAVE1, as it will be the only waveform being printed in the waveform section. |

| | |
|---|---|
| **WAVE3** | WAVE3 is the third waveform on the printout. By default, it is set to Off. It can only be used if the CHANNELS option is set to 3 and WAVE2 is also being used. If WAVE2 is turned off, WAVE3 will automatically be turned off. |
| **RECORD TIME** | The default RECORD TIME is set to 8s, not including the time it takes to print the header. The user may choose from 4s, 8s, 16s or Continuous. This is the amount of time the printer will print when the print option is used. |
| **SPEED** | The user may choose between 12.5mm/s, 25mm/s or 50mm/s. If the parameter waveform on screen was set at a different speed, the printer will still print at the speed designated here. |
| **AUTO PRINT** | AUTO PRINT may be set up to print the data on the screen in specific intervals. By default, AUTO PRINT is set to Off. The user may choose between Off, 5min, 30min, 60min and 120min. |

### 5.6.1 Printer

The Midmark Multiparameter Monitor uses a built-in 3-channel thermal array printer.

### 5.6.2 Manually Controlled Printing

Press the Quick Access Print Button  or the Quick Access Print Icon  to print the physiological parameters, history data, and monitoring waveforms. The printer will print for 8 seconds by default. To stop the printing before the 8 seconds, press the Print Button again. The user may change the default print time by accessing the Printer Setup Menu and following the steps outlined above in section 5.6.

### 5.6.3 Auto Printing

The monitor may be set to print at user selected intervals. Follow the steps below to enable interval printing:

**Step 1:** Press the “SETTINGS” Touch Screen Quick Access Icon.

**Step 2:** Select “PRINTER SETUP” to display the Printer Setup Menu.

**Step 3:** Select the drop down menu next to “AUTO PRINT” and choose from Off, 5min, 30min, 60min, and 120min. Once selected, the number will be highlighted in yellow and saved. Press the “X” in the upper right corner to exit the menu. The monitor will now print at the user designated interval until this setting is changed. Each time the monitor prints, it will print for the time set in the Record Time option, which is 8 seconds by default.

**To choose how many seconds to print every time, follow the steps below:**

**Step 1:** Press the “SETTINGS” Touch Screen Quick Access Icon.

**Step 2:** Select “PRINTER SETUP” to display the Printer Setup Menu.

**Step 3:** Select the drop down menu next to “RECORD TIME” and choose from 4s, 8s, 16s and “Continuous”. Once selected, the number will be highlighted in yellow and saved. Press the “X” in the upper right corner to exit the menu. The monitor will now print up to the selected time frame. If “Continuous” is chosen, the monitor will continue to print until the user presses the print button again to manually stop.

### 5.6.4 Printed Header and Content

The printed report includes a header and content. The header includes Name, Patient No., Client, Doctor, Weight, Record Time, and Date and Time the recording started. The content includes parameter values and waveforms. Parameters printed include HR(bpm), SpO2(%), PR, RESP, NIBP, T1, T2 and TD. Optionally, IBP1, IBP2, Et/In CO2, and RR may be printed if the IBP, CO2 or AG modules are turned on and in use. The waveform area will display the title of the waveform and the waveform speed.

Each time printing is initiated, the header will also be printed. However, the header does not take up the Record Time, which is reserved for the waveform content.

### 5.6.5 Printing Paper

The printing paper width is 50 mm. The paper should be kept in a cool and dry place, away from direct sunlight, high temperature, and humidity. For long-term storage (>5 years), it is recommended that photocopies be made.

### 5.6.6 Installing Paper

To install the paper roll in the printer, gently pull the grey-colored latch upward on the printer compartment. Place the roll of paper into the printer compartment. The paper should roll out from the bottom and hang over the edge of the door as shown below. Close the door and make sure that a small section of the paper is hanging out the door.

> ***NOTE***
> *Do not thread the paper under the black roller at the tip of the printer door.*


*Printer paper installation (Fig.5-4)*

## *5.7 Patient Setup*

There are multiple ways to enter information for the patient. The user may choose between Admit Patient or Quick Admit.

**Admit Patient** - Fully admit the patient by entering any or all of the following: Patient Name, Patient No., Client Name, Doctor, Patient Type, Gender, And Weight.

**Quick Admit** - This option may be used to quickly enter the patient when full details are not available or required.

### 5.7.1 Admit Patient

**Follow the steps below to admit the patient fully:**

**Step 1:** Press the “Pat.Set” (Patient Setup)  Touch Screen Quick Access Icon.

**Step 2:** Press “Admit Patient”. A warning will pop up letting you know that all current patient data will be purged if you were to continue to admit this new patient. Press “OK” to continue to the Patient Info menu.

**Step 3:** Enter any and all patient data as needed. Press “OK” to save the information.

> ***WARNING***
> *The Patient Info Menu can also be accessed by pressing on the Patient Info area on the Status Bar. This menu shows the details of the current patient and allows the user to change these details. Never use this option to enter a new patient as the historical data from the previous patient will not be cleared.*

***NOTE***
*The Patient Info area on the status bar may display a patient name already or it may be empty. Pressing this area with or without a name displayed will allow access to the Patient Setup Menu.*

**Patient Info Menu Options:**

| | |
|---|---|
| **PATIENT NAME:** | Enter the Patient Name here. There is a 20 character limit. |
| **PAT NO:** | Enter the Patient Number here. There is a 20 character limit. |
| **CLIENT NAME:** | Enter the Client Name here. There is a 20 character limit. |
| **DOCTOR:** | Enter the Doctor Name here. There is a 20 character limit. |
| **PATIENT TYPE:** | Choose from Cat, Dog, Horse or Other. Every selection with the exception of Other will have a corresponding picture displayed next to the Patient Name on the Status Bar. |
| **GENDER:** | Enter the gender of the animal. |
| **WEIGHT:** | Enter the weight of the animal. The weight unit may be set to lb or kg. Once set, the weight equivalent in the other unit is always displayed next to the field. |

***NOTE***
*The SUSPEND Quick Access Icon can be used in when attaching the patient to the monitor or adjusting the monitor sensors or the patient position. It prevents the monitor from alarming or recording values during this time.*

### 5.7.2 Quick Admit

**Follow the steps below to quickly admit the patient without full details:**

**Step 1:** Press the “Pat.Set” (Patient Setup)  Touch Screen Quick Access Icon.

**Step 2:** Press “Quick Admit”. A warning will pop up letting you know that all current patient data will be purged if you were to continue to admit this new patient. Press “OK” to continue to the Quick Admit menu.

**Step 3:** Enter all patient data within this menu. This is the basic information needed to set the monitor to the default settings suited for that particular animal. Press “OK” to save the information.

***WARNING***
***The Patient Info Menu can also be accessed by pressing on the Patient Info area on the Status Bar. This menu shows the details of the current patient and allows the user to change these details. Never use this option to enter a new patient as the historical data from the previous patient will not be cleared.***

***WARNING***
***Please adjust settings as needed based on the specific condition and needs of the animal. Never rely exclusively on the suggested default settings.***

### 5.7.3 Changing Patient Info

***WARNING***
***The Patient Info Menu can also be accessed by pressing on the Patient Info area on the Status Bar. This menu shows the details of the current patient and allows the user to change these details. Never use this option to enter a new patient as the historical data from the previous patient will not be cleared.***

**Follow the steps below to change the current patient’s info:**

**Step 1:** Press the top left corner of the status bar. Alternatively, you can press “Pat.Set” Quick Access Icon and then press “Patient Info”. This will bring you to the Patient Info menu.

**Step 2:** Change the information of the current patient here. Press “OK” when done to save and exit the screen.

## 5.8 Date and Time Setup

The monitor displays the date/time. Each time the machine is turned on, the system will display the current date and time in the time status bar located at the bottom right corner of the screen.

**Follow the steps below to enter the Date and Time Setup Menu:**

**Step 1:** Press the Date and Time display located at the bottom right corner of the screen. This will bring up the Time Setup menu.

**Step 2:** Press the numbers next to the Date and Time fields. A number pad will pop up. Input the number and press “Enter”. The new number will turn yellow and is now saved.

**Step 3:** Use the drop down menu for the Date Format and Time Format to select the option you would like to use.

**Step 4:** Once all the entries are complete, press the “X” on the upper right to exit the menu.

**Time Setup Menu Options:**

| | |
|---|---|
| DATE: | Enter the Day, Month and Year. |
| TIME: | Enter the Hour, Minute, and Second. |
| DATE FORMAT: | Choose between YYYY-MM-DD, MM-DD-YYYY, or DD-MM-YYYY. |
| TIME FORMAT: | Choose between 12 hour or 24 hour format. |

## 5.9 Checklist Setup Menu

The Checklist serves as a preliminary check for the user to review before a procedure. The user will be prompted with the Checklist each time the monitor is turned on or when a new patient is admitted. All items that apply will be checked and saved for review after being submitted.

**To turn on the Checklist:**

**Step 1:** Press the Setting icon.

**Step 2:** Select “Checklist Setup”.

**Step 3:** Press Checklist drop down box and select “On”.

> ***NOTE***
> *The Checklist will appear immediately once turned on. It will not appear for the first patient that is admitted as it was already completed after being enabled.*

**Checklist Menu Options:**

**Checklist:** Turn the Checklist On or Off.

**Staff Initials:** Turn Staff Initials On or Off. Require staff initials to be entered prior to submitting the Checklist.

**Review Last Submit:** Review the last Checklist submitted.

**Edit Checklist:** Enter custom descriptions for slots 9 and 10 or Default the Checklist.

## 5.10 Recall Functions

### 5.10.1 NIBP Recall

NIBP recall holds 1000 data points.

NIBP historical data may be observed on the main screen if display mode is set to Parameter Trend Screen. To see the NIBP historical data on its own screen, please reference Section 5.3.3 Displaying NIBP Trend Table.

#### 5.10.2 Alarm Recall

**Follow the steps below to enter the Alarm Recall screen:**

**Step 1:** Press the Alarm Message area of the Status Bar. This will open the Alarm menu.

**Step 2:** Press the “Physiological Alarms” tab or the “Technical Alarms” tab to see details of that particular kind of alarm.

**Step 3:** Use the up and down arrow to move through the alarms from most current to past alarms.

**Step 4:** Press the “REVIEW” button when viewing in Physiological Alarms to see more details of the alarm.

**Step 5:** Press the “X” on the upper right corner to exit the menu when finished.

#### 5.10.3 Wave Recall

**Follow the steps below to enter the Wave Recall screen:**

**Step 1:** Press the “SETTINGS” Touch Screen Quick Access Icon.

**Step 2:** Press the “WAVE RECALL” Button.

**Step 3:** Select the waveform you wish to see. Choose from ECG I, ECG II, SpO2 Channel and CO2 Channel.

The WAVE RECALL Screen shows the last 27 seconds of ECG waveforms and 18 seconds of SPO2 and CO2 waveforms for the above parameters.

## *5.11 Revert to Factory Default*

**Follow the steps below to revert the monitor to factory settings:**

**Step 1:** Press the “SETTINGS” Touch Screen Quick Access Icon.

**Step 2:** Press the “USER MAINTENANCE” Button.

**Step 3:** Enter the password: 2013. Press “Enter” Then press “OK”. This will open the User Maintenance menu.

**Step 4:** Press “DEFAULT” to set everything back to factory default. A warning will pop up. Press “OK” to continue.

***CAUTION***
*Using this DEFAULT option will affect Settings and Alarms for all parameters. If used, the current configuration will be lost.*

***NOTE***
*Using this DEFAULT will NOT change the current module status. For example, if the CO2 module is ON, it will remain ON after using this default method.*

## *5.12 Smart Flow Configuration*

The monitor can be configured to communicate with Smart Flow veterinary cloud software.

Follow the steps below to turn on Smart Flow:

**Step 1:** Press the “SETTINGS” Quick Access Button or the Touch Screen Quick Access Icon.

**Step 2:** Press “MODULE SETUP” to open the Module Setup Menu.

**Step 3:** Press the drop down option next to Network. Select “SmartFlow”

**Step 4:** Press the “X” on the upper right corner to exit the screen. A warning will pop up to let you know that a restart is required and that all current patient alarm data will be purged. Press “OK” to continue.

**Step 5:** The monitor will automatically shut down. After it shuts down, press the power button to turn it back on. The Smart Flow option will now be enabled.

## 5.13 Network Configuration

The monitor Network Settings need to be configured to allow for communication with the Smart Flow cloud software.

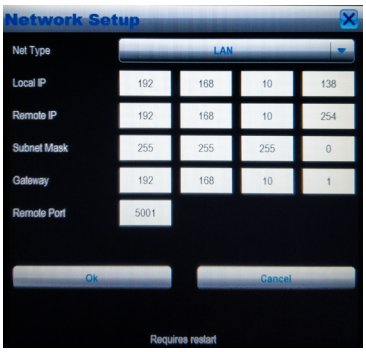
**Step 1:** Enter User Maintenance (password: 2013).

**Step2:** Select Network Setup.

**Step 3:** Configure Network Settings according to your router. The Remote Port is always 5001.

- Net Type: LAN
- Local IP:
- Remote IP:
- Subnet Mask:
- Gateway:
- Remote Port:

**Step 4:** Press OK to save and restart the monitor to save the network settings.




***NOTE***
*Each monitor will need a unique Local IP address if connecting multiple monitors to the same network.*

# SECTION 6 - ECG MONITORING

## 6.1 General Information

The Midmark Multiparameter Monitor records heart rate with electrode clips attached to the patient. Electrodes detect signals caused by changes of electrical conduction in the heart during the cardiac cycle. Heart rate is computed on a beat-to-beat basis using the R-R interval of the QRS complex. It is necessary to make sufficient preparations before monitoring in order to get accurate readings.

***WARNING***
***There is a label***  ***below the ECG socket, indicating that the signal input is insulated and defibrillation proof with a type CF applied part. Following exposure to a defibrillation event, ECG will resume normal operations after 5 seconds.***

## 6.2 Patient Cable

The patient cables consist of the main cable (connected to the veterinary monitor) and the lead wires (connected to the patient).

***CAUTION***
*Use only clips, ECG cable and lead wires recommended by Midmark.*

## 6.3 Animal Preparation and Lead Contact

Accurate clip placement is very important for obtaining a clear quality ECG trace. Sites where leads are attached to the body must be properly prepared to optimize contact. Dogs and cats may have enough electrolyte material on their skin and hair so that merely moistening lead sites with 70% isopropyl alcohol is appropriate. This will usually be sufficient for ECG recording/monitoring for a short time, 30 to 60 minutes, depending upon the relative humidity.

For monitoring during longer periods, an electrode gel should be used. It is best to first wet the hair at the lead attachment site with alcohol; then place gel on the moistened hair and skin. It is important that the gel be in direct contact with skin. For patients with dense undercoat, rub gel with fingers to assure that it has made contact with skin.

Copper alligator clips are supplied with this monitor and they must be opened wide enough to firmly but gently grasp the skin.

## 6.4 Attaching ECG Electrodes

### 6.4.1 Lead Wires and Color

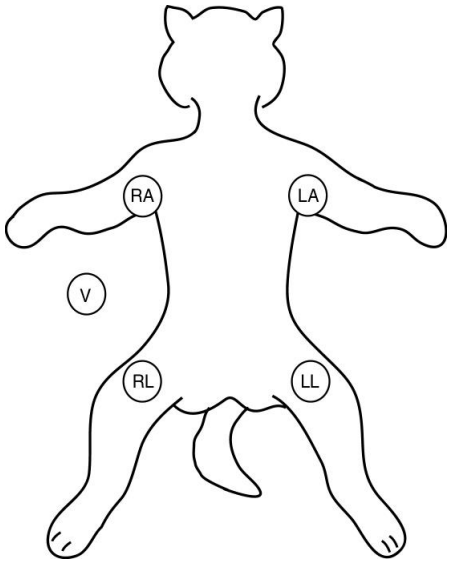
Table 6-1: 5-Lead Color and Coding

| USA Standard |
|---|
| LA = black (Left Foreleg) |
| RA = white (Right Foreleg) |
| RL = green (Right Hind Leg) |
| LL = red (Left Hind Leg) |
| V = brown (explore) |

Table 6-2: 3-Lead Color and Coding

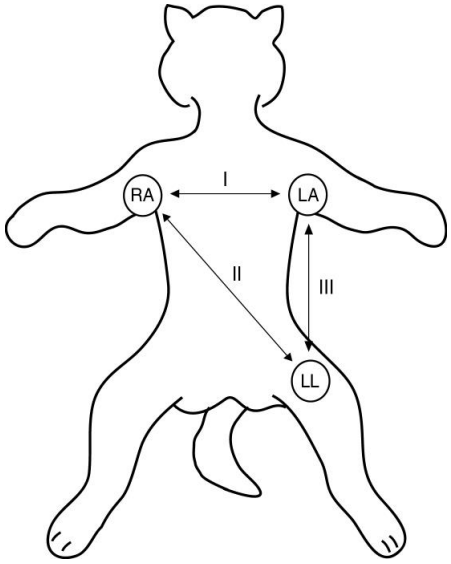
| USA Standard |
|---|
| LA = black (Left Foreleg) |
| RA = white (Right Foreleg) |
| LL = red (Left Hind Leg) |

### 6.4.2 Lead Placement




*5-Lead Placement (Fig. 6-1)*

For a 5 lead system, four limb leads can be applied (**RA**, **LA**, **RL**, and **LL**) with the exploring lead (**brown**) used for diagnostic purposes as needed. Otherwise, the exploring lead may be left unattached. Refer to Figure 6-1 and Table 6-1 for more information.




*3-Lead Placement (Fig. 6-2)*

For a 3 lead system, leads should be attached just below the elbow on the front leg and just above the stifle on the hind leg. The following lead sequence should be applied for a 3 lead system: Right Foreleg (**RA-white**); Left Foreleg (**LA-black**); Left Hind Leg (**LL-red**). Refer to Figure 6-2 and Table 6-2 for more information.

### 6.4.3 Positioning Anesthetized Patients

For ECG monitoring during anesthesia, it is most important to position patients properly on the table for the procedure. If standard lead placement as described above is not possible, leads should be attached to the body where they will be least subject to movement and away from the surgical site. It is preferable to view an upright QRS complex for monitoring ECG. A heart base to apex lead arrangement will be best if the negative lead is placed at the base (point of right shoulder at thoracic inlet) and the positive lead at the apex (low on caudal left thorax). Standard right forelimb lead is negative and standard left hind leg is positive in lead two; so if these leads are properly placed and the machine is set to Lead II, an upright complex should be the result.

### 6.4.4 Positioning Conscious Patients

Standard position for recording diagnostic ECG in dogs is right lateral recumbency. Diagnostic tracings can be obtained in cats in either right lateral or sternal position. Limbs should be perpendicular to the spine and parallel with their opposite member. For awake cats and

dogs, it is best to have the patient held by a veterinary technician or veterinary assistant. One lead should be applied first to determine comfort level and adjustment made as needed. Then the other clamps can be placed in position. It is important that the patient be kept still. A moving patient may cause clips to saw into skin tissue leading to discomfort and change in position of electrodes.

***NOTE***
*If lead (alligator clip) is touching both the patient's leg and body simultaneously this may distort the ECG waveform resulting in fluctuating or inaccurate HR.*

## *6.5 ECG Setup*

#### 6.5.1 ECG Setup Menu

**Follow the steps below to enter the ECG Setup Menu:**

**Step 1:** Select the ECG waveform or ECG data in the Parameter box to enter the ECG Setup Menu.

**ECG Setup Menu Options:**

| | |
|---|---|
| **HR SOURCE:** | Choose between Auto, ECG or SpO2. |
| **HR CHANNEL:** | This option is only available when Lead Type is set to 5 - Lead. Choose between Auto, I, II, V. |
| **ECG1:** | When in 3 - Lead mode, choose between I, II or III. When in 5 - Lead mode, choose between I, II, III, aVR, aVL, aVF and V. |
| **ECG2:** | This option is only available when Lead Type is set to 5 - Lead. Choose between I, II, III, aVR, aVL, aVF and V. |
| **WAVE GAIN:** | Choose from Auto, x0.25, x0.5, x1, x2, or x4. |
| **WAVE SPEED:** | Choose from 12.5, 25.0, or 50.0mm/s. |
| **CASCADE:** | Choose On or Off. Choose On to allow the ECG waveform to continue onto a second line for a longer waveform display. |
| **CATALOG:** | Choose between On or Off. The ECG catalog displays a selection of ECG waveforms in the second ECG channel for the user to scroll through and use as reference on the ECG Catalog Screen. |
| **FILTER:** | Choose from Diagnostic, Monitor, High Sensitivity or Surgery. See definitions in Section 6.5.2 below. |
| **NOTCH FILTER:** | Choose between On or Off. This option is only available in Diagnostic Mode. Depending on the country you are in, the power supply may cause interference. Turning On or Off the notch filter may improve signal acquisition. The Notch Filter may be set to 50Hz or 60Hz within the User Maintenance menu based on the country you are in. |
| **LEAD TYPE:** | Choose from 3 - Lead or 5 - Lead. When in 3 - Lead mode, certain options within this menu will not be available. |
| **HR BEAT VOLUME:** | Choose between 0 - 9, 9 being the loudest and 0 being silent. |
| **ALARM SETUP:** | This will take you to the ECG page of the Alarm Setup Menu. There, you can set the Alarm Level, HR Low Limit, HR High Limit, and revert to Default factory settings for the ECG parameter. Please see 4.3.2 Alarm Setup Menu for more details. |

Once the parameters are all set up, press the "X" button located on the upper right side of the menu to exit to the Main Screen.

#### 6.5.2 Filter Menu

The Diagnostic, Monitor, High Sensitivity and Surgery mode gives the user different levels of filters to accommodate various circumstances.

**Diagnostic Mode:** Displays the original ECG waveform unfiltered.

**Monitor Mode:** Filters out low-level interference.

**High Sensitivity Mode:** Allows detection of weak/low signals.

**Surgical Mode:** This is used during surgery where large amount of interference may exist. In this case the waveform displayed is significantly altered by the monitor's algorithm to negate the interference.

## 6.6 Alarm Setup

ECG monitoring alarms include parameter out of limit alarms and abnormal status alarms. When the monitored parameters are out of the preset limits, the monitor will give an audible and visible alarm.

### 6.6.1 Alarm Limit Setup

To set up the alarm parameters, please reference Section 4.3.2 Alarm Setup.Menu.

***WARNING***
***The default alarm limits are designed as general guidelines and for convenience so that values can be reset automatically to common starting points, but these may be adjusted with each patient according to their individual circumstances.***

### 6.6.2 Parameter Adjustment Range

| Parameter | Adjustment Range |
|---|---|
| HR (all other animals) | 15-350 bpm |
| HR (horse) | 15-350 bpm |

### 6.6.3 Abnormal Status Alarm

Abnormal Status alarm includes “Asystole” and “ECG Lead Off”.

***CAUTION***
*When ECG amplitude is too low (waveform is small), it may result in inaccurate heart rate or pseudo asystole. Try increasing the gain size and using the electrode gel to amplify the signal. Another option would be to try an alternate ECG lead which has a stronger amplitude or change Filter to “High Sensitivity”. Otherwise, the monitor may give an “Asystole” alarm.*

For a complete list of abnormal status alarms, please see the Monitor Troubleshooting Section 13.2.

## 6.7 Precautions

***WARNING***
***When a defibrillator is used, make sure the patient does not make contact with the ground, metal objects, or other conductors or devices. During defibrillation, never touch the patient, table or the device.***

***WARNING***
***Ensure conductive parts including electrodes of the patient cable do not come into contact with any conductive surfaces.***

***WARNING***
***Do not use the veterinary monitor during MRI or CT scan.***

***CAUTION***
*Leads and cables should be away from patient’s neck.*

## 6.8 Cleaning and Maintenance

> ***CAUTION***
> *When the cable or any leadwire is found to be worn out or damaged, replace it immediately.*

### 6.8.1 ECG Cable Cleaning

In order to keep the cable dust-free, clean it with a clean cloth and soapy water or a mild detergent.

### 6.8.2 ECG Cable Disinfection

In order to avoid long-term damage to the cable, we recommend that you only disinfect the cable when it's necessary by wiping it with an agent such as 70% isopropyl alcohol or according to your hospital regulations. Do not immerse the cable in liquid.

> ***CAUTION***
> *Do not autoclave the cable.*

## 6.9 Troubleshooting

### 6.9.1 Inaccurate Heart Rate

- Check patient's ECG signal.
    - Check /adjust lead placement.
    - Check/clean the patient's skin.
    - Check/replace ECG electrodes.
- Check if ECG waveform amplitude is normal.

### 6.9.2 No ECG Waveform

After lead wires are connected but there is no ECG waveform and the screen shows "ECG Lead Off" or "ECG Communication Stop".

- Check if the electrodes are in good contact with the patient and if the leadwires are in good condition.
- Check all the external connections of the ECG leadwires.
- Check the ECG electrodes. Prolonged placement of electrodes may result in polarized voltage and the electrodes should be replaced.
- If "ECG Communication Stop" is displayed on the ECG channel, then the ECG module has a communication problem with the main unit. Turn off the machine and turn it on again. If problem still remains, contact Midmark.

### 6.9.3 ECG Baseline Shift

ECG scan baseline is not stable on the display.

- Check if the working environment is too humid and if the machine has moisture inside. If yes, keep the machine on for 24 hours and keep the ambient environment dry.
- Check the electrode quality and whether the skin is clean where the electrode is placed.

# SECTION 7 - NIBP MONITORING

## 7.1 General Information

The Midmark Multiparameter Monitor uses oscillometric principles to calculate the systolic (SYS), diastolic (DIA), and mean arterial pressure (MAP) values. The MAP is calculated as the lowest cuff pressure that provides the maximum cuff oscillations. Therefore, MAP is the largest signal received and is the most accurate reading using oscillometric methods. Systolic pressure is calculated as the cuff pressure at which an increase in cuff oscillations is perceived. The diastolic pressure is the cuff pressure when oscillations are no longer decreasing as pressure is released from the cuff. Special veterinary specific algorithms have been designed to ensure reliable and accurate measurements from kittens to horses.

The veterinary monitor features adaptvie blood pressure and inflates the cuff to a pressure of 30 mmHg higher than the systolic pressure. Then, the cuff slowly deflates. When the cuff pressure is higher than systolic pressure, the artery is blocked and there are small amplitude oscillometric waveforms. When the cuff pressure is equal to the systolic pressure, the oscillometric amplitude will increase. With the decrease of the cuff pressure, the oscillometric amplitude increases. When the cuff pressure reaches a certain value, the oscillometric amplitude reaches a maximum value, and then the cuff pressure is mean arterial pressure. It uses the changes of the oscillometric amplitude under different cuff pressures to identify mean pressure and calculate the systolic and diastolic pressure.

***WARNING***
***There is a label below the NIBP receptacle, indicating that the signal input is insulated and defibrillation proof with a type CF applied part. Following exposure to a defibrillation event, NIBP will resume normal operations after 10 seconds.***

## 7.2 Cuff Placement

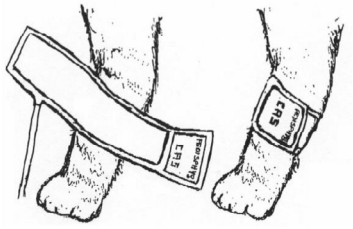
**CAUTION**
*Only accessories recommended by Midmark should be used.*

***NOTE***
*Place the patient on a padded surface to provide comfort, and warmth. Any movement, even inadvertent shivering, may prevent the monitor from taking an accurate measurement.*

### 7.2.1 Cuff Placement for Cat

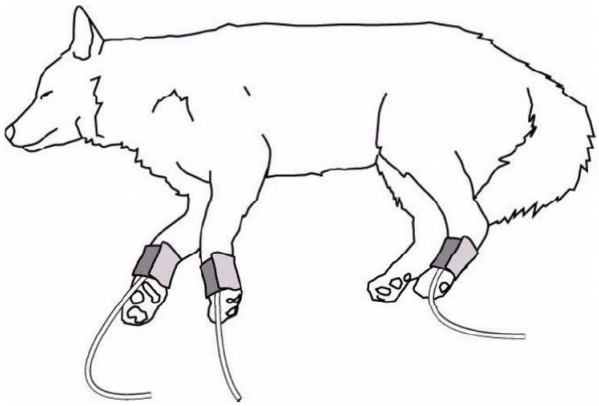
A cat may be left in its owner's lap to keep it calm. Measurements are best done in an area of the hospital away from noise and bright lights. The animal may be held so that the front limbs are free for cuff placement. In conscious patients, the tail may be the most appropriate location for placement of the cuff. Cats may be most comfortable in sternal recumbency making the tail a more preferable site. For the median artery on the foreleg, place the cuff around the forelimb, between the elbow and carpus. It is not necessary to center the cuff over the artery which is on the medial side of the leg because of the fully encircling bladder design. Hair need not be clipped except when heavily matted. In cats less than five (5) pounds when measurements are difficult to obtain, place the cuff around the leg above the elbow to obtain measurements from the brachial artery. Measurements from the coccygeal artery may be used by placing the cuff around the base of the tail but not in anesthetized patients.

Cat Cuff Placement



### 7.2.2 Cuff Placement for Dog

For measurements in dogs, it is preferable to use the right lateral, sternal or dorsal recumbent positions. That is not a problem in anesthetized patients, but it may be difficult to get large dogs to cooperate for proper positioning when conscious. If the dog is in a sitting position, place the front paw on the operator's knee and take measurements from the metacarpus. Sites for cuff placement are the metacarpus, metatarsus and anterior tibial. In anesthetized patients, most surgeries are done on the posterior part of the body so the metacarpal area of the forelimb is most convenient. In situations where this is not possible, the cuff should be wrapped around the metatarsus just proximal to the tarsal pad or around the hind leg just distal to the hock. The tail site should not be used for cuff placement during anesthesia. It is not necessary to center the cuff over the artery because of the fully encircling bladder design. If the hair over the artery site is too thick or matted for good contact, it should be clipped.



***NOTE***
*To achieve the most accurate readings, it is important to keep the cuff on a horizontal plane with the heart.*

### 7.2.3 Large Animals

A large animal such as a horse should be in a stall, standing still, or lying down. For horses and cows, the cuff can be wrapped around the base of the tail using the coccygeal artery on the ventral surface.

***WARNING***
***When monitoring over an extended period of time, or at frequent intervals, periodically observe the patient's limb to make sure that the circulation is not impaired for a prolonged period of time.***

### 7.2.4 Cuff Size Selections

The widest cuff that can be placed on the patient, without extending beyond the joint, should be selected. Appropriate sized cuffs may be selected based on published guidelines that cuff width should be 40 – 60% of limb circumference. We recommend the use of the Cardell® Cuff Selector included with the accessory pack. The cuff should be wrapped for a snug fit.

Overlapping the cuff will not affect measurement results. Make sure the hook and loop sections of the cuff are fully engaged when it is wrapped around the limb. If not fully engaged, the cuff will detach during bladder inflation. If that happens, select the next size bigger cuff. Adhesive tape or other material should not be used to secure the cuff.

In addition to the Cardell® Cuff Selector, the following table may be used as a guide to select the correct size.

**Small Animal Cuff Selection**

| Cuff Reorder Number | Bladder Size (width) | Limb Circumference Range |
|---|---|---|
| SV1 | 2.0 cm | 3-6 cm |
| SV2 | 2.5 cm | 4-8 cm |
| SV3 | 3.5 cm | 6-11 cm |
| SV4 | 4.0 cm | 7-13 cm |
| SV5 | 5.0 cm | 8-15 cm |
| SV600 (Kit) | Includes all the above | |

**Large Animal Cuff Selection**

| Cuff Reorder Number | Bladder Size (width) | Limb Circumference Range |
|---|---|---|
| SV8 | 8.0 cm | 13-20 cm |
| SV10 | 10.2 cm | 18-26 cm |

***References:***

*Pedersen KM, Butler MA, Ersboll AK, Pedersen HD (2002). Evaluation of an oscillometric blood pressure monitor for use in anesthetized cats. JAVMA 221: 646-650.*

*Sawyer DC, Guikema AH, Siegel EM (2004). Evaluation of a new oscillometric blood pressure monitor in isoflurane anesthetized dogs. Vet Anaesth Analg 31: 27 – 39.*

***NOTE***
*For species specific reference values, see Appendix 2.*

## *7.3 NIBP Setup*

### 7.3.1 NIBP Setup Menu

**Follow the steps below to enter the NIBP Setup Menu:**

**Step 1:** Select the NIBP data in the Parameter box to enter the NIBP Setup Menu.

**NIBP Setup Menu Options:**

| | |
|---|---|
| **UNIT:** | Choose between mmHg or kPa. |
| **CUFF SIZE:** | Choose between Small (SV1-SV5) or Large (SV8-SV10). |
| **INITIAL PRESSURE:** | Set the Initial Inflation Pressure here. The default pressure is 150mmHg. Pressure selection varies for Small (SV1-SV5) and Large (SV8-SV10). |
| **INTERVAL:** | Choose between Manual, 1min, 2min, 3min, 4min, 5min, 10min, 15min, 30min, 60min or 90min. |
| **START MEASUREMENT:** | Press this to manually start the NIBP measurement. Only one measurement will be taken. |
| **CONTINUOUS MEASUREMENT** | 5Min/5Sec. Pause. This is the STAT mode. |
| **ALARM SETUP:** | This will take you to the NIBP page of the Alarm Setup Menu. There, you can set the Alarm Level, SYS Low Limit, SYS High Limit, DIA Low Limit, DIA High Limit, MAP Low Limit, MAP High Limit and revert to Default factory settings for the NIBP parameter. Please see 4.3.2 Alarm Setup Menu for more details. |

Once the parameters are all set up, press the “X” button located on the upper right side of the menu to exit to the Main Screen.

### 7.3.2 Select Cuff Size

The current cuff size is displayed above the blood pressure value in the upper right corner of the NIBP Parameter Box. Choose from Small (SV1-SV5) or Large (SV8-SV10).

***CAUTION***
*Before measurement, make sure you have chosen the right cuff size in the NIBP Setup Menu. Small corresponds to cuff sizes SV1-SV5. Large corresponds to cuff size SV8 or SV10.*

### 7.3.3 Select Measurement Mode

***NOTE***
*The current NIBP Measurement Mode is displayed above the blood pressure value in the upper left corner of the NIBP Parameter Box on the Main Screen.*

**Manual**

Press the NIBP Quick Access Button  on the front of the monitor or the Quick Access Icon  on the main screen to manually start the NIBP measurement.

> ***NOTE***
> *During an NIBP measurement, if the NIBP Start/Stop button is pressed again, the measurement will be stopped immediately.*

> ***CAUTION***
> *The initial inflation pressure default is 150 mmHg.*

**Automatic**

The veterinary monitor will inflate the cuff at the start of each automatic measurement cycle.

During Automatic Mode, the user can select between the following time intervals: 1-5min, 10min, 15min, 30min, 60min, or 90min. The time interval means the time between the last NIBP measurement start to the next NIBP measurement start.

> ***NOTE***
> *Anytime during NIBP measurement, pressing the NIBP Start/Stop button will stop the NIBP measurement immediately.*

> ***WARNING***
> ***In Auto mode, if no NIBP value can be measured, the current measurement will be stopped, but the countdown will continue.***

**Continuous Measurement**

Continuous Measurement Mode is located in the NIBP Setup Menu. This function will continuously measure patient's NIBP for 5 minutes, pausing 5 seconds between each measurement. After 5 minutes, it will stop automatically. The mode is mainly used to closely monitor a patient's blood pressure changes in emergency situations.

During the Continuous measurement, press the NIBP Start/Stop button on the front panel, and the measurement will immediately stop.

> ***WARNING***
> ***Pressing the NIBP Start/Stop button during Continuous Measurement will stop the current measurement and cancel Continuous Measurement. The monitor will return to Manual measurement.***

NIBP monitoring provides numerical information only - no waveform.

### 7.3.4 NIBP Screening Mode

The average Systolic, Diastolic, and MAP will be displayed on the 5th measurement. The monitor will record 5 consecutive NIBP measurements and will exclude the measurement with the largest difference when computing the average.

**To turn on NIBP Screening Mode:** Press and hold the screen BP icon or the lower BP button for 3 seconds. The BP screen icon will then turn orange indicating NIBP Screening Mode is enabled.

**Manual and Auto Mode:** NIBP screening measurements can be taken using both modes. Manually pressing the BP Start icon will start the first Screening measurement in Manual Mode. For Auto Mode, select the desired interval and press the BP Start icon to start the first Auto Screening measurement.

**Real-Time Display**

Once NIBP Screening Mode is enabled, "Screen" will appear within the NIBP numerical reading display indicating a NIBP Screen measurement has not been recorded. The NIBP Screening State will update with following statuses after each measurement is recorded.

Measurement #1 will display as "Screen 1"

Measurement #2 will display as “Screen 2”

Measurement #3 will display as “Screen 3”

Measurement #4 will display as “Screen 4”

Measurement # 5 will display as “Scr-Avg” indicating the measurement values displayed are the computed average of the 4 measurements recorded (1 measurement removed with largest difference).

**To turn off NIBP Screening Mode:** Press and hold the screen BP icon or the lower BP button for 3 seconds. The BP screen icon will then turn blue indicating NIBP Screening Mode is disabled.

#### 7.3.5 Alarm Limit Setup

For different patients, different limits may be required. To set up the alarm parameters, reference Section 4.3.2 Alarm Setup.

| Parameter | Alarm Range |
|---|---|
| Systolic Pressure | 40 to 240 mmHg |
| Diastolic Pressure | 10 to 210 mmHg |
| Mean Pressure | 20 to 230 mmHg |

#### 7.3.6 Alarm for Abnormal Status

The Alarm triggers when the following abnormal events occur and the following messages will be displayed in the NIBP parameter area: “Loose or No Cuff”, “Air Leak”, “Meas. (Measurement) error”, or “NIBP Time Out”. Take the following steps after seeing the messages.

For a complete list of abnormal status alarms, please see the Monitor Troubleshooting Section 13.2.

## *7.4 Troubleshooting*

**Cuff Leak:** If the NIBP status bar displays “Cuff Leak”, it means a small leak has been detected. Please check the position of the cuff first, and check whether the inflation hose is damaged.

**Cuff Loose or No Cuff:** If the NIBP status bar displays “Cuff Loose or No Cuff”, it means a large leak has been detected. Please check the cuffs and the extension tube for damage. If the NIBP cuff and extension tube is undamaged, check that they are connected properly to each other and that the tube is connected properly to the monitor. If this does not resolve the problem, try to measure the NIBP with a different cuff and tube set. If error persists, contact Midmark.

**NIBP System Error:** If the NIBP status bar displays “NIBP System Error”, it may be the result of a system self-test error, the patient being over excited, trembling or there may be an air leakage. Calm the patient down and perform the measurement again. If the message persists, please contact Midmark.

**Measurement Timeout:** This may occur if the NIBP is set to Continuous Measurement or Interval use. To correct this error, go into the NIBP Setup Menu and change the NIBP back to Manual. Then reset it to Continuous Measurement or Interval as desired. If error persists, contact Midmark.

## *7.5 Precautions*

The following circumstances may affect the measurement results:

1. Patient motion
2. Rapid change in pressure
3. Shock or hypothermia

### *WARNINGS:*

1. Make sure there is no other pressure on the cuff.
2. Wrong cuff size may result in inaccurate measurements.
3. Make sure monitor is set to Large (SV8-SV10) or Small (SV1-SV5) corresponding to cuff used.

4. To ensure the patient's safety, never use cuff on the same limb where an infusion is going on.
5. Do not measure SpO2 or other parameters on the same limb where blood pressure is measured.
6. Do not apply cuff on an injured limb.
7. Do not measure a patient's blood pressure continuously or repetitively for a long time.
8. Use only accessories recommended by the manufacturer.
9. Do not alter the monitor's air hose. Proper monitor performance is not ensured if the tubing is altered. Modification of the air hose will void the warranty.

## *7.6 Preparations*

1. Use cuffs of proper size.
2. Ensure the cuff has been completely deflated.
3. Place the properly sized cuff on the patient's limb.
4. Install the cuff hose to the NIBP connector of the veterinary monitor.

> ***WARNING***
> ***When inserting or removing NIBP hose, do not turn the NIBP connector.***

5. Make sure there is no block between the monitor and the hose. Avoid compression or restriction of pressure tubes.
6. Set blood pressure measurement correctly in the setup menu.
7. The cuff on the patient's limb should be at the same level as the heart.
8. Press the blood pressure start key and start measuring blood pressure.

## *7.7 Maintenance*

#### 7.7.1 Cuffs

Prior to each patient use, inspect the blood pressure cuff and its hose for damage.

> ***NOTE***
> *We do not recommend submersion of the cuff. Liquid should not be permitted to enter the cuff bladder because instrument damage may occur. The cuff should be allowed to thoroughly dry before use.*

#### 7.7.2 Reusable (Nylon) Large Cuffs

As necessary, wipe the cuff with mild detergents/dilute bleach solution (1-2%), rinse with water and dry.

#### 7.7.3 Disposable (Vinyl) Small Cuffs

As necessary, the preferred method for cleaning the cuff is to wipe it down with a damp, soapy cloth. A damp, detergent-free cloth should then be used to rinse the cuff.

In certain situations, the cuff may become soiled during its use. In these situations a water-based detergent is suitable for wiping the cuff.

#### 7.7.4 Calibrating NIBP

Calibration of NIBP is not typically necessary during the warranty period. NIBP calibration is not intended to be performed by the user. NIBP Calibration is included as part of the Preventative Maintenance service recommended every two years post warranty.

**Leak Test - Check for air leaks within the NIBP system.**

To be performed if the user suspects there is a leak within the NIBP system. Connect blood pressure hose and cuff to the NIBP port. Select Leak Test to begin. If a leak is detected within the NIBP system, then “Cuff Leak” will appear in the NIBP channel display. If no leak is detected, then “Leakage test stopped” will appear.

**Reset - Perform NIBP module reset**

To be performed if a NIBP communication error appears. Select Reset to reset the NIBP module. The “Module resetting” status will then appear indicating a module reset is in progress. If the reset is successful, then “Module reset success” will appear. If the Module reset is unsuccessful, then the “Module resetting” message will continue to be displayed indicating there is a problem. Contact Midmark if the problem continues.

**Static pressure test - Test pressure accuracy within the NIBP system.**

To be performed to check the pressure accuracy of the NIBP system. A “T” hose connection set up is needed to connect to the NIBP port on the monitor side-panel. One end of the T will connect to the blood pressure cuff and the other end will connect to the blood pressure test device. Set the blood pressure test device (NIBP simulator) to the desired pressure. Select Static pressure test and the NIBP module will begin inflating and will maintain the set pressure. Check the pressure value displayed in the NIBP channel display. The displayed pressure value should be within 3 mmHg of the set value of your blood pressure test device. Please contact Midmark if the pressure value is out of range.

# SECTION 8 - SpO2 MONITORING

## 8.1 General Information

The Midmark Multiparameter Monitor continuously monitors and displays arterial blood oxygen saturation (SpO2) and pulse rate. If the ECG HR From is set to SpO2 or Auto and there is no ECG signal, the monitor beeps with each pulse beat. It allows you to choose alarm limits and audible tone volumes. You can select the high and low alarm limits for SpO2 and pulse rate and choose the alarm level.

The Midmark Multiparameter Monitor determines SpO2 and pulse rate by passing two wavelengths of light, one red (660nm) and the other infrared (940nm), through body tissue to a photo detector. Pulse identification is accomplished by using plethysmography techniques, and oxygen saturation measurements are determined using spectrophotometric oximetry principles. During measurement, the signal strength resulting from each light source depends on the color and thickness of the body tissue, the sensor placement, the intensity of the light sources, and the absorption of the arterial and venous blood (including the time varying effects of the pulse) in the body tissues.

The monitor processes these signals, separating the time invariant parameters (tissue thickness, skin color, light intensity, and venous blood) from the time variant parameters (arterial volume and SpO2) to identify the pulse and calculate oxygen saturation. Oxygen saturation calculations can be performed because blood saturated with oxygen predictably absorbs less red light than oxygen depleted blood.

Since measurement of SpO2 depends on a pulsating vascular bed, any condition that restricts blood flow, such as use of a blood pressure cuff or extremes in systemic vascular resistance, may cause an inability to determine accurate pulse and SpO2 readings. The Pulse Quality Gauge to the right of the SpO2 value, displays the strength of the pulse rate signal. Bars rise and fall with each pulse, indicating pulse signal strength; the greater the number of bars indicates a greater pulse quality signal strength.

***WARNING***
***There is a label  below the SpO2 socket, indicating that the signal input is insulated and defibrillation proof with a type CF applied part. Following exposure to a defibrillation event, SpO2 will resume normal operations after 10 seconds.***

***CAUTION***
*SpO2 sensors are fragile and must be handled with care.*

## 8.2 Sensor Placement

***WARNING***
***Use only Nellcor® veterinary oxygen sensors. Use of other oxygen sensors may cause improper performance.***

**Instructions for Use**

***NOTE***
*Reusable sensors may be used on the same site for a maximum of four (4) hours, provided the site is inspected routinely to ensure skin integrity and correct positioning. Because individual skin condition affects the ability of the skin to tolerate sensor placement, it may be necessary to change the sensor site more frequently with some patients. If skin integrity changes, move the sensor to another site.*

1. Select a sensor and clip that is appropriate for the patient. There are two (2) sizes of VetSat veterinary sensor clips: model VSC-S (small), and model VSC-L (large).
2. Clean the VetSat sensor and clip separately before and after each use.
3. Open the clip by pressing with the thumb and forefinger.
4. Slide one of the sensor's alignment buttons along the clip slot until the sensor pad is fully engaged in the clip.
5. Slide the second sensor button along the other clip slot until the second sensor pad is fully engaged in its side of the clip.

***NOTE***
*Verify the sensor pads are oriented so the optical components face each other directly.*

6. The sensor is now ready to be applied to the patient. The preferred sensor application site for canine, feline and equine animals is on the tongue, with the sensor's optical components positioned on the center of the tongue. Alternatively, the sensor and clip may be applied to the animal's lip, toe, ear, prepuce, or vulva.

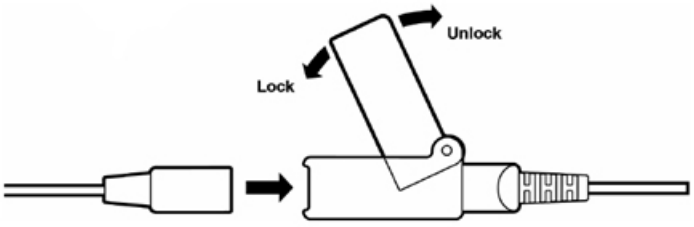
***NOTE***
*If the sensor does not track the pulse reliably, it may be incorrectly positioned, or the sensor site may be too thick, thin, or deeply pigmented to permit appropriate light transmission. If any of these situations occur, reposition the sensor or try another sensor site. If the sensor site is covered with fur, try shaving the site and reapplying the sensor.*

7. Be sure to position the sensor cable along the side of the animal's face and body to avoid entanglement with the animal.

***WARNING***
***Do not use supplemental tape to adhere the clip and sensor directly to the site; this can restrict blood flow and cause inaccurate measurements. For best results, secure the sensor cable independently from the sensor.***

8. Connect the sensor assembly to the Interface Cable:
9. Place the plastic hinged cover in the unlocked position (perpendicular to the connector).
10. Connect the sensor assembly to the Interface Cable.
11. Lock the plastic hinged cover to prevent accidental cable disconnection.

**Sensor to Interface Cable**




12. Plug the Interface Cable into the SpO2 connector on the side panel of the monitor. Push the cable in until you hear an audible "click".
13. Verify that the sensor is properly positioned by observing at least ten seconds of a continuous SpO2 waveform being displayed across the screen. When a valid signal is detected, the monitor displays the % SpO2 and Pulse Rate in the SpO2 Parameter box. If the perfusion light level is low, reposition the sensor or try a different sensor. If normal operation cannot be achieved, contact Midmark.

***NOTE***
*In addition to the V-SAT sensor and clips that are included with the monitor, there is an optional reflectance sensor, the MAXFAST-1 that can be used on the base of the tail. This is mainly used as an alternative when head/neck/dental procedures are being performed.*

## *8.3 SpO2 Setup Menu*

**Follow the steps below to enter the SpO2 Setup Menu:**

**Step 1:** Select the SpO2 waveform or SpO2 data in the Parameter box to enter the SpO2 Setup Menu.

**SpO2 Setup Menu Options:**

| | |
|---|---|
| **WAVE SPEED:** | Choose between 12.5 or 25mm/s. |
| **WAVE MODE:** | Choose between Scan or Fill. |
| **SAT SECONDS LIMIT:** | Choose between Off, 10, 25, 50, or 100s. |
| **PULSE VOLUME:** | Choose between 0 - 9, 9 being the loudest and 0 being silent. |
| **ALARM SETUP:** | This will take you to the SpO2 page of the Alarm Setup Menu. There, you can set the Alarm Level, PR Low Limit, PR High Limit, SpO2 Low Limit, SpO2 High Limit and revert to Default factory settings for the SpO2 parameter. Please see 4.3.2 Alarm Setup Menu for more details. |

**SatSeconds™ Alarm Management**

The SatSeconds function can be activated from the SpO2 Setup menu by selecting a SatSeconds limit, or “clock” of 10, 25, 50, 100 or Disabled SatSeconds. Clinicians who choose to employ the SatSeconds function should select a limit suited to their clinical environment and patient conditions. Think of SatSeconds as the product of magnitude and time a patient exceeds SpO2 alarm limits. For example, 3 points below the alarm limit for 10 seconds equals 30 SatSeconds. An alarm is only triggered if a desaturation event occurs that reaches the SatSeconds limit you selected. As a safety net, when three or more SpO2 alarm violations occur within 60 seconds, an alarm will sound even if the SatSeconds limit has not been reached.

When SatSeconds is set to Disabled, the monitor will immediately alarm for %SpO2 limit violations based on the selection made in the Alarm Limits menu.

Once the parameters are all set up, press the “X” button located on the upper right side of the menu to exit to the Main Screen.

## *8.4 Alarm Setup*

The SpO2 alarm is for parameter out of limit or abnormal status. When the parameter exceeds the limit, the monitor will give both visual and audio alarms. For different patients, different limits may be required. To set up the alarm parameters, reference Section 4.3.2 Alarm Setup.

### 8.4.1 Alarm Range

| Parameter | Range |
|---|---|
| SpO2 | 0 to 100% |
| Pulse Rate | 20 to 300 bpm |

***WARNING***
***If the SpO2 upper limit is set to 100%, then, it is equivalent to no alarm limit.***

For a complete list of abnormal status alarms, please see the Monitor Troubleshooting Section 13.2.

## *8.5 Preparation for Monitoring*

1. Select a sensor and clip that is appropriate for the patient.
2. Apply the sensor to a proper position on the patient. If possible, keep the sensor at the same level of the patient’s heart.

***WARNING***

- ***Do not apply the SpO2 sensor to an extremity where there is arterial catheter, blood pressure cuff or injection tube.***
- ***Make sure the light emitting part and light detecting part face each other.***
- ***Make sure the sensor is applied to a region of arterial blood flow.***
- ***Make sure there is no extreme motion.***
- ***Make sure skin where the sensor is applied is neither too thick nor too thin.***
- ***Make sure there is no strong ambient light coming into the sensor. Cover the site with opaque material.***

3. Set the upper and lower limits of SpO2.

***CAUTION***
*Handle the sensor and the wiring with care. There are sensitive electrical parts in the sensor that can be damaged by negligent treatment. Keep the wiring away from sharp items. Normal wear-and-tear caused by patient motion or sensor cleaning will limit the life of the sensor. Longevity can be extended by careful treatment.*

***WARNING***
***Reusable sensors may be used on the same site for a maximum of four (4) hours, provided the site is inspected routinely to ensure skin integrity and correct positioning. Because individual skin condition affects the ability of the skin to tolerate sensor placement, it may be necessary to change the sensor site more frequently with some patients. If skin integrity changes, move the sensor to another site.***

**Sensor Removal**

***CAUTION***
*For the comfort of the patient and to avoid damaging the sensor, do not pull on the interface or sensor cable when removing the sensor and clip from the sensor site, but rather, press the clip open and remove.*

When SpO2 monitoring is completed, remove the sensor from the patient.

To remove the sensor and clip from the patient, press the clip open and remove. When the sensor is removed from the patient, the message “SpO2 Sensor Off” is displayed and an audible alarm sounds, indicating a connection has been lost. To acknowledge the alarm, press the SILENCE/RESET pushbutton. The monitor silences the audible and visual alarms for the ALARM PAUSE TIME (default is 120 seconds) and the message “SpO2 Sensor Off” remains on the display.

## *8.6 Cleaning and Maintenance*

***CAUTION***
*Clean the sensor and sensor clip separately before and after each use.*

***CAUTION***
*Do not sterilize the sensor or clip by irradiation, steam, or ethylene oxide.*

***CAUTION***
*To avoid damage to the sensor, remove it from the clip before cleaning either piece.*

#### 8.6.1 Clean the Sensor and Clip

1. To remove the sensor from the clip, grasp the end of each sensor pad and pull it through to the inside of the clip. The sensor should pop out of the clip easily. Do not pull on the sensor or interface cable.

2. The sensor may be surface-cleaned by wiping it with an agent such as 70% isopropyl alcohol. Do not immerse the sensor in liquid. The clip may be cleaned by either wiping it with, or soaking it for ten minutes in, 70% isopropyl alcohol. If the clip is soaked, be sure to rinse it with water and air dry it prior to use on the next animal.

3. After each cleaning and prior to each use, inspect the sensor and cable for fraying, cracking, breakage, or other damage. Inspect the clip for cracking or breakage, or loss of spring tension that would allow slippage or movement of the sensor from its proper position. If defects are noted, do not use the sensor or clip.

#### 8.6.2 Clean the Cable

1. Clean the cable surface with soapy water or alcohol. Do not let liquid enter the cable connections.

2. Dry it with clean cloth.

> ***CAUTION***
> *Do not immerse the cable or sensor in any liquid or let the liquid enter into the connectors.*

## *8.7 Troubleshooting*

#### 8.7.1 No SpO2 Data

**Failure Phenomenon:** During monitoring process, there is no SpO2 waveform or data.

**Inspection Method:** Check if the red light on the sensor is on.

**Solution:** If there is no red light inside the sensor, the wiring connectors may have become loose, or the wire inside the cable may have grown frayed over time. Try it on your finger or earlobe, and if no reading is obtained, it may indicate that the V-SAT sensor must be replaced. If “SpO2 Communication Stop” is displayed on the screen, then there is a communication problem between the SpO2 module and the host. Turn off the machine and turn it on again. If the problem still remains, consult Midmark.

> ***CAUTION***
> *Certain drugs, including alpha-2s, are vaso-constrictive, and may cause difficulty in obtaining readings on patient extremities. Moving the sensor further back on the patient’s tongue, or exploring alternate sites (lip, ear, toe webbing, prepuce, vulva), may restore the readings.*

#### 8.7.2 Intermittent SpO2 Value

**Failure Phenomenon:** When patient SpO2 is measured, the SpO2 value is not continuous.

**Inspection Method:**

1. Check for patient motion.

2. Check for loose connections with the SpO2 extension cable or V-SAT sensor.

**Solution:** Keep the patient as still as possible. Value loss caused by patient motion can be considered normal.

# SECTION 9 - TEMPERATURE AND RESPIRATION MONITORING

## 9.1 General Information

### 9.1.1 Temperature

A continuous temperature monitor is used to measure a patient's core body temperature during the administration of general anesthesia, detection and treatment of hyperthermia, post-surgical recovery, and other various cases that may require constant body temperature monitoring.

The monitor has 2 channels available to display continuous electronic temperature readings of the core body temperature via a rectal/esophageal probe included with the monitor. ECG, respiration, and temperature can also be monitored with optional ECG esophageal probes.

Temperature monitoring provides numerical information only - no waveform. As with other parameters, data is displayed in the temperature parameter window on the right side of the screen.

***WARNING***
***TEMP sockets are labeled with  ,showing the signal input part is insulated and defibrillation proof with a type CF applied part. Following exposure to a defibrillation event, TEMP will resume normal operations after 10 seconds.***

## 9.2 Temperature Monitoring

1. Select temperature probe.

***WARNING***
***Rectal/esophageal probes are not exchangeable.***

2. Probe provided with the monitor may be used either in the esophagus or the rectum of the patient.

***CAUTION***
*To avoid cross-contamination, we suggest you label the probe with tape indicating which way it's been used.*

3. Insert the temperature probe into one of the two temperature sockets in the side panel.

***WARNING***
***Connect temperature probe with patient and insert the other end of the cable into the temperature socket of the monitor completely. The screen will display the temperature reading.***

4. Set temperature alarm limits. To set up the alarm parameters, reference Section 4.3.2 Alarm Setup.

***WARNING***
***Before performing temperature measurement, do not get the temperature probe close to a heat source. If it has been close to a heat source, then let it cool down for 5 minutes before performing measurement.***

5. Start to monitor patient's temperature.

***CAUTION***
*It takes 8 seconds for the veterinary monitor to display stable reading.*

## 9.3 Temperature Setup Menu

**Follow the steps below to enter the TEMP Setup Menu:**

**Step 1:** Select the TEMP data in the Parameter box to enter the TEMP Setup Menu.

**TEMP Setup Menu Options:**

| | |
|---|---|
| **UNIT:** | Choose from °F or °C. |
| **ALARM SETUP:** | This will take you to the TEMP page of the Alarm Setup Menu. There, you can set the Alarm Level, T1 Low Limit, T1 High Limit, T2 Low Limit, T2 High Limit, TD High Limit and revert to Default factory settings for the TEMP parameter. Please see 4.3.2 Alarm Setup Menu for more details. |

Once the parameters are all set up, press the “X” button located on the upper right side of the menu to exit to the Main Screen.

## 9.4 Temperature Probe Cleaning

As necessary, the probes should be cleaned with a mild detergent and water to remove excess bioburden. When necessary, the probes may be disinfected using a soft cloth saturated with a 10% (1:10) solution of chlorine bleach in tap water or 70% isopropyl alcohol. When all of the surfaces have been disinfected, wipe the entire surface of the probe using a soft cloth dampened with fresh water to remove any trace amounts of residue and/or fumes.

## 9.5 Respiration Monitoring

The monitor provides two respiration monitoring methods: thoracic impedance (standard) and through the Mainstream or Sidestream CO2 or AG sensors (optional).

1. Place electrodes in proper positions.
2. Select proper respiration lead combination.
3. Set respiration alarm limits.

***NOTE***
*ECG Clips must be placed in proper positions.*

***CAUTION***
*Patient motion may result in a respiration measurement error.*

***NOTE***
*If the patient is intubated, direct respiration monitoring through CO2 monitoring is recommended. If you choose to monitor respiration using the thoracic impedance method, place the ECG electrodes on the patient’s trunk for more reliable readings.*

## 9.6 Respiration Setup Menu

***NOTE***
*RESP will not be displayed if the CO2 or AG module is on. To display RESP waveform and numerical data, be sure to turn off the CO2 or AG module first.*

***NOTE***
*If the CO2 module is on, the display mode may show CO2 instead of RESP. Press the CO2 waveform or numerical data to enter the CO2 setup menu. Press the dropdown menu next to “SHOW” and choose RESP. This will display RESP information on the screen.*

**Follow the steps below to enter the RESP Setup Menu:**

**Step 1:** Select the RESP waveform or RESP data in the Parameter box to enter the RESP Setup Menu.

**RESP Setup Menu Options:**

| | |
|---|---|
| **APNEA TIME:** | Choose from 20, 25, 30, 35, 40, 45, 50, 55, or 60s. Within the specified time, if there is no respiration waveform, apnea alarm will be activated. Apnea alarm is independent of ALM Sound setting. The Apnea Alarm is not affected by the Alarm Silence feature. |
| **WAVE GAIN:** | Choose between x0.25, x0.5, x1, x2, and x4. |
| **WAVE SPEED:** | Choose between 6.25, 12.5, and 25mm/s. |
| **WAVE MODE:** | Choose between Scan or Fill. |
| **RESP LEAD:** | Choose between RA-LA, RA-LL, LA-RL and LL-RL. |
| **SENSITIVITY:** | Choose between 1, 2, 3, 4 and 5. The sensitivity should be increased as the signal strength decrease. 5 is the most sensitive setting. |
| **SHOW:** | Choose between RESP or CO2. This setting allows you to choose to display either the RESP waveform or the CO2 waveform on the main screen. This setting is only available when the CO2 module is turned on. |
| **ALARM SETUP:** | This will take you to the RESP page of the Alarm Setup Menu. There, you can set the Alarm Level, RR Low Limit, RR High Limit and revert to Default factory settings for the RESP parameter. Please see 4.3.2 Alarm Setup Menu for more details. |

Once the parameters are all set up, press the “X” button located on the upper right side of the menu to exit to the Main Screen.

## *9.7 Alarm Setup*

The respiration and temperature alarms include a parameter out-of-limit alarm and an abnormal status alarm. When the parameter is out of limit, the monitor will give an alarm sound automatically, and the value displayed on the screen flashes at the same time.

***WARNING***
***Alarm limits should be adjusted based on an individual patient’s condition.***

**Parameter Range:**

| **Parameter** | **Adjustment Range** |
|---|---|
| Respiration | 6 to 120 rpm |
| Temperature 1 | 32 to 122 °F |
| Temperature 2 | 32 to 122 °F |

**Alarm for abnormal status:**

| **Parameter** | **Alarm** |
|---|---|
| Respiration | “ECG LEAD OFF” |
| Temperature | “T1 Sensor Off”, “T2 Sensor Off” |

To set up the alarm parameters, reference Section 4.3.2 Alarm Setup.

For a complete list of abnormal status alarms, please see the Monitor Troubleshooting Section 13.2.

# SECTION 10 - CO2 MONITORING (Optional)

## 10.1 General Information

The Midmark Multiparameter Monitor includes the capability to monitor end-tidal CO2 using the optional Mainstream or Sidestream CO2 sensor. This measures CO2 by using the infrared absorption technique, which has endured and evolved in the clinical setting for over two decades and remains the most popular and versatile technique today.

The principle is based on the fact that CO2 molecules absorb infrared (IR) light energy of specific wavelengths, with the amount of energy absorbed being directly related to the CO2 concentration. When an IR beam is passed through a gas sample containing CO2, the electronic signal from the photodetector (which measures the remaining light energy) can be obtained. This signal is then compared to the energy of the IR source and calibrated to accurately reflect CO2 concentration in the sample. To calibrate, the photodetector's response to a known concentration of CO2 is stored in the monitor's memory. A reference channel accounts for optical changes in the sensor, allowing the system to remain in calibration without user intervention.

***WARNING***

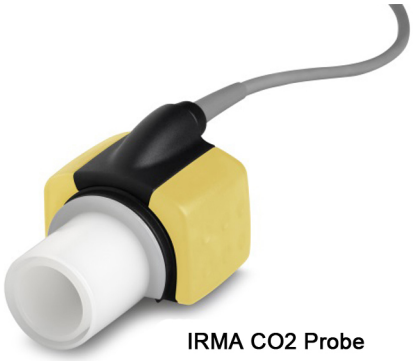
***There is a label***  ***below the CO2 socket, indicating that the signal input is insulated and defibrillation proof with a type BF applied part. Following exposure to a defibrillation event, CO2 will resume normal operations after 10 seconds.***

If you have a Multi-gas analyzer, refer to Section 12 for Multi-gas monitoring which includes CO2.

If you have a Respironics CO2 gas monitoring device, please refer to Section 10.2.



If you have a Masimo CO2 gas monitoring device, please refer to Section 10.3 as well as the Masimo User's Guide provided with your IRMA CO2 probe and NomoLine ISA CO2 analyzer.



IRMA CO2 Probe


NomoLine® ISA CO2™ analyzer

## *10.2 Respironics CO2*

### 10.2.1 CO2 Setup Menu

The CO2 Menu will only be available if the CO2 module is turned on.

**Follow the steps below to turn on the CO2 module:**

**Step 1:** Press the “SETTINGS” Quick Access Button or the Touch Screen Quick Access Icon.

**Step 2:** Press the “MODULE SETUP” to open the Module Setup Menu.

**Step 3:** Press the drop down option next to CO2. Select On to turn the module on.

**Step 4:** Press the “X” on the upper right corner to exit the screen. A warning will pop up to let you know that a restart would be required and that all current patient alarm data will be purged. Press “OK” to continue.

**Step 5:** The monitor will automatically shut down. After it shuts down, press the power button to turn it back on. The CO2 module should now be on.

> ***CAUTION***
>
> This will turn off the RESP waveform automatically and replace the RESP waveform on the Main Screen with the CO2 waveform. However, the user may change it back to the RESP waveform if desired. Please see the “SHOW” option described below in the Setup Menu section. If the user uses the RESP waveform instead, the CO2 module will automatically be changed to Standby Mode and CO2 data will no longer be collected or monitored.

> ***NOTE***
>
> *Turning modules On or Off always requires a restart. During restart, the alarm data of the current patient will be purged. Please set up all modules before the start of monitoring.*

**Follow the steps below to enter the CO2 Setup Menu:**

**Step 1:** Select the CO2 waveform or CO2 data in the Parameter box to enter the CO2 Setup Menu.

**CO2 Setup Menu Options:**

| | |
|---|---|
| **APNEA TIME:** | Choose from 20s, 25s, 30s, 35s, 40s, 45s, 50s, 55s and 60s. Within the specified time, if there is no CO2 waveform, apnea alarm will be activated. The Apnea Alarm is not affected by the Alarm Silence feature. |
| **OPERATING MODE:** | Choose from Standby or Measure. |
| **UNIT:** | Choose from mmHg, Kpa or %. |
| **WAVE SPEED:** | Choose from 6.25, 12.5 or 25.0mm/s. |
| **WAVE MODE:** | Choose from Scan or Fill. |
| **SHOW:** | Choose from RESP or CO2. When the CO2 module is on, all the display modes will default to showing the CO2 waveform. However, if the user should choose to do so, they may switch it with the RESP waveform and data by using this option. |
| **WAVE GRID:** | Choose from On or Off. |
| **CO2 SODA LIME ABSORBENT REMINDER** | Choose from On or Off. |
| **CO2 CATALOG** | This will display a collection of reference CO2 waveforms under the patient’s actual waveform to assist with waveform recognition. Choose from On or Off. Select in the Historical Data Table on the Parameter Trend Screen to display CO2 catalog. |
| **START ZERO CALIBRATION** | For use when manually adjusting the Respironics sensor - (See Section 10.2.5). |
| **ALARM SETUP:** | This will take you to the CO2 page of the Alarm Setup Menu. There, you can set the Alarm Level, EtCO2 Low Limit, EtCO2 High Limit, InCO2 High Limit, RR Low Limit, RR High Limit and revert to Default factory settings for the CO2 parameter. Please see 4.3.2 Alarm Setup Menu for more details. |

Once the parameters are all set up, press the “X” button located on the upper right side of the menu to exit to CO2 Setup Menu.

**Additional CO2 Options**

**To access additional options, follow the steps below:**

**Step 1:** Press the “SETTINGS” quick access icon.

**Step 2:** Press the “USER MAINTENANCE” button. Enter the password: 2013 and press “OK”.

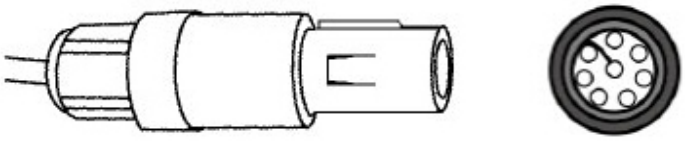
**Step 3:** Press the “MODULE MAINTENANCE” button.

**Step 4:** Press CO2 to access the following CO2 options:

| | |
|---|---|
| **BALANCE GAS** | Choose from Room Air, N2O, or Helium. |
| **O2 COMPEN** | Oxygen compensation, the user can input a number using the number pad. (See appendix 5) |
| **ATM PRESSURE** | Default set to 760 mmHg at 0 ft altitude. This cannot be changed by the user. It is calculated automatically depending on the Altitude value. |

### 10.2.2 Connecting the CO2 Sensor to the Monitor

1. Insert the CAPNOSTAT 5 CO2 Sensor connector into the CO2/AG receptacle of the Midmark Multiparameter Monitor as shown below.

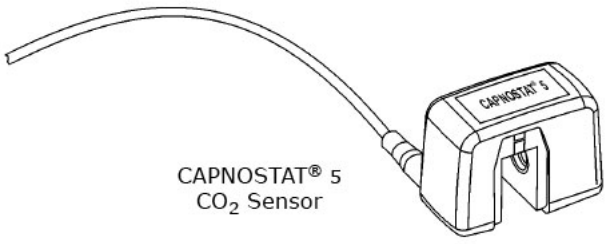


2. Make sure the arrows on the connector are at the top of the connector. Line up the two keys of the connector with the receptacle and insert.
3. To remove the connector, grasp the body portion of the connector, pull in direction of arrow and remove.

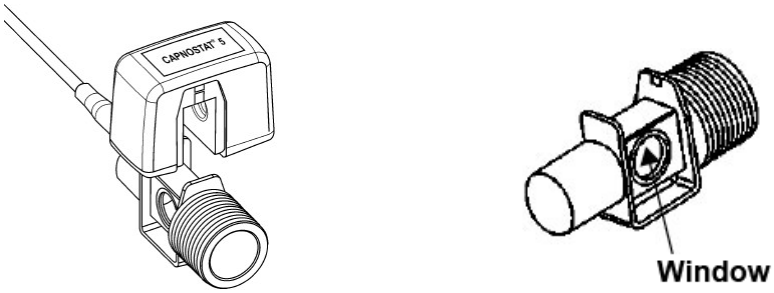
> ***NOTE***
> *Do not remove by pulling cable.*

### 10.2.3 CAPNOSTAT 5 Sensor - Mainstream

The CAPNOSTAT 5 CO2 Sensor is a rugged, solid-state, Mainstream sensor. It is factory calibrated and does not require further calibration.




Connecting the CAPNOSTAT 5 CO2 Sensor to a Respironics CO2 airway adapter




CAPNOSTAT 5 CO2 Sensor

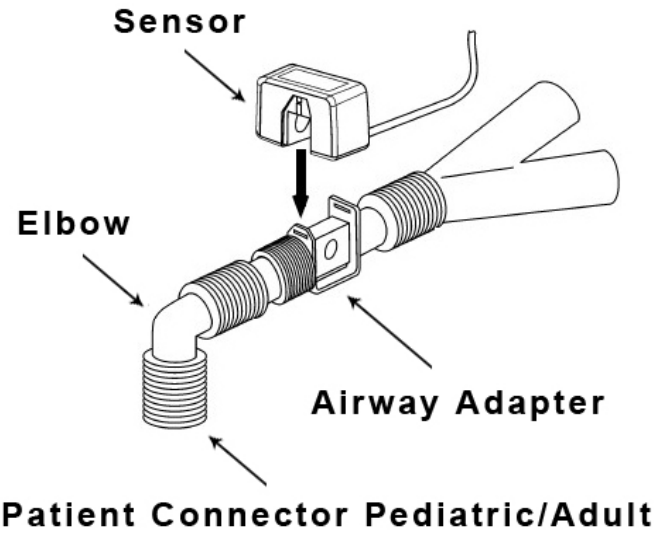
Select the correct airway adapter to minimize dead space. Large airway adapter for ET tubes > 4.0 mm (≈ 6 ml dead space). Small airway adapter for ET tubes ≤ 4.0 mm (≤ 1 ml dead space).

4. Connect: Press the CAPNOSTAT CO2 sensor onto the airway adapter. It will click into place when properly seated. Keep the windows of the adapter in the vertical position as shown during use. This will keep water and patient secretions from pooling on the windows.

5. When initially connected, your C-STAT5 will perform a zeroing procedure automatically (allow the C-Stat5 to warm up then select Start Zero Calibration to zero sensor). Make sure to successfully Zero your sensor before use. (See section 10.2.5)

6. Remove: Remove by sliding airway adaptor from CAPNOSTAT 5 CO2 sensor.

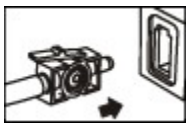
Shown below is the CAPNOSTAT 5 CO2 Sensor with a patient circuit:




**10.2.4 LoFlo CO2 Sensor - Sidestream**

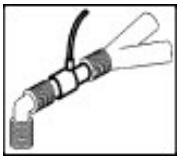
1. After connecting the sensor, wait two minutes to allow the sensor to initialize and warm up.

2. Select the correct sampling line to minimize dead space and snap into LoFlo sensor. Sampling line with large airway adapter for ET tubes > 4.0 mm (≈ 7 ml dead space). Sampling line with small airway adapter for ET tubes ≤ 4.0mm (≤ 1 ml dead space).



3. When initially connected, allow the LoFlo to warm up then select Start Zero Calibration to zero sensor.. Make sure to successfully Zero your sensor before use. (See section 10.2.5)

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



5. For intubated patients with an integrated airway adapter in the breathing circuit, connect the male luer connector on the straight sample line to the female port on the airway adapter.

***CAUTION***
*LoFlo CO2 sampling lines are intended for single patient use.*

***WARNING***
***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.***

#### 10.2.5 Zeroing the CAPNOSTAT 5 and LoFlo CO2 Sensors

***WARNING***
*Incorrect probe zeroing will result in false gas readings.*

The following instructions are for when a manual zero is needed, or an initial zero is unsuccessful.

***CAUTION***
*Never zero the Capnostat® or LoFlo® sensor without an adapter or sampling kit installed. Alarms relating to the adapter may prevent a successful zero. When zeroing, always remove the adapter or cannula from the patient and keep all sources of CO2 away from the sensor, including your own breath. CO2 is heavier than air.*

**To Zero your sensor, follow the steps below:**

**Step 1:** Plug in the Respironics CO2 sensor.

**Step 2:** Install the airway adapter or sampling line

***NOTE***
*The Respironics® module may be plugged in before or after you start the monitor.*

**Step 3:** Select the CO2 waveform or CO2 data in the parameter box to enter the CO2 Setup Menu.

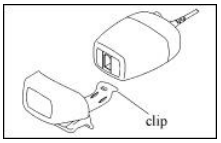
**Step 4:** Make sure the sensor is not being used or connected to the patient. Press “START ZERO CALIBRATION”.

**Step 5:** The “START ZERO CALIBRATION” function will now be grayed out on the menu. Upon successful completion, the “CO2 ZERO SUCCESSFUL” message will be displayed in the CO2 menu. If Zeroing failed, the reason for failure will be displayed in the technical alarm status bar.

#### 10.2.6 LoFlo CO2 Sensor Holder (Optional)

The Sidestream sensor holder can be used to clamp the sensor onto an IV pole or a shelf.

1. Push the sensor into the holder until it clicks into position.
2. Clamp the holder onto an IV pole, a shelf, or another appropriate location.
3. To remove the sensor from the holder, release the clip and pull the sensor out of the holder.




### 10.2.7 Removing Exhaust Gases from the System

> ***WARNING***
> ***Regarding Anesthetics: When using the Sidestream CO2 measurement on patients who are receiving or having recently received anesthetics, connect the outlet to a scavenging system, to avoid exposing the veterinary staff to anesthetics.***

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

### 10.2.8 Alarm Setup

The CO2 alarm is for parameter out of limit or abnormal status. When the parameter exceeds the limit, the monitor will give both visual and audio alarms.

**Alarm Range:**

| Parameter | Range |
|---|---|
| Airway Respiratory Rate | 0 to 150 rpm |
| EtCO2 | 0 to 150 mmHg |
| InCO2 | 0 to 150 mmHg |

> ***WARNING***
> ***Alarm limits should be adjusted based on an individual patient's condition.***

To set up the alarm parameters, please reference Section 4.3.2 Alarm Setup.

For a complete list of abnormal status alarms, please see the Monitor Troubleshooting Section 13.2.

### 10.2.9 Cleaning & Maintenance

**Cleaning the *outside* of the CAPNOSTAT 5 CO2 Sensor:**

1. Ensure that the sensor is disconnected and cooled to room temperature for 30 minutes before cleaning.
2. Use a cloth dampened with isopropyl alcohol 70%, a 10% aqueous solution of sodium hypochlorite (bleach), or disinfectant spray cleaner such as Steris Coverage® Spray HB.
3. Wipe down with a clean water-dampened lint free cloth to rinse and dry before use. Make certain that the sensor windows are clean and dry before reuse. Extra care should be taken when cleaning the lens/windows of the probe as to not scratch them. Only use cotton-tipped applicators and distilled water.
4. Keeping an airway adapter installed when not in use will protect the sensor windows.

**Cleaning the LoFlo CO2 Module case, Cable and connector:**

1. Use a cloth dampened with isopropyl alcohol 70%, a 10% aqueous solution of sodium hypochlorite (bleach), a 2% gluteraldehyde solution, ammonia, mild soap or disinfectant spray cleaner such as Steris Coverage® Spray HB.
2. Wipe down with a clean water-dampened cloth to rinse and dry before use. Make certain that the sensor windows are clean and dry before reuse.

**Airway Adapters**

Capnostat airway adapters are intended for single patient use.

***CAUTION***
*DO NOT insert any object, such as a brush, into the CAPNOSTAT 5 CO2 airway adapter or sensor adapter channel. Irreparable damage may occur to the CO2 windows.*

## *10.3 Masimo CO2*

The CO2 Menu will only be available if the CO2 module is turned on.

Before turning on the CO2 module, the correct type of CO2 must be selected.

**Follow the steps below to select the Masimo CO2 module:**

**Step 1:** Press the “SETTINGS” Quick Access Button or the Touch Screen Quick Access Icon.

**Step 2:** Select the “USER MAINTENANCE” Touch Screen Button and enter the password: 2013. Press “OK”

**Step 3:** Within the User Maintenance screen, press the dropdown button next to CO2 Type. Select Masimo. A warning will pop up to let you know that a monitor reset would be required. Press “OK” to continue. The monitor will return to the previous page. Press “X” at the top right corner of the menu to exit. The reset is complete. No restart is required.

Once the correct CO2 type has been established, the CO2 module must be turned ON.

**Follow the steps below to turn on the CO2 module:**

**Step 1:** Press the “SETTINGS” Quick Access Button or the Touch Screen Quick Access Icon.

**Step 2:** Press the “MODULE SETUP” to open the Module Setup Menu.

**Step 3:** Press the drop down option next to CO2. Select On to turn the module on.

**Step 4:** Press the “X” on the upper right corner to exit the screen. A warning will pop up to let you know that a restart would be required and that all current patient alarm data will be purged. Press “OK” to continue.

**Step 5:** The monitor will automatically shut down. After it shuts down, press the power button to turn it back on. The CO2 module should now be on.

***CAUTION***

This will turn off the RESP waveform automatically and replace the RESP waveform on the Main Screen with the CO2 waveform. However, the user may change it back to the RESP waveform if desired. Please see the “SHOW” option described below in the Setup Menu section. If the user uses the RESP waveform instead, the CO2 module will automatically be changed to Standby Mode and CO2 data will no longer be collected or monitored.

***NOTE***
*Turning modules On or Off always requires a restart. During restart, the alarm data of the current patient will be purged. Please set up all modules before the start of monitoring.*

**Follow the steps below to enter the CO2 Setup Menu:**

**Step 1:** Select the CO2 waveform or CO2 data in the Parameter box to enter the CO2 Setup Menu.

**CO2 Setup Menu Options:**

| | |
|---|---|
| **APNEA TIME:** | Choose from 20s, 25s, 30s, 35s, 40s, 45s, 50s, 55s or 60s. This selected time is the additional delay before the apnea alarm/text will be activated. The Apnea Alarm is not affected by the Alarm Silence feature. |
| **OPERATING MODE:** | Choose from Standby or Measure. (See Section 10.3.4). |
| **O2 COMPEN:** | This is for the Oxygen Compensation. Choose from Low, Mid and High. Refer to Appendix 5 for more details. |

| | |
|---|---|
| **N2O COMPEN:** | This is for the Nitrous Oxide Compensation Choose from On or Off. Refer to Appendix 5 for more details. |
| **UNIT:** | Choose from mmHg, Kpa or %. |
| **WAVE GRID:** | Choose from On or Off. |
| **WAVE SPEED:** | Choose from 6.25, 12.5 or 25.0mm/s. |
| **WAVE MODE:** | Choose from Scan or Fill. |
| **SHOW:** | Choose from RESP or CO2. When the CO2 module is on, all the display modes will default to showing the CO2 waveform. However, if the user should choose to do so, they may switch it with the RESP waveform and data by using this option. |
| **CO2 SODA LIME ABSORBENT REMINDER** | Choose from On or Off. |
| **CO2 CATALOG** | This will display a collection of reference CO2 waveforms under the patient's actual waveform to assist with waveform recognition. Choose from On or Off. Select in the Historical Data Table on the Parameter Trend Screen to display CO2 catalog. |
| **START ZERO CALIBRATION** | For use when manually adjusting the IRMA CO2 probe - (See Section 10.3.8). |
| **ALARM SETUP:** | This will take you to the CO2 page of the Alarm Setup Menu. There, you can set the Alarm Level, EtCO2 Low Limit, EtCO2 High Limit, InCO2 High Limit, RR Low Limit, RR High Limit and revert to Default factory settings for the CO2 parameter. Please see 4.3.2 Alarm Setup Menu for more details. |

Once the parameters are all set up, press the "X" button located on the upper right side of the menu to exit to the CO2 Setup Menu.

**Additional CO2 Options**

**To access additional options, follow the steps below:**

**Step 1:** Press the "SETTINGS" quick access icon.

**Step 2:** Press the "USER MAINTENANCE" button. Enter the password: 2013 and press "OK".

**Step 3:** Press the "MODULE MAINTENANCE" button.

**Step 4:** Press CO2 to access the following CO2 options:

| | |
|---|---|
| **ATM PRESSURE** | Atmospheric pressure/Ambient pressure. This cannot be set by the user. |
| **Atm Press-Cuvette Press** | Atmospheric pressure/Ambient pressure minus the pressure in in the measuring cuvette (ISA). This cannot be set by the user. |
| **CO2 Calibration** | This is the Span calibration. The service technician can set the % volume to a value between 4.0 and 11.0. |
| **Zero Bef Calibration (CO2)** | Zero Before Calibration (Zeroing) is used to establish a zero reference level for the gas measurements. |
| **Calibration Module (CO2)** | Manually perform a zero calibration |

### 10.3.2 IRMA CO2 Probe

***NOTE***
*Please refer to the IRMA CO2 Probe user guide for all technical specifications associated with this product.*

***WARNING***
***Please refer to the IRMA CO2 Probe user guide for all Warnings and Cautions associated with this product.***

**The following parts are included with your IRMA CO2 probe kit.**

1. IRMA (Mainstream) CO2 probe.
2. IRMA™ airway adapters.
3. CO2 kit instructions.

**Connecting the IRMA CO2 probe to the monitor**.

The IRMA CO2 probe is an external and independent part of the Midmark Multiparameter Monitor.

**Step 1:** With the monitor off, plug the IRMA CO2 probe into monitor side panel by lining up the two keys of the connector with the receptacle and insert.

**Step 2:** Select the correct airway adapter to minimize dead space. Large airway adapter for ET tubes > 4.0 mm (≈ 6 ml dead space). Small airway adapter for ET tubes ≤ 4.0 mm (≤ 1 ml dead space).

**Step 3:** Snap the IRMA CO2 probe on top of the IRMA airway adapter. It will click into place when properly seated.

**Step 4:** Turn on the monitor.

**Step 5:** If CO2 is not displayed, turn on the CO2 module within the Module Setup Menu. Refer to Section 10.3.1 CO2 Setup Menu.

***NOTE***
*The end user must turn on the CO2 module function within the monitor the first time the CO2 device is plugged in for use. Refer to Section 10.3.1 CO2 Setup Menu.*

***NOTE***
*The end user must plug in the CO2 probe prior to turning on the monitor for proper functioning of the device.*

**Step 6:** A green LED indicates that the IRMA CO2 probe is ready for use.

**Step 7:** Connect IRMA airway adapter male connector to the breathing circuit Y-piece. Connect the IRMA airway adapter female connector to the patient's endotracheal tube. Position the IRMA CO2 probe with the LED pointing upwards.

A HME (Heat Moisture Exchanger) may be connected between the patient's endotracheal tube and the IRMA CO2 probe to protect the IRMA airway adapter from secretions and effects of water vapor and eliminate the need of changing the adapter. It allows free positioning of the IRMA CO2 probe as well.

***NOTE***
*A HME will add Dead Space and Resistance to the breathing circuit. Refer to manufacturer's information for amounts and recommendations for replacement.*

***NOTE***
*Unless the IRMA CO2 probe is protected with a HME, always position the IRMA CO2 probe with the LED pointing upwards.*

The IRMA disposable airway adapter is inserted between the endotracheal tube and the Y-piece of the breathing circuit. The respiratory gas measurements are obtained through the XTP windows in the sides of the adapter. As the airway adapter is positioned directly in the airway, its performance can be affected by water vapor, patient secretions or nebulized medications that can accumulate on the adapter's windows. For optimal results, the airway adapter shall not be placed between an endotracheal tube and an elbow, as this may allow patient secretions to block the adapter windows. The IRMA airway adapter shall be positioned with its windows in a vertical position to help keep patient secretions from pooling on the windows. The disposable IRMA airway adapter is treated to prevent moisture buildup and drift, so please do not clean the interior of the airway adapters. Please select an airway adapter appropriate for the size of the patient (Small for patients 20 lbs and below, Standard for patients larger than 20 lbs) for optimal performance.

***WARNING***
***The IRMA™ CO2 probe is not intended to be in patient contact.***

***WARNING***
***If, for whatever the reason, the IRMA™ CO2 probe is in direct contact with any parts of the patient's body, an insulation material shall be paced between the IRMA™ CO2 probe and the body.***

When connecting the IRMA CO2 probe to a patient circuit it is important to avoid a direct contact between the IRMA CO2 probe and the patient's body.

**Step 8:** To remove the IRMA CO2 probe, grasp the body portion of the connector and pull to remove.

***NOTE***
*Do not remove by pulling cable.*

***CAUTION***
*IRMA™ CO2 airway adapters are intended for single patient use.*

#### 10.3.3 NomoLine ISA CO2 Gas Analyzer

***NOTE***
*Please refer to the NomoLine ISA CO2 Analyzer user guide for all technical specifications associated with this product.*

***WARNING***
***Please refer to the NomoLine ISA CO2 Analyzer user guide for all Warnings and Cautions associated with this product.***

**The following parts are included with your NomoLine ISA CO2 gas analyzer.**

1. NomoLine ISA CO2 (Sidestream) gas analyzer.
2. NomoLine Sampling lines.
3. CO2 kit instructions.

**Connecting the NomoLine ISA CO2 gas analyzer to the monitor**.

The NomoLine ISA CO2 gas analyzer is an external and independent part of the Midmark Multiparameter Monitor.

**Step 1:** Securely mount or place the NomoLine ISA CO2 gas analyzer in a safe location.

**Step 2:** With the monitor off, plug the NomoLine ISA CO2 gas analyzer into the monitor side panel.

**Step 3:** Select the correct sampling line to minimize dead space and connect sampling line to the NomoLine ISA CO2 gas analyzer input connector. Sampling line with large airway adapter for ET tubes > 4.0 mm ( ≤6 ml dead space). Sampling line with small airway adapter for ET tubes ≤ 4.0 mm (≤0.7 ml dead space).

**Step 4:** Connect the gas sample exhaust port to a scavenging system or return the gas to the patient circuit to prevent pollution of the operation room when N2O and/or anesthetic agents are being used. See section 10.3.5 CO2 Exhaust.

**Step 5:** Turn on the monitor.

**Step 6:** A green LED indicates that the NomoLine ISA CO2 gas analyzer is ready for use. Perform a pre-use check as described in the Section 10.3.6 Pre-Use Checks.

**Step 7:** If CO2 is not displayed, turn on the CO2 Module within the Main Menu. Refer to Section 10.3.1 CO2 Setup Menu.

***NOTE***
*The end user must turn on the CO2 module function within the monitor the first time the CO2 device is plugged in for use. Refer to Section 10.3.1 CO2 Setup Menu.*

***CAUTION***
*In order to ensure good ventilation of the module, please keep a minimum of 5cm from each side of the analyzer to the wall or cabinet.*

It is recommended to place the NomoLine ISA CO2 gas analyzer at a place higher or at the same level of patient position.

**Step 8:** To remove the NomoLine ISA CO2 gas analyzer, grasp the body portion of the connector and pull to remove.

***NOTE***
*Do not remove by pulling cable.*

***CAUTION***
*NomoLine® ISA™ CO2 sampling lines are intended for single patient use.*

**10.3.4 Turn On or Off the CO2 Work Mode**

The IRMA CO2 probe defaults to Standby mode and will have to be switched to measurement mode before use. Zeroing needs to be performed ONLY when an offset in gas values is observed, or when an unspecified accuracy message is displayed. Allow 10 seconds for warm up of the IRMA CO2 probe 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.

A zero may to be performed manually by selecting “Start Zero Calibration”, please refer to section 10.3.8.

For the NomoLine ISA CO2 gas analyzer, Zeroing is performed when the NomoLine sampling line is unplugged, and only if considered necessary.

***NOTE***
The new NomoLine ISA™ CO2 analyzer does not perform a automatic zeroing as the legacy ISA™ CO2 analyzer did.

The monitor will default to Measure Mode. To save operational time, the user may elect to turn the monitor to Standby mode when not using the IRMA CO2 probe or NomoLine ISA CO2 gas analyzer.

***NOTE***
*The end user must plug in the CO2 probe prior to turning on the monitor for proper functioning of the device.*

**To change the Work Mode for the IRMA CO2 probe and NomoLine ISA CO2 gas analyzer, follow the steps below:**

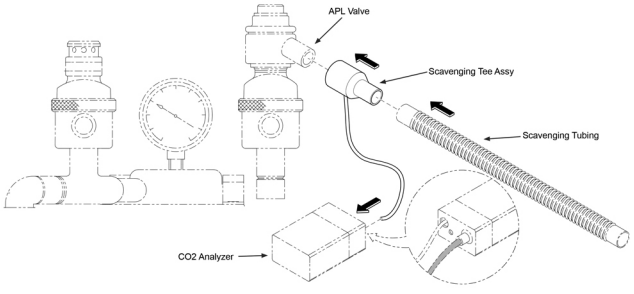
**Step 1:** Press on the CO2 Waveform Area or Parameter box to open the CO2 Setup Menu.

**Step 2:** Press the drop down button next to “OPERATING MODE” and choose between “Standby” or “Measure”.

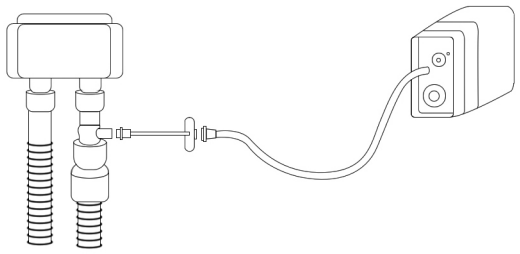
**Step 3:** Press the “X” on the upper right corner of the menu to exit.

**10.3.5 CO2 Exhaust**

Connect the gas sample exhaust port to a scavenging system or return the gas to the patient circuit to prevent pollution of the operation room when N2O and/or anesthetic agents are being used. Due to the risk of patient cross-infection, always use a bacteria filter on the exhaust port side if sampled gas is intended to be re-breathed.




or



***NOTE***
*The exhaust line is not supplied with the NomoLine® ISA™ CO2 analyzer but a scavenging kit solution is available as an optional accessory (See Appendix 6).*

### 10.3.6 Pre-Use Checks

**IRMA CO2 Probe**

Always verify gas readings and waveforms on the monitor before connecting the airway adapter to the patient circuit. To do this, breathe into the airway adapter with the IRMA CO2 probe attached.

Perform a tightness check of the patient circuit with the IRMA CO2 probe snapped on the IRMA airway adapter.

**NomoLine ISA CO2 Gas Analyzer**

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

1. Connect the sampling line to the NomoLine ISA CO2 gas analyzer light emitting gas inlet connector (LEGI).
2. Check that the LEGI shows a steady green light (indicating that the system is OK).
3. Breathe into the sampling line and check that valid CO2 waveforms and values are displayed.
4. Occlude the sampling line with a fingertip and wait for 10 seconds.
5. Check that an occlusion alarm, “Sampling Line Clogged”, is displayed and that the LEGI shows a flashing red light.
6. If applicable: Perform a tightness check of the patient circuit with the sampling line attached.

**Leakage Check**

Leakage check should be performed if there is a suspected leakage and also annually. Leakage tests shall be performed by an authorized service technician only as it requires proprietary software. Please contact your service technician or Midmark for assistance.

### 10.3.7 Using CO2

1. Connect the module to the Midmark Multiparameter Monitor and turn the monitor on.
2. If CO2 is not displayed, turn on the CO2 module. Refer to Section 10.3.1 CO2 Setup Menu.
3. For the NomoLine ISA CO2 gas analyzer, Zeroing is performed when the NomoLine sampling line is unplugged, and only if considered necessary. For the IRMA CO2 probe, when needed, please refer to Section 10.3.8 to manually zero the probe.
4. Connect the module to the patient circuit. Once the module detects breathing, the related values will automatically be displayed.

***NOTE***
*The infrared gas analyzer needs to establish a zero reference level for the CO2 gas measurement. This zero calibration is referred to as “Start Zero Calibration”.*

***WARNING***
***Incorrect analyzer zeroing will result in false gas readings.***

### 10.3.8 Start Zero Calibration

***WARNING***
*Incorrect probe zeroing will result in false gas readings.*

**IRMA CO2 Probe**

**In order to secure high precision of the IRMA CO2 probe measurements the following zeroing recommendations should be followed:**

1. Special care should be taken to avoid breathing near the airway adapter before or during the Zeroing procedure. The presence of ambient air (21% O2 and 0% CO2) in the IRMA airway adapter is of crucial importance for a successful Zeroing. If a “Zero required” alarm should appear directly after a Zeroing procedure, the procedure has to be repeated.
2. Always perform a pre-use check after zeroing the probe. See section 10.2.6 Pre-Use Checks.

3. Zeroing should be performed only when an offset in gas values or an unspecified gas accuracy message is displayed.

4. The option to Zero will be unavailable during warm up and zeroing. The green LED on the probe will be blinking for approximately 5 seconds while zeroing is in progress.

**To zero the IRMA CO2 probe, follow the steps below:**

**Step 1:** Snap a new IRMA airway adapter onto the IRMA CO2 probe, without connecting the airway adapter to the patient circuit.

**Step 2:** Select the CO2 waveform or CO2 data in the Parameter box to enter the CO2 Setup Menu.

**Step 3:** Press the “START ZERO CALIBRATION” button. The visual technical alarm “CO2 is Zeroing” will appear along with the technical audible alarm. When completed, “CO2 Zero Success” will display. If Zeroing failed, the reason for failure will be displayed in the technical alarm status bar.

**NomoLine ISA CO2 Gas Analyzer**

The highly stable NomoLine ISA CO2 gas analyzer system spectrometer requires no regular zeroing. A room air reference measurement is performed when the NomoLine is disconnected from the LEGI connector, provided that CO2 measurements are stable. This zeroing procedure is indicated by the LEGI blinking green.

### 10.3.9 Alarm Setup

The CO2 alarm is for parameter out of limit or abnormal status. When the parameter exceeds the limit, the monitor will give both visual and audio alarms.

**Alarm Range:**

| Parameter | Range |
|---|---|
| Airway Respiratory Rate | 0 to 150 rpm |
| EtCO2 | 0 to 150 mmHg |
| InCO2 | 0 to 150 mmHg |

The Masimo CO2 sensors come with a LED status indicator on the probe themselves, shown in the table below.

| Indication | Status |
|---|---|
| Steady Green Light | System OK |
| Blinking Green Light | Zeroing In Progress |
| Steady Red Light | Sensor Error |
| Blinking Red Light | Check Sampling Line or Adapter |

The CO2 module has alarms for values exceeding the preset limits, apnea, and for abnormal status.

**Alarm for Parameters Exceeding Preset Limits**

Alarm will be activated when the measured parameter exceeds the preset parameter alarm limits.

For CAT/DOG/HORSE/Other: EtCO2 low/high (mmHg) – 20/60, InCO2 low/high (mmHg) – 0/10, RR low/high (rpm)—5/55.

**Apnea Alarm**

If no breath is detected for the selected apnea time, the apnea alarm will be activated.

***NOTE***
*The CO2 module and the patient monitor system have a smart apnea alarm function. That is, there will be no alarm during the period when the patient monitor is just powered on. It will only activate the apnea alarm after it has detected respiration and later it identifies there is apnea.*

***NOTE***
*The apnea alarm is a high priority alarm. So when the apnea alarm occurs, the red light flashes on the monitor display. The Alarm Silence feature will only silence the audible portion of the Apnea Alarm.*

**Abnormal Status**

Abnormal status refers to technical alarms such as “Sampling Line Clogged” or “Check Adapter (CO2)”. For a complete list of abnormal status alarms, please see the Monitor Troubleshooting Section 13.2.

### 10.3.10 Cleaning and Maintenance

> ***CAUTION***
> *Anyone not properly trained and certified must not attempt to perform any service or maintenance of the Masimo Sweden product..*

**CO2 Module Cleaning**

> ***WARNING***
> ***Do not use Chlorine disinfectants or Chlorine cleaners with the NomoLine® ISA™ CO2 or IRMA analyzers as this will damage them.***

The IRMA CO2 probe can be cleaned using a cloth moistened with ethanol or isopropyl alcohol (< 70 %). Extra care should be taken when cleaning the lens/windows of the probe as to not scratch them. Only use cotton-tipped applicators and alcohol.

> ***CAUTION***
> *The IRMA™ sensor and airway adapters are non-sterile devices. Do not autoclave the devices as this will damage them.*

> ***CAUTION***
> *Never sterilize or immerse the IRMA™ analyzer in liquid.*

Cleaning of the NomoLine ISA CO2 gas analyzer should be performed at regular intervals or in accordance with hospital, as well as local and governmental regulations.

> ***WARNING***
> ***To avoid electric shock, always physically disconnect the NomoLine ISA™ CO2 analyzer and all patient connections before cleaning.***

> ***CAUTION***
> ***To avoid permanent damage to the NomoLine ISA™ CO2 analyzer, do not use undiluted bleach (5% - 5.25% sodium hypochlorite) or any other cleaning solution not recommended.***

> ***NOTE***
> ***To prevent cleaning liquids and dust from entering the NomoLine capnography gas analyzer through its sampling gas inlet connector, keep the sampling line fitted while cleaning NomoLine ISA™ CO2 analyzer.***

The surfaces of the NomoLine ISA CO2 gas analyzer may be cleaned with the following solution(s):

- 70% ethyl alcohol
- 70% isopropyl alcohol
- Glutaraldehyde Solution
- Quaternary Ammonium Chloride Wipe
- 0.5% Sodium Hypochlorite/Water Solution
- Accelerated Hydrogen Peroxide

***WARNING***
***Never sterilize or immerse the* NomoLine ISA CO2 *sidestream gas analyzer in liquid.***

**NomoLine ISA CO2 Gas Analyzer Maintenance**

Once every year, or whenever gas readings are questionable, perform a leakage check according to section 10.3.6 and verify gas readings with a reference instrument or with calibration gas.

**Airway Adapters and Sampling Lines**

IRMA airway adapters and NomoLine sampling lines are intended for single patient use.

# SECTION 11 - IBP MONITORING (Optional)

## 11.1 General Information

The device displays the maximum systolic pressure, minimum diastolic pressure, mean pressure and an IBP waveform. The IBP waveform can be observed in 2 channels, and the waveform speed is defaulted at 25mm/s. The sweep speed for both channels are linked but may be altered to the user's requirements as needed. In the IBP waveform channel has a scale on the left and the IBP reading is displayed to the right of the waveform in the parameter box.

***WARNING***

***There is a label [♥] below the IBP sockets, indicating that the signal input is insulated and defibrillation proof with a type CF applied part. Following exposure to a defibrillation event, IBP will resume normal operations after 10 seconds.***

***NOTE***

*For a thorough discussion, see Appendix 4; Direct Blood Pressure Monitoring, by Marc R. Raffe DVM, MS, DACVA, DACVECC, IVECCS proceedings.*

## 11.2 IBP Setup Menu

The IBP Menu will only be available if the IBP module is turned on.

**Follow the steps below to turn on the IBP module:**

**Step 1:** Press the "SETTINGS" Quick Access Button or the Touch Screen Quick Access Icon.

**Step 2:** Press the "MODULE SETUP" to open the Module Setup Menu.

**Step 3:** Press the drop down option next to IBP. Select 2IBP to turn the module on.

**Step 4:** Press the "X" on the upper right corner to exit the screen. A warning will pop up to let you know that a restart would be required and that all current patient alarm data will be purged. Press "OK" to continue.

**Step 5:** The monitor will automatically shut down. After it shuts down, press the power button to turn it back on. The IBP module should now be on.

**Follow the steps below to enter the IBP Setup Menu:**

**Step 1:** Select the IBP waveform or IBP data in the Parameter box to enter the IBP Setup Menu.

***NOTE***

*If IBP waveform and data is not on the screen after the module is turned on, press the "Displays" Quick Access Icon to rotate through the display options. Stop at the display option that shows the IBP parameter.*

| | |
|---|---|
| **WAVE SPEED:** | Choose between 12.5 or 25mm/s. The Wave Speed for Channel 1 and Channel 2 are connected. Therefore, the two channels cannot have different sweep speeds. |
| **WAVE MODE:** | Choose between Scan or Fill. |
| **UNIT:** | Choose between mmHg or kPa. |
| **ALARM SETUP:** | This will take you to the IBP 1&2 page of the Alarm Setup Menu. There, you can set the Alarm Level, ART1 Low Limit (for SYS, DIA and MAP), ART1 High Limit (for SYS, DIA and MAP), CVP2 Low Limit, CVP2 High Limit and revert to Default factory settings for the IBP parameter. Please see 4.3.2 Alarm Setup Menu for more details. |
| **PRESSURE:** | Set the option for IBP Channel 1 and 2. For Channel 1, choose from: ART1, PA1, CVP1, AO1, RA1, ICP1, and FA1. For Channel 2, choose from: ART2, PA2, CVP2, AO2, RA2, ICP2 and FA2. |

| | |
|---|---|
| **WAVE SCALE** | The user may adjust the maximum and minimum pressure value for Channel 1 and Channel 2. The user may choose from Auto, (-10,10), (-20,20), (-30,30), (-50,50), (0,40), (0,120), (0,200), (0,300) and (0,400). |
| **IBP1 ZERO** | The user may zero IBP1. Please reference Section 11.5 Zeroing the IBP Sensor. |
| **IBP2 ZERO** | The user may zero IBP2. Please reference Section 11.5 Zeroing the IBP Sensor. |
| **SHOW** | The user may choose to display Arterial or MAP readings within the IBP channels. |

Once the parameters are all set up, press the “X” button located on the upper right side of the menu to exit to the Main Screen.

## *11.3 Transducer*

IBP transducers provided are in conformity with ANSI/AAMI BP22:1994 standards and with sensitivity 5uV/V/mmHg. Check transducer cable before connecting it to the device.

***NOTE***
*The disposable transducer is for single use only. Never attempt to reuse the parts. Discard the used transducers properly.*

***WARNING***
***Use only the recommended IBP cable and transducers.***

### 11.3.1 Transducer Connection

1. When the device is turned on and the IBP module is activated, the IBP channels will be displayed on the main screen without any waveforms.
2. Plug the transducer cable into the IBP1 or IBP2 socket, the other end of the transducer cable is connected as follows:


IBP Transducer Connection Diagram (Fig. 11-1)

| |
|---|
| The T (1) is used to open the transducer (2) to air. |
| The T (3) is used to block (2) from (3) and (4). |
| The pressure monitoring tube (4) is to ensure the accuracy of the measurement. |
| The (5) in the above diagram is to connect patient catheter. |

3. Fill in the catheter system from T (3) and make sure there is no bubble in the system.
4. Connect patient catheter to pressure monitoring tube, make sure there is no air in catheter, pressure monitoring tube or transducer.

***WARNING***
***If there are bubbles in the pressure tube or transducer, flush the catheter system with physiological saline.***

## *11.4 Preparation for Measurement*

***CAUTION***
*Make sure the IBP sensors are properly zeroed before use. See Section 11.5 Zeroing the Sensor.*

**Step 1:** Make sure your monitor comes with the IBP feature. Check the side panel to see if there are 2 IBP connectors. If it does, then the unit you ordered has IBP.

**Step 2:** Connect the IBP cable to the monitor and turn the monitor on. Follow the directions in 11.3.1 Transducer Connection to make certain the transducer is connected accurately.

**Step 3:** Prepare the pressure tube and sensor. To do so, fill up the system with normal saline, making sure there are no bubbles within the tube system.

**Step 4:** Connect the patient tube to the pressure tube, making sure there is no air in the tubes or the sensor.

**Step 5:** Make sure the IBP transducers are not connected to the patient in any way.

**Step 6:** Place the sensor and the heart at the same level, approximately at middle axillary line, and vent the sensor to air.

**Step 7:** Make sure that you have selected the correct designation. Refer to Section 11.2 IBP Setup Menu for available designations.

**Step 8:** Zero the sensor. Please refer to Section 11.5 Zeroing the Sensor.

## *11.5 Zeroing the IBP Sensor*

Transducer zeroing is very important for accurate measurement, so zeroing should be performed regularly and before each new sensor is used. Before zeroing, be certain to vent the transducer to atmosphere at a level consistent with the heart of the patient.

**Follow the steps below to zero the sensor:**

**Step 1:** Press on the IBP Waveform Area to open the IBP Setup Menu.

> ***NOTE***
> *If IBP waveform and data is not on the screen after the module is turned on, press the "DISPLAYS" Quick Access Icon to rotate through the display options. Stop at the display option that shows the IBP parameter.*

**Step 2:** Press either the "IBP1 ZERO" or "IBP2 ZERO" to zero the channel you are using for IBP. If you are using both channels, you must zero both channels separately. Once you press the "IBP1 ZERO" or "IBP2 ZERO" button, the button will turn yellow indicating that Zeroing is in progress. Once it is complete, the message will change to "IBP1 Zero Success" or "IBP2 Zero Success". If the zeroing failed, the message will be "IBP1 Zero Fail" or "IBP2 Zero Fail".

## *11.6 IBP Labeling*

The Midmark Multiparameter Monitor allows you to label various sites for monitoring pressure. The possible labels consist of: ART1, PA1, CVP1, AO1, RA1, ICP1, FA1, ART2, PA2, CVP2, AO2, RA2, ICP2, and FA2.

ART1 or ART2: Arterial Pressure, i.e. the arterial blood pressure being monitored

PA: Pulmonary Artery Pressure

CVP: Central Vein Pressure

AO: Aorta Pressure

RA: Radial Artery Pressure

ICP: Intracranial Pressure

FA: Femoral Artery Pressure

## *11.7 Alarm Setup*

IBP monitoring alarm includes parameter limit alarm and abnormal status alarm. Alarm is to give alert when the monitoring results are abnormal. It is audible and visual with LED indicators and flashing readings.

> ***NOTE***
> *Adjust default alarm limits according to the circumstances and the patient status.*

| | Cat | | Dog | | Horse | | Other | |
|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Low** | **High** | **Low** | **High** | **Low** | **High** | **Low** | **High** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| IBP SYS (mmHg) – ART1, ART2, AO, RA, FA | 100 | 160 | 100 | 160 | 100 | 130 | 100 | 160 |
| IBP DIA (mmHg) – ART1, ART2, AO, RA, FA | 50 | 90 | 50 | 90 | 50 | 80 | 50 | 90 |
| IBP MAP (mmHg) –ART1, ART2, AO, RA, FA | 60 | 120 | 70 | 130 | 60 | 100 | 70 | 130 |
| IBP SYS (mmHg) – PA | 5 | 38 | 5 | 38 | 5 | 38 | 5 | 38 |
| IBP DIA (mmHg) – PA | -4 | 4 | -4 | 4 | 0 | 16 | -4 | 4 |
| IBP MAP (mmHg) – PA | 12 | 16 | 12 | 16 | 8 | 25 | 12 | 16 |
| IBP MAP (mmHg) – CVP | 0 | 7 | 0 | 7 | 0 | 23 | 0 | 7 |
| IBP MAP (mmHg) – ICP | 0 | 4 | 0 | 4 | 0 | 10 | 0 | 4 |

***NOTE***
*If CVP or ICP mode is selected, there are no SYS and DIA alarms.*

To set up the alarm parameters, please reference Section 4.3.2 Alarm Setup.

## *11.8 Precautions*

**WARNING:**

- If liquid enters the monitor, turn it off immediately, and contact Midmark.
- If liquid enters the accessories, turn off the monitor and disconnect the sensors from the patient. Switch to another sensor and alert hospital technicians or contact Midmark to repair or replace the original sensor as needed.
- When the monitor is connected to electrosurgical units, make sure the transducers and cables do not make contact with the electrosurgical unit. The patient lead and conducting wire must be far away from the operating table and other devices. The electrosurgical unit should be properly grounded.
- When a defibrillator is used, make sure the patient cable is not in contact with metal or other conductors or device grounding part. During defibrillation, do not touch the patient, table or device.
- When using an accessory, make sure that the selected accessory meets medical instrument safety requirements.
- When connecting or using an accessory, avoid touching any metal part connected to an electric appliance.
- When the monitor is connected to high frequency electrosurgical equipment, do not allow the sensor from the monitor to come into contact with the high frequency electrosurgical equipment or its cables. Otherwise, electric leakage may occur and may cause burns to the patient.
- Do not repeatedly use a disposable pressure sensor.
- Before starting monitoring, check to make sure the sensor cable is working and undamaged.

**CAUTION**

- Before starting IBP monitoring, the user should carry out zeroing on the transducer.
- During monitoring, the user should make certain the pressure sensor is at the heart level at all times to prevent the tube from clogging. Heparin saline should be continuously injected to wash the tube and maintain the unobstructed condition of the pressure measurement path. The tube must be securely fixed to prevent it from moving or coming off, which will affect invasive blood pressure measurement.

# SECTION 12 - MULTI-GAS MONITORING (Optional)

## 12.1 General Information

The Midmark Multiparameter Monitor multi-gas module (AG) measures CO2, N2O, and one of the five anesthesia gases (*Halothane, Isoflurane, Enflurane, Sevoflurane, Desflurane*) The Multigas sensor will detect Anesthetic agent and adjust alarm defaults accordingly. Each gas is displayed in a monitoring channel, with waveforms showing minimum inhalation volume and maximum exhalation volume. Multi-gas monitoring is available by using the optional Masimo IRMA AX+ and ISA AX+ analyzers.

Please refer to this chapter as well as the Masimo User's Guide provided with your IRMA AX+ and ISA AX+ analyzers.

***WARNING***
***There is a label***  ***below the AG socket, indicating that the signal input is insulated and defibrillation proof with a type BF applied part. Following exposure to a defibrillation event, AG will resume normal operations after 10 seconds.***

***NOTE***
*Each channel displays only one gas at a time.*

**Gas Measurement:** Non-dispersive infrared technology is used in the multi-gas measurement.

## 12.2 Installation and Connection

### 12.2.1 Parts

**The following parts are included with your Multi-gas kit:**

- Multi-gas ISA AX+ (Sidestream) analyzer or IRMA AX+ (Mainstream) probe.
- IRMA airway adapters (with Mainstream kit).
- NomoLine® sampling lines (with Sidestream kit).
- Multi-gas kit instructions.

***WARNING***
***Please refer to the IRMA AX+ Probe user guide for all Warnings and Cautions associated with this product.***

***WARNING***
***Please refer to the ISA AX+ Analyzer user guide for all Warnings and Cautions associated with this product.***

### 12.2.2 IRMA AX+ Connection Procedures

**Connecting the IRMA AX+ probe to the monitor**

1. With the monitor off, plug the IRMA AX+ probe into the monitor side panel by lining up the two keys of the connector with the receptacle and insert.
2. Select the correct airway adapter to minimize dead space. Large airway adapter for ET tubes > 4.0 mm (≈ 6 ml dead space). Small airway adapter for ET tubes ≤ 4.0 mm (≤ 1 ml dead space).
3. Snap the IRMA AX+ probe on top of the IRMA airway adapter. It will click into place when properly seated.
4. Turn ON the monitor.
5. Please refer to the instructions included in the Multi-gas Kit.

- Enter Module Setup and press AG drop down. Select “Masimo” and restart monitor.
- Turn on the Multi-gas Module within the Settings/Module Setup menu. Refer to Section 12.2.4 Turn on the Multi-gas Module.
- Turn on the Multi-gas Screen Display. Refer to Section 12.2.5 Turn on the Multi-gas Screen Display.

***NOTE***
*The end user must plug in the Multi Gas* IRMA AX+ *probe prior to turning on the monitor for proper functioning of the device.*

***NOTE***
*The end user must turn on the Multi-gas module function within the monitor the first time the Multi-gas device is plugged in for use. Refer to Section 12.2.4 Turn on the Multi-gas Module. Keep the Multi-gas module plugged in during all restarts of the monitor. Otherwise, the monitor will alarm as it will no longer be able to detect the module. To use the monitor without Multi-gas, the end user must turn the module off again.*

***NOTE***
*The end user must turn on the Multi-gas display (AG Screen) once the Multi-gas module is turned on. Refer to Section 12.2.5 Turn on the Multi-gas Screen Display.*

6. A green LED indicates that the IRMA AX+ probe is ready for use.
7. Connect IRMA airway adapter male connector to the breathing circuit Y-piece. Connect the IRMA airway adapter female connector to the patient’s endotracheal tube. Position the IRMA AX+ probe with the LED pointing upwards.

A HME (Heat Moisture Exchanger) may be connected between the patient’s endotracheal tube and the IRMA AX+ probe to protect the airway adapter from secretions and effects of water vapor and eliminate the need of changing the adapter. It allows free positioning of the IRMA AX+ probe as well.

***NOTE***
*A HME will add Dead Space and Resistance to the breathing circuit. Refer to manufacturer’s information for amounts and recommendations for replacement.*

***NOTE***
*Unless the* IRMA AX+ *probe is protected with a HME, always position the* IRMA AX+ *probe with the LED pointing upwards.*

The IRMA disposable airway adapter is inserted between the endotracheal tube and the Y-piece of the breathing circuit. The respiratory gas measurements are obtained through the XTP windows in the sides of the adapter. As the airway adapter is positioned directly in the airway, its performance can be affected by water vapor, patient secretions or nebulized medications that can accumulate on the adapter’s windows. For optimal results, the airway adapter shall not be placed between an endotracheal tube and an elbow, as this may allow patient secretions to block the adapter windows. The IRMA airway adapter shall be positioned with its windows in a vertical position to help keep patient secretions from pooling on the windows. The disposable IRMA airway adapter is treated to prevent moisture buildup and drift, so please do not clean the interior of the airway adapters. Please select an airway adapter appropriate for the size of the patient (Small for patients 20 lbs and below, Standard for patients larger than 20 lbs) for optimal performance.

***WARNING***
***The IRMA™ probe is not intended to be in patient contact.***

***WARNING***
***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.***

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

material shall be placed between the IRMA AX+ probe and the body.

8. To remove the IRMA AX+ probe, grasp the body portion of the connector and pull to remove.

***NOTE***
*Do not remove by pulling cable.*

***CAUTION***
*The IRMA airway adapters are intended for single patient use.*

#### 12.2.3 ISA AX+ Analyzer Connection Procedures

**Connecting the ISA AX+ analyzer to the monitor**

The ISA AX+ multi-gas analyzer is an external and independent part of the Midmark Multiparameter Monitor patient monitor.

1. Securely mount or place the ISA AX+ analyzer in a safe location.
2. With the monitor off, plug the ISA AX+ analyzer into the monitor side panel by lining up the two keys of the connector with the receptacle and insert.
3. Select the correct sampling line to minimize dead space and connect sampling line to the ISA AX+ analyzer input connector. Sampling line with large airway adapter for ET tubes > 4.0 mm ( ≤6 ml dead space). Sampling line with small airway adapter for ET tubes ≤ 4mm (≤0.7 ml dead space).
4. Connect the gas sample exhaust port to a scavenging system or return the gas to the patient circuit to prevent pollution of the operation room when N2O and/or anesthetic agents are being used. See Section 12.2.7 Multi-gas Exhaust.
5. Turn ON the monitor.
6. A green LED indicates that the ISA AX+ analyzer is ready for use. Perform a pre-use check as described in the Section 12.4.1 Pre-Use Checks.
7. Please refer to the instructions included in the Multi-gas kit.
    - Enter Module Setup and press AG drop down. Select “Masimo” and restart monitor.
    - Turn on the Multi-gas Module within the Settings/Module Setup menu. Refer to Section 12.2.4 Turn on the Multi-gas Module.
    - Turn on the Multi-gas Screen Display. Refer to Section 12.2.5 Turn on the Multi-gas Screen Display.

***NOTE***
*The end user must turn on the Multi-gas module function within the monitor the first time the Multi-gas device is plugged in for use. Refer to Section 12.2.4 Turn on the Multi-gas Module. Keep the Multi-gas device plugged in during all restarts of the monitor.*

***NOTE***
*The end user must turn on the Multi-gas display (AG Screen) once the Multi-gas module is turned on. Refer to Section 12.2.5 Turn on the Multi-gas Screen Display.*

***CAUTION***
*In order to ensure good ventilation of the module, please keep a minimum of 5cm from each side of the analyzer to the wall or cabinet.*

It is recommended to place the Multi-gas ISA AX+ analyzer at a place higher or at the same level of patient position.

8. To remove the NomoLine sampling line, grasp the body portion of the connector and pull to remove.

***NOTE***
*Do not remove by pulling cable.*

***CAUTION***
*The NomoLine sampling lines are intended for single patient use.*

**12.2.4 Turn on the Multi-gas Module**

**Step 1:** Press the “SETTINGS” Quick Access Button or the Touch Screen Quick Access Icon.

**Step 2:** Press the “MODULE SETUP” to open the Module Setup Menu.

**Step 3:** Press the drop down option next to AG. Select Masimo to turn the Masimo AG module on.

**Step 4:** Press the “X” on the upper right corner to exit the screen. A warning will pop up to let you know that a restart would be required and that all current patient alarm data will be purged. Press “OK” to continue.

**Step 5:** The monitor will automatically shut down. After it shuts down, press the power button to turn it back on. The AG module should now be on.

**12.2.5 Turn on the Multi-gas Screen Display**

The end user must turn on the Multi-gas Screen Display in order to see the Multi-gas data.

**To turn on the Multi-gas Screen Display, follow the steps below:**

**Step 1:** Turn on the monitor.

**Step 2:** Press the “DISPLAY MODES” Touch Screen Quick Access Icon to rotate through the display mode options. Stop at the display for AG.

**12.2.6 Turn On or Off the Multi-gas Work Mode**

When the monitor is turned on and the user plugs in the multi-gas IRMA AX+ probe, the monitor will automatically detect the sensor and change to Measure mode.

When the monitor is turned on with the multi-gas IRMA AX+ probe already plugged in, the monitor will start in Standby mode.

**To use multi-gas, the user will need to turn the feature on manually by following the steps below:**

**Step 1:** Press the CO2 or AA data in the parameter box to enter the CO2 or AA Setup Menu.

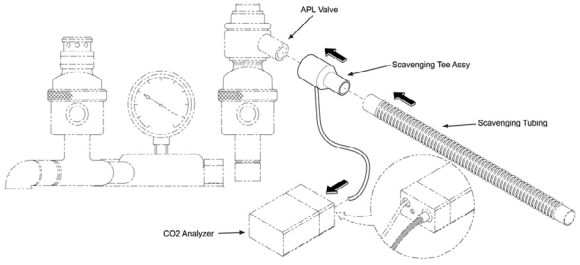
**Step 2:** Press the drop down option next to Operating Mode. Select Measure to turn the Masimo AG module on.

**Step 3:** Press the “Measure” button.

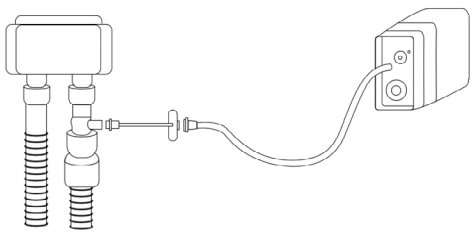
For the ISA AX+ analyzer, no matter if it was plugged in before or after the monitor is turned on, it will always switch automatically to Measurement mode in order to Zero itself. To save operational time, the user may elect to turn on Standby mode for the AG option. However, the ISA AX+ analyzer will always go into measurement mode upon restart of the monitor.

**12.2.7 Multi-gas Exhaust**

Connect the gas sample exhaust port to a scavenging system or return the gas to the patient circuit to prevent pollution of the operation room when N2O and/or anesthetic agents are being used. Due to the risk of patient cross-infection, always use a bacteria filter on the exhaust port side if sampled gas is intended to be re-breathed.




or



***NOTE***
*The exhaust line is not supplied with the NomoLine® ISA™ CO2 analyzer but a scavenging kit solution is available as an optional accessory (See Appendix 6).*

## *12.3 Multi-gas Setup Menu*

#### 12.3.1 Multi-gas Measurement Menu

The AG Menu will only be available if the AG module is turned on. Follow the steps in Section 12.2.4 to turn on the AG Module.

**Follow the steps below to enter the AG Setup Menu:**

**Step 1:** Press the CO2, N2O, or AA waveform to enter the desired setup menu below.

#### 12.3.2 CO2 Setup Menu Options

| | |
|---|---|
| **APNEA TIME** | The IRMA AX+ probe or ISA AX+ analyzer are programmed to display “0” values after 20 seconds without a detected breath. Choose from 20s, 25s, 30s, 35s, 40s, 45s, 50s, 55s and 60s. The Apnea Alarm is not affected by the Alarm Silence feature. |
| **OPERATING MODE** | Choose from Standby or Measure. |
| **O2 COMPEN** | This is for the Oxygen Compensation. Choose from Low, Mid and High. Refer to Appendix 5 for more details. |
| **UNIT** | Choose from mmHg or kPa. |
| **WAVE SPEED** | Choose from 6.25, 12.5 or 25.0 mm/s. |
| **WAVE MODE** | Choose from Line or Fill. |
| **WAVE GRID** | Choose from On or Off |
| **CO2 SODA LIME** | This is a reminder to change the CO2 soda lime absorbent. Choose from On or Off |
| **CO2 CATALOG** | This will display a collection of reference CO2 waveforms under the patient’s actual waveform to assist with waveform recognition. Choose from On or Off |
| **START ZERO CALIBRATION** | For use when manually zeroing the IRMA AX+ probe or ISA AX+ analyzer. |
| **ALARM SETUP** | This will take you to the CO2 page of the Alarm Setup Menu. There, you can set the Alarm Level, EtCO2 Low Limit, EtCO2 High Limit, InCO2 High Limit, RR Low Limit, RR High Limit and revert to Default factory settings for the CO2 parameter. Please see 4.3.2 Alarm Setup Menu for more details. |

#### 12.3.3 N2O Setup Menu Options

| | |
|---|---|
| **ALARM SETUP** | This will take you to the N2O page of the Alarm Setup Menu. There, you can set the Alarm Level, EtN2O High Limit, EtN2O Low Limit, FiN2O High Limit, FiN2O Low Limit and revert to Default factory settings for the N2O parameter. Please see 4.3.2 Alarm Setup Menu for more details. |
| **APNEA TIME** | The IRMA AX+ probe or ISA AX+ analyzer is programmed to display “0” values after 20 seconds without a detected breath. Choose from 20s, 25s, 30s, 35s, 40s, 45s, 50s, 55s and 60s. The Apnea Alarm is not affected by the Alarm Silence feature. |
| **OPERATING MODE** | Choose from Standby or Measure. |
| **O2 COMPEN** | This is for the Oxygen Compensation. Choose from Low, Mid and High. Refer to Appendix 5 for more details. |
| **WAVE SPEED** | Choose from 6.25 or 12.5 mm/s. |
| **WAVE SCALE** | Choose Auto, 20%, 40%, 60%, 80%, 100%. |
| **WAVE MODE** | Choose from Scan or Fill. |
| **WAVE GRID** | Choose from On or Off. |

| | |
|---|---|
| **START ZERO CALIBRATION** | For use when manually zeroing the IRMA AX+ probe or ISA AX+ analyzer. |

#### 12.3.4 AA Setup Menu Options

| | |
|---|---|
| **OPERATING MODE** | Choose from Standby or Measure. Please reference Section 12.2.6 Turn On or Off the Multi-gas Work Mode. |
| **ALARM SETUP** | This will take you to the CO2 page of the Alarm Setup Menu. There, you can set the Alarm Level, EtCO2 Low Limit, EtCO2 High Limit, InCO2 High Limit, RR Low Limit, RR High Limit and revert to Default factory settings for the CO2 parameter. Please see 4.3.2 Alarm Setup Menu for more details. |
| **START ZERO CALIBRATION** | For use when manually adjusting the IRMA AX+ probe. Please reference Section 12.4.3 Zeroing IRMA AX+ Probe. |
| **WAVE SPEED** | Choose from 6.25 or 12.5 mm/s. |
| **N2O DISPLAY** | Choose from On or Off. |
| **APNEA TIME** | The IRMA AX+ probe or ISA AX+ analyzer are programmed to display “0” values after 20 seconds without a detected breath. Choose from 20s, 25s, 30s, 35s, 40s, 45s, 50s, 55s and 60s. The Apnea Alarm is not affected by the Alarm Silence feature. |
| **O2 COMPENSATE** | This is for the Oxygen Compensation. Choose from Low, Mid and High. Refer to Appendix 5 for more details. |
| **WAVE SCALE** | Choose Auto, 20%, 40%, 60%, 80%, 100%. |
| **WAVE MODE** | Choose from Scan or Fill. |
| **WAVE GRID** | Choose from On or Off. |

## *12.4 Monitoring*

#### 12.4.1 Pre-Use Checks

**IRMA AX+ Probe**

> ***WARNING***
> ***Please refer to the IRMA AX+ Probe user guide for all Warnings and Cautions associated with this product.***

- Always verify gas readings and waveforms on the monitor before connecting the airway adapter to the patient circuit. To do this, breathe into the airway adapter with the IRMA AX+ probe attached.
- Perform a tightness check of the patient circuit with the IRMA AX+ probe snapped on the IRMA airway adapter.

**ISA AX+ Analyzer**

> ***WARNING***
> ***Please refer to the ISA AX+ Analyzer user guide for all Warnings and Cautions associated with this product.***

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

1. Connect the sampling line to the ISA AX+ analyzer light emitting gas inlet connector (LEGI).
2. Check that the LEGI shows a steady green light (indicating that the system is OK).
3. Breathe into the sampling line and check that valid CO2 waveforms and values are displayed.
4. Occlude the sampling line with a fingertip and wait for 10 seconds.
5. Check that an occlusion alarm, “check sampling line”, is displayed and that the LEGI shows a flashing red light.
6. *If applicable:* Perform a tightness check of the patient circuit with the sampling line attached.

**Leakage Check**

Leakage check should be performed if there is a suspected leakage and also annually. Leakage tests shall be performed by an authorized service technician only as it requires proprietary software. Please contact your service technician or Midmark for assistance.

#### 12.4.2 Using Multi-gas

1. Connect the module to the Midmark Multiparameter Monitor and turn the monitor on.
2. Turn on the multi-gas module. Refer to Section 12.2.4.
3. Turn on the multi-gas display screen. Refer to Section 12.2.5.
4. The ISA AX+ analyzer will perform a zeroing procedure automatically. For the IRMA AX+ probe, please refer to Section 12.4.3 to manually zero the probe.
5. Connect the module to the patient circuit. Once the module detects breathing, the related values will automatically be displayed.

> ***NOTE***
> *The infrared gas analyzer needs to establish a zero reference level for the CO2, N2O and anesthetic agent gas measurement. This zero calibration is here referred to as "zeroing".*

> ***WARNING***
> ***Incorrect analyzer zeroing will result in false gas readings.***

#### 12.4.3 Zeroing IRMA AX+ Probe

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

- Special care should be taken to avoid breathing near the airway adapter before or during the Zeroing procedure. The presence of ambient air (21% O2 and 0% CO2) in the IRMA airway adapter is of crucial importance for a successful Zeroing. If a "Zero required" alarm should appear directly after a Zeroing procedure, the procedure must be repeated.
- Always perform a pre-use check after zeroing the probe. Refer to Section 12.4.1.
- 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+ probe after power on and after changing the IRMA airway adapter before proceeding with the Zeroing Procedure. The option to Zero will be unavailable during warm up and zeroing. The green LED on the probe will be blinking for approximately 5 seconds while zeroing is in progress.

**Step 1:** Snap a new IRMA airway adapter onto the IRMA AX+ probe, without connecting the airway adapter to the patient circuit.

**Step 2:** Select the AA waveform area to enter the AA Setup Menu.

**Step 3:** Press the "START ZERO CALIBRATION" button. The visual technical alarm "AA is Zeroing" will appear in the technical alarm status bar as well as within the AA Setup Menu. An audible alarm will also be present. When completed, "AA Zero Successful" will display within the AA Setup Menu only. If Zeroing failed, the reason for failure will be displayed within the technical alarm status bar.

#### 12.4.4 Zeroing ISA AX+ Analyzer

ISA AX+ analyzer performs zeroing by switching the gas sampling from the respiratory circuit to ambient air. The automatic zeroing is performed 1 to 3 times per day, and takes less than 3 seconds for NomoLine ISA CO2 gas analyzers and less than 10 seconds for ISA AX+ multigas analyzers.

During zeroing, if ISA's exhaust gas is returned to the patient circuit, the returned gas level will be different from the gas level at the sampling site.

## *12.5 Alarm Setup*

The Masimo analyzers come with a LED status indicator on the probe themselves, shown in the below 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 or Adapter |

The multi-gas module has alarms for values exceeding the preset limits, apnea, and for abnormal status.

**Alarm for Parameters Exceeding Preset Limits**

Alarm will be activated when the measured parameter exceeds the preset parameter alarm limits.

| | Cat | | Dog | | Horse | | Other | |
|---|---|---|---|---|---|---|---|---|
| AG: Et CO2 (mmHg) | 20 | 60 | 20 | 60 | 20 | 60 | 20 | 60 |
| AG: Fi CO2 (mmHg) | 0 | 10 | 0 | 10 | 0 | 10 | 0 | 10 |
| AG: AwRR (rpm) | 5 | 55 | 5 | 55 | 5 | 55 | 5 | 55 |
| AG: Et N2O (%) | 40 | 70 | 40 | 70 | 40 | 70 | 40 | 70 |
| AG: Fi N2O (%) | 40 | 70 | 40 | 70 | 40 | 70 | 40 | 70 |
| AG: Et HAL (%) | 1.0 | 3.0 | 1.0 | 3.0 | 2.0 | 4.0 | 1.0 | 3.0 |
| AG: Fi HAL (%) | 1.0 | 3.0 | 1.0 | 3.0 | 2.0 | 4.0 | 1.0 | 3.0 |
| AG: Et ENF (%) | 2.0 | 5.0 | 2.0 | 5.0 | 2.0 | 5.0 | 2.0 | 5.0 |
| AG: Fi ENF (%) | 2.0 | 5.0 | 2.0 | 5.0 | 2.0 | 5.0 | 2.0 | 5.0 |
| AG: Et ISO (%) | 1.5 | 3.0 | 1.0 | 3.0 | 1.5 | 3.5 | 1.0 | 3.0 |
| AG: Fi ISO (%) | 1.5 | 3.0 | 1.0 | 3.0 | 1.5 | 3.5 | 1.0 | 3.0 |
| AG: Et DES (%) | 9.0 | 14 | 7.0 | 14 | 7.0 | 15 | 7.0 | 14 |
| AG: Fi DES (%) | 9.0 | 14 | 7.0 | 14 | 7.0 | 15 | 7.0 | 14 |
| AG: Et SEV (%) | 2.5 | 5.0 | 2.0 | 5.0 | 2.5 | 6.0 | 2.0 | 5.0 |
| AG: Fi SEV (%) | 2.5 | 5.0 | 2.0 | 5.0 | 2.5 | 6.0 | 2.0 | 5.0 |

**Apnea Alarm**

If no breath is detected for the selected apnea time, the apnea alarm will be activated.

***NOTE***
*The Multi-gas module and the patient monitor system have a smart apnea alarm function. That is, there will be no alarm during the period when the patient monitor is just powered on. It will only activate the apnea alarm after it has detected respiration and later it identifies there is an apnea.*

***NOTE***
*The apnea alarm is a high priority alarm. So when the apnea alarm occurs, the red light flashes on the monitor display. The Alarm Silence feature will only silence the audible portion of the Apnea Alarm.*

**Abnormal Status**

Abnormal status refers to technical alarms such as “Sampling Line Clogged” and “Check Adapter (AA)”. For a complete list of abnormal status alarms, please see the Monitor Troubleshooting Section 13.2.

## *12.6 Cleaning and Maintenance*

***CAUTION***
*Anyone not properly trained and certified must not attempt to perform any service or maintenance of the Masimo Sweden product..*

**Multi-gas Module Cleaning**

The IRMA AX+ probe can be cleaned using a cloth moistened with ethanol or isopropyl alcohol (< 70 %).

***CAUTION***
*The IRMA™ sensor and airway adapters are non-sterile devices. Do not autoclave the devices as this will damage them.*

***CAUTION***
*Never sterilize or immerse the IRMA analyzer in liquid.*

The ISA AX+ sidestream gas analyzers and sampling line adapter can be cleaned using a cloth moistened with ethanol or isopropyl alcohol (< 70 %).

To prevent cleaning liquids and dust from entering the ISA AX+ Multigas analyzer through its LEGI connector, keep the sampling line connected while cleaning the analyzer.

***WARNING***
***Never sterilize or immerse the ISA AX+ sidestream gas analyzer in liquid.***

**ISA AX+ Multigas Analyzer Maintenance**

Once every year, or whenever gas readings are questionable, perform a leakage check according to section 12.4.1 and verify gas readings with a reference instrument or with calibration gas.

# SECTION 13 - CLEANING, TROUBLESHOOTING, WARRANTY

## 13.1 Cleaning

***CAUTION***
*DO NOT open the monitor to clean or repair it. Contact Midmark for service needs.*

***WARNING***
***DO NOT, under any circumstances, perform any testing or maintenance on the monitor while the monitor is being used to monitor a patient. The monitor must be turned "OFF". Unplug the monitor from AC power source and remove the internal battery.***

***CAUTION***
*Disconnect all accessories from the monitor before cleaning. DO NOT immerse any part of the electrical connectors of cables or accessories in the cleaning or disinfection solution at any time. DO NOT use an abrasive cloth or cleaner on the accessories. Immersing the cables or lead wires in any liquid may result in moisture entering. This may cause internal damage and reduce the product life. Alcohol and organic solvents may cause stiffness and brittleness.*

### 13.1.1 The Monitor

On a daily basis, examine the monitor's case for damage and check the AC power cord for bent or broken prongs, cracks or fraying. Neither the monitor nor the power cord should be used if damaged. If any damage is noted, contact Midmark.

***CAUTION***
*Do not spray or pour any water or cleaning solution directly onto the monitor.*

As needed, clean the monitor using a soft cloth dampened with a mild dishwashing detergent solution. Gently rub the soiled area until clean. Use a clean soft cloth to dry the monitor. Do not use abrasive cleaners on the monitor. Do not use either isopropyl alcohol or solvent to clean the monitor. Use of these cleaners can cause damage to the monitor's surface. Do not immerse the monitor or power cord in the cleaning solution.

When necessary, the monitor surfaces may be disinfected using a soft cloth saturated with a 10% (1:10) solution of chlorine bleach in tap water. When all of the surfaces have been disinfected, wipe the entire surface of the monitor using a soft cloth dampened with fresh water to remove any trace amounts of residue and/or fumes.

***NOTE***
*Thoroughly wipe off any excess cleaning solutions. Care should be taken to prevent water or cleaning solution to run into connector openings or crevices.*

### 13.1.2 The Display

***CAUTION***
*Use care when cleaning the display. Do not use a paper towel to clean the display as this may cause scratches*

Occasionally, as needed, clean the display window using a soft, lint-free cloth sprayed with an alcohol free glass cleaner. When necessary, the monitor display may be disinfected using a .5% Hydrogen Peroxide or a Potassium peroxymonosulfate/sodium chloride oxidizing agent according to manufacturer's directions. When display has been disinfected, wipe the entire surface using a soft cloth dampened with fresh water to remove any residual film. The use of paper towels is not recommended as it may scratch the surface.

***NOTE***
*Smudges and fingerprints on the surface of the touch screen can cause it to malfunction. Care should be taken to clean the screen when such errors occur.*

#### 13.1.3 Patient Cable and Lead Wires

Prior to each patient use, inspect the patient cable and lead wires for damage. As necessary, clean the patient cable and lead wires using a soft cloth dampened with a germicidal solution.

#### 13.1.4 Cuffs

Prior to each patient use, inspect the blood pressure cuff and its hose for damage.

#### 13.1.5 Reusable (Nylon) Cuffs

As necessary, for normal cleaning with mild detergents / dilute bleach solution (1-2%), wipe the cuff with the cleaning solution, rinse with water and dry.

***NOTE***
*Midmark does not recommend submersion of the cuff. Liquid should not be permitted to enter the cuff bladder because instrument damage may occur. The cuff should be allowed to thoroughly dry before use.*

#### 13.1.6 Disposable (Vinyl) Cuffs

In certain situations, the cuff may become soiled during its use. In these situations a water-based detergent is suitable for wiping the cuff.

As necessary, the preferred method for cleaning the cuff is to wipe it down with a damp, soapy cloth. A damp, detergent-free cloth should then be used to rinse the cuff.

***NOTE***
*Midmark does not recommend submersion of the cuff. Liquid should not be permitted to enter the cuff bladder because instrument damage may occur. The cuff should be allowed to thoroughly dry before use.*

#### 13.1.7 Pneumatic Tubing

Prior to each patient use, inspect the NIBP Inflation Hose for proper connection, cracks and kinks. As necessary, clean the pneumatic tubing using a soft cloth dampened with a germicidal solution.

#### 13.1.8 Sensor and Clips

***CAUTION***
*To avoid damage to the V-SAT sensor, remove it from the clip before cleaning either piece.*

***CAUTION***
*DO NOT sterilize the sensor or clips by irradiation, steam or ethylene oxide. DO NOT immerse the sensors in water or cleaning solution.*

When necessary, the sensor may be surface-cleaned by wiping it with an agent such as 70% Isopropyl Alcohol.

The clip may be cleaned by either wiping it with, or soaking it for ten (10) minutes in, 70% Isopropyl Alcohol. If the clip is soaked, be sure to rinse it with water and air-dry it prior to use on the next patient.

After each cleaning and prior to each use, inspect the sensor and cable for fraying, cracking, breakage, or other damage. Inspect the clip for cracking or breakage, or loss of spring tension that would allow slippage or movement of the sensor from its proper position.

***NOTE***
*If defects are noted, do not use the sensor or clip.*

Refer to the Directions For Use pamphlet enclosed with the sensor for more information.

#### 13.1.9 Temperature Probes

As necessary, the probes should be cleaned with a mild detergent and water to remove excess bioburden. When necessary, the probes may be disinfected using a soft cloth saturated with a 10% (1:10) solution of chlorine bleach in tap water or 70% isopropyl alcohol. When all of the surfaces have been disinfected, wipe the entire surface of the monitor using a soft cloth dampened with fresh water to remove any trace amounts of residue and/or fumes.

## *13.2 Troubleshooting*

The Midmark Multiparameter Monitor displays a variety of messages to aid the user in monitor operation. If a technical message is displayed during a measurement, follow the actions listed to correct the situation.

If the monitor is in need of servicing, it must be referred to the appropriate service personnel. Service performed by unauthorized personnel could be detrimental to the monitor and may void the warranty. For service, contact Midmark.

| Technical Alarm/Parameter Message | Possible Cause | Possible Solution |
|---|---|---|
| **ECG** | | |
| Asystole | ECG amplitude is too low. | Increase the gain and use electrode gel, or change the ECG lead to a larger amplitude. |
| ECG Communication Stop | ECG module can't communicate with the main system. | Restart the monitor. If error persists, contact Midmark. |
| ECG Lead Off | ECG lead cable connection may be loose. | Check the connection of all ECG lead cables. |
| ECG V Lead Off | ECG V-lead cable connection may be loose. | Check the connection of the ECG V-lead cable. |
| ECG LL Lead Off | ECG LL-lead cable connection may be loose. | Check the connection of the ECG LL-lead cable. |
| ECG LA Lead Off | ECG LA-lead cable connection may be loose. | Check the connection of the ECG LA-lead cable. |
| ECG RA Lead Off | ECG RA-lead cable connection may be loose. | Check the connection of the ECG RA-lead cable. |
| ECG Overload | One of the leads may have overloaded. | Check the connections of the leads to the patient. |
| **RESP** | | |
| RESP Interference | This error will occur when HR and RESP rate are nearly the same. | This physiological reaction from the animal creates the interference to the monitor. Therefore, RESP Interference will continue until HR and RESP are no longer similar. |
| **SPO2** | | |
| SpO2 Communication Stop | SPO2 module can't communicate with the main system. | Restart the monitor. If error persists, contact Midmark. |
| SpO2 No Sensor Connected | SPO2 cable has disconnected from the sensor or monitor. | Check the connection of the SPO2 sensor and cable. |
| SpO2 Sensor Off | SPO2 sensor has disconnected from the patient. | Check the connection of the SPO2 sensor and cable. |
| SpO2 Search Timeout | The SpO2 sensor may have fallen off or may have disconnected from the monitor. The SpO2 sensor may have malfunctioned or a sensor that is not specifically recommended by the manufacturer is being used. | Check the SpO2 sensor's connection to the monitor and the patient. Check to see if the SpO2 sensor has any damage. Reconnect the sensor properly an dmake sure only recommended sensors are used. |

| | | |
|---|---|---|
| SpO2 Pulse Search | The SPO2 sensor is trying to find the pulse of the patient. | Allow time for the pulse and SPO2 to be detected. |
| **TEMP** | | |
| TEMP1 Sensor Off | TEMP sensor 1 has disconnected from the monitor. | Check the connection of the TEMP sensor. |
| TEMP2 Sensor Off | TEMP sensor 2 has disconnected from the monitor. | Check the connection of the TEMP sensor. |
| **NIBP** | | |
| NIBP signal weak | Patient's pulse may be weak or cuff is too loose. | Check the condition of the patient and place the cuff in a suitable position. If the error persists, replace the cuff. |
| NIBP Communication Stop | NIBP module can't communicate with the main system. | Restart the monitor. |
| NIBP Selfcheck Error | NIBP module may have failed. | Restart the monitor. |
| NIBP system error | If failure occurs during measurement, the system may not be able to analyze and calculate the data. | Check the patient's condition and the position and connection of the cuffs. |
| Measurement Timeout | NIBP measurement process has gone beyond the allotted time for detection. | Verify that connections are sound and patient is still. Change setting to Manual, and then back to Interval or Continuous Measurement. If error persists, contact Midmark. |
| Cuff Type Error | The cuff being used does not match the set patient category. | Verify the patient category and replace the cuff. |
| Cuff loose or no cuff | NIBP cuff isn't placed or connected properly or there is an air leak. | Check that the cuff is connected properly and there are no leaks in the cuff or tubing. |
| Cuff leak | There may be an air leak in the cuff or tubing. | Check the cuff and tubing for air leaks. |
| Air pressure error | NIBP was not able to stabilize the pressure value. The tubing may have kinks. | Confirm that the environment complies with the monitor's specifications, and check the tubing for kinks. |
| NIBP over range | NIBP values are beyond the measurement range. | Reset the NIBP measurement module or restart the monitor. If error persists, contact Midmark. |
| NIBP signal unstable | Excessive patient movement may result in too much motion artifact or interference in the signal during measurement. | Calm the patient and prevent movement during measurement. |
| NIBP signal saturated | Excessive patient movement detected. | Calm the patient and prevent movement during measurement. |
| NIBP over pressure | Cuff and tubing may be blocked or constricted. | Check the path of the air and make sure the tubing is not tangled, blocked or constricted. |
| **CO2** | | |
| CO2 Comm. Stop | CO2 module or sensor can't communicate with the main system. | Reconnect the CO2 sensor with the monitor and restart the monitor. If errors persist, contact Midmark. |
| Check Adapter (CO2) | Your CO2 sensor cannot detect the airway adapter. | Please insert the Airway Adapter or Zero the CO2 sensor. |
| Check Sampling Line | The sampling line is clogged. | Replace the sampling line. |
| Software Error (CO2) | There's an error with the sensor software. | Restart your CO2 sensor. If error persists, contact Midmark. |
| Hardware Error (CO2) | There's an error with the sensor hardware. | Your CO2 sensor should be serviced. |
| Sampling line clogged | The sampling line is clogged. | Replace the sampling line. |
| No Sampling line | There's no sampling line detected. | Insert the sampling line. |
| No Adapter (CO2) | No adapter detected | Install new adapter |

| | | |
|---|---|---|
| CO2 out of accuracy | CO2 is outside of the specified accuracy range. | Restart your CO2 sensor. If error persists, contact Midmark. |
| Temp out of accuracy (CO2) | The internal temperature of the probe is outside of the operating range for Masimo CO2. | Allow CO2 sensor to cool down. If error persists, contact Midmark. |
| Pressure out of accuracy (CO2) | The ambient pressure is outside of the operating range. | Your CO2 sensor should be serviced. |
| Zero required (CO2) | Zero reference calibration (Zeroing) of IR level is required for accurate measurements. | Zero your CO2 sensor. |
| CO2 is zeroing | The CO2 sensor is performing zeroing calibration. | Wait for the zeroing process to be completed. |
| CO2 is sleeping | Changing the Operating Mode is required to operate the sensor. | See Chapter 10 for details. |
| Span Calibrating (CO2) | The CO2 module is calibrating. | Wait for the calibration process to be completed. |
| Span Cal Error (CO2) | A CO2 module calibration error occurred. | Restart your CO2 sensor. If error persists, contact Midmark. |
| CO2 Out of Range | CO2 value is outside of the specified accuracy range. | Your CO2 sensor may require a zero or servicing. |
| TEMP Out of Range (CO2) | The internal temperature of the probe is outside of the operating range for Respironics CO2. | Your CO2 sensor should be allowed to cool down or serviced. |
| CO2 is warming up | The CO2 sensor is activating and warming to operational temperatures. | Allow sensor to warm to operational temperatures. |
| Sensor Faulty (CO2) | CO2 sensor is faulty. | Your CO2 sensor should be serviced. |
| CO2 Zero Successful | CO2 sensor zero calibration is successful. | |
| **IBP** | | |
| IBP Communication Stop | IBP module can't communicate with the main system. | Restart the monitor. If error persists, contact Midmark. |
| IBP CH1 Sensor Off | IBP1 cable has disconnected from the sensor or monitor. | Check the connection of the IBP1 sensor and cable. |
| IBP CH2 Sensor Off | IBP2 cable has disconnected from the sensor or monitor. | Check the connection of the IBP2 sensor and cable. |
| Zero required (IBP1) | IBP1 Zero calibration needed. | Zero IBP1. Disconnect and reconnect IBP1 cable if unable to zero. If error persists, contact Midmark. |
| Zero required (IBP2) | IBP2 Zero calibration needed. | Zero IBP2. Disconnect and reconnect IBP2 cable if unable to zero. If error persists, contact Midmark. |
| IBP1 zero success | IBP1 Zero calibration has been successfully performed. | Disconnect and reconnect IBP1 cable if unable to zero. If errors persist, contact Midmark. |
| IBP2 zero success | IBP2 Zero calibration has been successfully performed. | Disconnect and reconnect IBP2 cable if unable to zero. If errors persist, contact Midmark. |
| **AA** | | |
| AA Communication Stop | AG module or sensor can't communicate with the main system. | Reconnect the multi-gas sensor with the monitor and restart the monitor if needed. If error persists, contact Midmark. |
| Software Error (AA) | There's an error with the sensor software. | Your multi-gas sensor should be serviced. |
| Hardware Error (AA) | There's an error with the sensor hardware | Your multi-gas sensor should be serviced. |
| Motor out of accuracy (AA) | The analyzer's motor speed is out of bounds. | Your multi-gas sensor should be serviced. |
| Factory Calibration lost (AA) | The factory calibration is lost or missing. | Your multi-gas sensor should be serviced. |
| Replace Adapter (AA) | The AA adapter is dirty or damaged. | Replace the AA adapter. |
| No Adapter (AA) | No adapter detected. | Install new adapter. |

| | | |
|---|---|---|
| N2O Out of accuracy (AA) | N2O is outside of the specified accuracy range. | The multi-gas sensor may require a zero or servicing. Restart your AA sensor. If error persists, contact Midmark. |
| AA Out of accuracy (AA) | At least one anesthetic agent is outside of the specified accuracy range. | The multi-gas sensor may require a zero or servicing. |
| Temp Out of accuracy (AA) | The internal temperature of the probe is outside of the operating range. | Your multi-gas sensor should be allowed to cool down or should be serviced. |
| Pressure Out of accuracy (AA) | The ambient pressure is outside of the operating range. | Your multi-gas sensor should be serviced. |
| Mixed Agents | Multigas module detected more than two agents. | |
| Zero required (AA) | Zero reference calibration (Zeroing) of IR level is required for accurate measurements. | Zero your multi-gas sensor. |
| AA ID&Conc unreliable | Agent identification and concentrations are unreliable. | Switch AA sensor to Measure mode. |
| AA is zeroing | Zeroing in progress. | Allow sensor to complete the zeroing process. |
| AA is sleeping | AA sensor has been put on Standby. | Switch multi-gas sensor to Measure mode. |
| Span Calibrating (AA) | Span calibration and validation in progress. | Wait for calibration to be completed. |
| Span Cal Error (AA) | Latest span calibration command failed. | Your multi-gas sensor should be serviced. |
| AA Zero Successful | AA Zero calibration successfully performed. | |
| **Printer** | | |
| No Printer | No printer installed. | Restart monitor. If error persists, contact Midmark. |
| No Paper | No printer paper installed. | Install printer paper. |
| Printer Error | Printer paper jammed. | Ensure paper is fed through opening of printer door. |
| **System** | | |
| System will shutdown | Battery level is low. Monitor will turn off. | Charge the battery. |
| Restart monitor after updating software | Software update was just performed. Restart is required. | Restart the monitor. |
| **Battery** | | |
| BATTERY TOO LOW | The button battery's connection is loose or the button battery is low on power. | Contact Midmark for service. |

## *13.3 System Calibration and Maintenance*

Besides the routine cleaning of the monitor and accessories outlined in the previous section, and replacement of accessories due to normal wear and tear, calibration of the monitor should not be necessary during the warranty period.

If the monitor is in need of repair, it must be referred to the appropriate service personnel. Service performed by unauthorized personnel could be detrimental to the monitor and may void the warranty. For service, contact Midmark.

Following the warranty period, preventative maintenance can be an important factor in ensuring the monitor's continuing accurate and reliable performance. It is recommended that preventative maintenance be performed every two (2) years following the warranty period.

## *13.4 Limited Warranty*

### 13.4.1 Registration

Register your monitor at midmark.com/vet-register to:

- Log your product warranty with Midmark

- Keep you informed on important warranty information and product updates
- Provide you with faster, more convenient service in the event you experience a problem
- Enhance customer service benefits tailored to your product and account

### 13.4.2 Scope of Warranty

Midmark Corporation (“Midmark”) warrants to the original retail purchaser that it will repair or replace components of the animal health products manufactured by Midmark (except for products and components not warranted under “Exclusions”) that are defective in material or workmanship under normal use and service. The sole remedy under this limited warranty is the repair or replacement, at Midmark’s option, of the applicable products or components. This limited warranty shall only apply to defects that: (i) are reported to Midmark within the applicable warranty period; and (ii) are determined to exist upon examination by Midmark. This limited warranty extends only to the original retail purchaser of a product, and is not transferable or assignable.

### 13.4.3 Applicable Warranty Period

The applicable warranty period for each Midmark product commences on the date of delivery to the original retail purchaser of the product and shall continue for the period specified. The Midmark Multiparameter Monitor is warranted against defect in material and workmanship for a period of two years from the time of delivery.

Monitor Accessories are warranted against defect in material and workmanship for a period indicated below from the time of delivery:

| | |
|---|---|
| Capnostat Mainstream and LoFlo Sidestream CO2 Modules | 1 year |
| Masimo Mainstream and Sidestream CO2 and Multi-gas Modules | 2 years |
| Temperature and IBP Cables | 1 year |
| Nellcor V-SAT SpO2 Sensors | 9 months |
| ECG Esophageal Probes, Nellcor DOC-10 SpO2 Cable, and battery | 6 months |
| Blood pressure cuffs, CO2 Sidestream sampling lines, CO2 Mainstream adapters, Multigas filterline, Multigas adaptors and ECG cable/wire sets | * |

*The warranty as to these products or components only applies if such products or components are defective in material or workmanship at the time of delivery to the original retail purchaser and such defects are reported to Midmark within three (3) days from the date of delivery.

### 13.4.4 Exclusions

This limited warranty does not cover and Midmark shall not be liable for the following:

- Defects, damage, or other conditions caused, in whole or in part, by misuse, abuse, negligence, alteration, accident (including animal acts of any kind), freight damage, tampering, or failure to seek and obtain repair or replacement in a timely manner.
- Matching of color, grain, or texture except to commercially acceptable standards.
- Changes in color caused by natural or artificial light.
- Products which are not installed, used, and properly cleaned and maintained as required in the Users Manuals and Quick Reference Guide for the applicable product.
- Products considered to be of a consumable nature.
- Accessories or parts not manufactured by Midmark.
- Specially manufactured products.
- Charges by anyone (including Midmark’s authorized dealers) for adjustments, repairs, replacement parts, installation, or other work performed upon or in connection with such products which are not expressly authorized in writing in advance by Midmark.
- Costs and expenses of routine maintenance and cleaning.
- Representations and warranties made by any person or entity other than Midmark; and
- With respect to software that is a product or a component thereof, that the software will be error free, can be used without problems or interruptions, or will be free from vulnerability to intrusion or attack by viruses or other methods.

#### 13.4.5 Exclusive Remedy; Consequential Damages Disclaimer

Midmark's only obligation under this LIMITED warranty is the repair or replacement of defective parts. Midmark shall not be liable for and hereby disclaims any direct, special, indirect, incidental, exemplary or consequential damages or delays including, but not limited to, damages for loss of profits or income, loss of use, downtime, cover, and employee or independent contractor wages, payments, and benefits. This disclaimer shall survive any failure or asserted failure of the essential purpose of this limited warranty or its remedies specified herein.

#### 13.4.6 No Authorization

No person or firm is authorized to create or approve for Midmark any other obligation or liability in connection with Midmark products.

#### 13.4.7 Warranty Disclaimer

**THIS WARRANTY IS MIDMARK'S ONLY WARRANTY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. MIDMARK MAKES NO IMPLIED WARRANTIES OF ANY KIND INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.**

#### 13.4.8 Statute of Limitations

No action may be brought against Midmark for breach of this limited warranty, an implied warranty, if any, or for any other claim arising out of or relating to the products, more than ninety (90) days following expiration of the warranty period. In the event multiple warranty periods exist with respect to a product, the ninety (90) day period provided for herein shall begin to run from expiration of the warranty period for the component to which the claim relates.

## *13.5 After-sale Service and Support*

To obtain service or product support, please contact Midmark at 800-643-6275 or visit the website at midmark.com. Have the following information available:

- Model and serial number of the equipment
- Date of purchase and distributor name

*It is the retail purchaser's obligation to arrange for delivery of a product to Midmark or one of its authorized dealers for warranty service, which delivery shall be at retail purchaser's expense. It is also the retail purchaser's obligation to comply with the warranty service instructions provided either by Midmark or its authorized dealer. The retail purchaser must provide Midmark with completed warranty registration information within thirty (30) days after purchase in order to obtain the benefits of this limited warranty.*

# APPENDIX 1 - SPECIFICATIONS

## I. Safety

| | |
|---|---|
| Type: | Class I, with internal power supply |
| Protection: | BF, CF |
| Category: | Continuous operation non AP/APG common device |

## II. Power Supply Requirements

| | |
|---|---|
| Rated Input Voltage: | AC 100V-240V |
| Rated Frequency: | 50Hz/60Hz |
| Rated Input power: | 160VA |
| Fuses: | T1.6AH, 250V fuse* |
| Battery: | 11.1V, 4400 mAh Lithium polymer |
| | ** Note: T1.6AL can also be used* |

## III. Parameter Specifications

### A. ECG

| | |
|---|---|
| Heart Rate Measurement and Alarm Range: | 15-350bpm (all other animals) |
| | 15-300bpm (horses) |
| Accuracy: | +/-1bpm or 1% whichever is greater |
| Connector: | AAMI 12-1 pin |
| Lead Selection: | 3-lead: I, II, and III<br>5-lead: I, II, III, aVR, aVL, aVF, and V |
| Lead Off Alarm: | Visual and audible |
| Input: | 3-lead ECG cable or 5-lead ECG cable |
| QRS Indicator: | Visual and audio |
| Sweep Speed: | 12.5 /25 /50mm/s |
| Amplitude Selection: | Auto, x0.25, x0.5, x1, x2, x4 |
| Trend: | 7 days of data and 1000 NIBP data points. |
| Bandwidth: | Monitoring Mode: 0.5 to 40Hz |
| | Diagnostic Mode: 0.05 to 100Hz |
| | Surgical Mode: 1 to 25 Hz |
| | High Sensitivity Mode: 1 to 25 Hz |
| Heart Rate Alarm Response Time: | Less than 7 seconds |

### B. Pulse Oximetry (SpO2) - Nellcor

| | |
|---|---|
| Measurement and Alarm Range: | 0-100% |
| SpO2 Average: | 8 beat average |
| Accuracy: | ±2% (70-100%), ±3% (50-69%) |
| SpO2 Pulse Rate Range: | 20-300bpm |

| | |
|---|---|
| SpO2 Pulse Rate Average: | 8 seconds |
| SpO2 Pulse Rate Accuracy: | ±3 bpm |
| Refresh Time: | Approx. ≤3 seconds |
| Pulse Sound: | Pulse sound indication |
| Sensor Type: | Nellcor V-SAT digital lingual sensor provided with small and large clip |

**C. Non-invasive Blood Pressure (NIBP) – Cardell®**

| | |
|---|---|
| Measurement Method: | Oscillometric |
| Parameters: | Systolic, Diastolic, Mean, Pulse Rate |
| Unit: | mmHg or kPa |
| Operation Mode: | Auto, Manual, Continuous Measurement, Screening |
| Measurement Range: | Systolic: 30-265mmHg |
| | Diastolic: 15-220mmHg |
| | Mean: 20-235mmHg |
| Alarm Range: | Systolic: 40-240mmHg |
| | Diastolic: 10-210mmHg |
| | Mean: 20-230mmHg |
| Cuff Pressure Range: | 60-240 mmHg (small cuff), 80-240 mmHg (large cuff) |
| Initial Cuff Inflation Pressure: | 150mmHg |
| Subsequent Cuff Inflation: | 30mmHg (4.0kPa) higher than last systolic pressure. |
| Auto Cycle Time: | 1, 2, 3, 4, 5, 10, 15, 30, 60, 90min |

**D. End-tidal CO2**

**Respironics (Optional)**

| | |
|---|---|
| Method: | Mainstream or Sidestream Capnography |
| Principle of Operation: | Non-dispersive infrared (NDIR) single beam optics, dual wavelength, no moving parts |
| Initialization time: | Displayed in less than 15 seconds, full specifications within 2 minutes |
| Measurement range: | 0-150mmHg, 0 to 19.7%, 0 to 20kPa (at 760mmHg) |
| Rise time: | Less than 60ms. |
| CO2 Resolution: | 0.1mmHg 0 to 69 mmHg |
| | 0.25 mmHg 70 to 150 mmHg |
| CO2 Accuracy: | 0-40 mmHg ±2 mmHg |
| | 41-70mmHg ±5% of reading |
| | 71-100mmHg ±8% of reading |
| | 101-150mmHg ±10% of reading |
| Respiration range: | 0 to 150 Breaths/minute |
| Respiration accuracy: | ±1 breath |
| Calibration: | No routine user calibration required |

**Masimo (Optional)**

| | |
|---|---|
| Method: | Mainstream or Sidestream Capnography |
| Detection Equipment: | Ultra compact multi-channel infrared micro bench and barometric pressure sensor |
| Classification: | Please reference the IRMA CO2 Probe and the NomoLine ISA CO2 Analyzer user guides for complete classification information of these products. |
| Warm-up time: | Less than 10 seconds for concentrations reported and full accuracy |
| Measurement range: | 0-114mmHg, 0 to 15%, 0 to 15.2kPa (at 760mmHg) |

| | |
|---|---|
| IRMA CO2<br><br>Rise time* (@ 10 l/min): | CO2 ≤ 90 ms<br><br>N2O ≤ 300 ms<br><br>HAL, ISO, ENF, SEV, DES ≤ 300 ms<br><br>* Measured @ 10 l/min with gas concentration steps corresponding to 30% of total measuring range for each gas. |
| NomoLine ISA CO2<br><br>Rise time** at 50 sml/min sample flow: | ISA CO2<br>$CO_2$ ≤ 200 ms<br>ISA OR+/AX+<br>$CO_2$ ≤ 300 ms<br>$N_2O$, $O_2$, ENF, ISO, SEV, DES ≤ 400 ms<br>HAL ≤ 500 ms<br><br>** Measured according to EN ISO 80601-2-55. |
| CO2 Accuracy | ±(0.2vol% + 2% of reading) for dry single gases at 22 ± 5 °C and 101.3 ± 4.0 kPa |
| CO2 Accuracy (all conditions): | ±(0.3kPa + 4% of reading) |
| Respiration range: | 0 to 150 breaths/minute, displayed after 3 breaths, average updated every breath |
| Respiration accuracy: | ±1 breath |
| Calibration: | No span calibration required for the IR Bench |

**E. Temperature (2-channel)**

| | |
|---|---|
| Measurement and Alarm Limit: | 32~122°F (0-50°C) |
| Probe: | Skin surface or rectal /esophageal |
| Unit: | Fahrenheit/Celsius |
| Accuracy: | ±0.1°F (±0.1°C) |
| Resolution: | 0.1°F (0.1°C) |
| Refresh time: | Approx. 1 second |

**F. Respiration**

| | |
|---|---|
| Measurement Mode: | Thoracic Impedance (indirect)<br><br>Respiration is also available from CO2. Please see the CO2 section for information on Respiration through Capnography (direct) |
| Respiration Rate Measurement and Alarm Range: | 6-120brpm +/-2brpm |
| Waveform Display Speed: | 6.25, 12.5 and 25mm/s |
| Refresh time: | 2 seconds |

**G. Multi-gas (Optional)**

Please reference the IRMA AX+ Probe and the ISA AX+ Analyzer user guides for complete classification information of these products.

**IRMA AX+ Accuracy - Standard Conditions**

The following accuracy specifications are valid for dry single gases at 22 ± 5 °C and 1013 ± 40 hPa.

| Gas | Range* | Accuracy |
|---|---|---|
| CO2 | 0 to 15 vol%<br>15 to 25 vol% | ±(0.2 vol% + 2% of reading)<br>Unspecified |
| N2O | 0 to 100 vol% | ±(2 vol% + 2% of reading) |
| HAL, ISO, ENF | 0 to 8 vol%<br>8 to 25 vol% | ±(0.15 vol% + 5% of reading) Unspecified |

| | | |
|---|---|---|
| SEV | 0 to 10 vol%<br>10 to 25 vol% | ±(0.15 vol% + 5% of reading)<br>Unspecified |
| DES | 0 to 22 vol%<br>22 to 25 vol% | ±(0.15 vol% + 5% of reading)<br>Unspecified |

**IRMA AX+ Accuracy - All Conditions**

The following accuracy specifications are valid for all specified environmental conditions except for interference specified in section 8.6 (effects from water vapor partial pressure on gas readings and section 11.7 (interfering gas effects) within the IRMA developer's Manual. Please reference the IRMA developer's manual for complete details.

| Gas | Accuracy |
|---|---|
| CO2 | ±(0.3 kPa + 4% of reading) |
| N2O | ±(2 kPa + 5% of reading) |
| Agents** | ±(0.2 kPa + 10% of reading) |
| **The accuracy specification for IRMA AX+ is not valid if more than two agents are present in the gas mixture. | |

**ISA AX+ Accuracy - Standard Conditions**

The following accuracy specifications are valid for dry single gases at 22 ± 5 °C and 1013 ± 40 hPa.

| Gas | Range* | Accuracy |
|---|---|---|
| CO2 | 0 to 15 vol%<br>15 to 25 vol% | ±(0.2 vol% + 2% of reading)<br>Unspecified |
| N2O | 0 to 100 vol% | ±(2 vol% + 2% of reading) |
| HAL, ISO, ENF | 0 to 8 vol%<br>8 to 25 vol% | ±(0.15 vol% + 5% of reading)<br>Unspecified |
| SEV | 0 to 10 vol%<br>10 to 25 vol% | ±(0.15 vol% + 5% of reading)<br>Unspecified |
| DES | 0 to 22 vol%<br>22 to 25 vol% | ±(0.15 vol% + 5% of reading)<br>Unspecified |
| O2 | 0 to 100 vol% | ±(1 vol% + 2% of reading) |

**ISA AX+ Accuracy - All Conditions**

The following accuracy specifications are valid for all specified environmental conditions except for interference specified in section 11.7 (effects from water vapor partial pressure on gas readings) and section 11.8 (interfering gas effects) within the ISA developer's Manual. Please reference the ISA developer's manual for complete details.

| Gas | Accuracy |
|---|---|
| CO2 | ±(0.3 kPa + 4% of reading) |
| N2O | ±(2 kPa + 5% of reading) |

**H. IBP (Optional)**

| | | |
|---|---|---|
| Measurement and alarm range: | ART1, ART2, AO, RA: | 0-300mmHg |
| | FA: | -50 to 300mmHg |
| | ICP/CVP: | -10 to 40mmHg |
| | PA: | -6 to 120mmHg |
| Unit: | mmHg/kPa | |
| Channel: | 1 or 2 | |
| Resolution: | 1 mmHg | |
| Trend: | 7 days of data. | |
| Sweep Speed: | 12.5, 25 mm/s | |

### I. Display

| | |
|---|---|
| Display type: | Color TFT LCD Touch Screen Size: 12.1 inches |
| Resolution: | 800 (H) x 600 (V) pixels |
| Display channel: | Minimum of 3. Maximum of 7. |

### J. Printer (Optional)

| | |
|---|---|
| Type: | 3-channel thermal printer |
| Printing mode: | Manual or Auto. |
| Resolution: | Vertical (400dpi), Horizontal (800dpi) |
| Printing speed: | 12.5, 25.0, and 50mm/s. |

### K. Physical Specifications

| | |
|---|---|
| Net weight without batteries: | 8.1 lbs (3.7kg) |
| Dimensions: | 12.875in (32.70cm) x 11in (27.94cm) x 4.5in (11.43cm) |
| Weight subject to change depending on parameters and materials chosen. | |
| Specifications are subject to change without prior notice. | |

# *APPENDIX 2 - BP REFERENCE VALUES*

**Which Blood Pressure is Normal in Dogs or Cats?[1]**

It is essential to know the reference range of blood pressure in a given species in order to properly evaluate the animal's blood pressure and detect hypertension or hypotension. When using different measurement techniques (oscillometry or direct blood pressure measurements), one must also remember that methodological factors influence results. Therefore, technique-specific reference values should be known. Species-specific, breed- specific, and individual differences in normal blood pressure ranges can be observed. The most accurate assessments are made by comparing different blood pressure readings over time using serial measurements made at regular intervals (at least once yearly). This makes it possible to detect the initial signs of related disease (e.g. cardiovascular and renal disease) more sensitively and at an earlier stage. The normal values for dogs and cats are not identical.

**FELINE NORMAL VALUES**

The blood pressure values for cats are not breed-specific. However, the most sensitive way to detect changes in feline blood pressure is also by comparing individual blood pressure readings taken over time.

**Normal feline blood pressure: 124/84**

| Feline Reference Values | | |
|---|---|---|
| **Systolic (mmHg)** | **Diastolic (mmHg)** | |
| 125 ± 11 | 89 ± 9 | Brown et al, 1997 |
| 123 ± 14 | 88 ± 15 | Curtet, 2001 |
| 125 ± 12 | 86 ± 15 | Weber et al, 2002 |

Other investigators have reported comparable reference values.

**CANINE NORMAL VALUES**

The normal values for dogs are breed-specific. Those for Golden Retrievers, Labradors and giant breeds tend to be lower than the overall average and those for greyhounds and in general racing hounds tend to be higher. The table that follows lists the normal values for common dog breeds using oscillometric blood pressure monitors.

**Average canine blood pressure: 133/75**

This figure was calculated as the mean of 1782 oscillometric measurements in clinically healthy dogs of different breeds. The overall average serves as a point of reference only. The individual or at least breed-specific value must be known to accurately determine whether a given patient's blood pressure deviates from normal.

| Breed | Systolic (mmHg) | Diastolic (mmHg) | Pulse Rate |
|---|---|---|---|
| Labrador Retriever | 118 ± 17 | 66 ± 13 | 99 ± 19 |
| Golden Retriever | 122 ± 14 | 70 ± 11 | 95 ± 15 |
| Great Pyrenees | 120 ± 16 | 66 ± 6 | 95 ± 15 |
| Yorkshire Terrier | 121 ± 12 | 69 ± 13 | 120 ± 14 |
| West Highland | 126 ± 6 | 83 ± 7 | 112 ± 13 |
| Border Collie | 131 ± 14 | 75 ± 12 | 101 ± 21 |
| King Charles Spaniel | 131 ± 16 | 72 ± 14 | 124 ± 24 |
| German Shepherd | 132 ± 13 | 75 ± 10 | 108 ± 23 |
| Terrier | 136 ± 16 | 76 ± 12 | 104 ± 16 |
| Bullterrier | 134 ± 12 | 77 ± 17 | 122 ± 6 |
| Chihuahua | 134 ± 9 | 84 ± 12 | 109 ± 12 |
| Miniature Breeds | 136 ± 13 | 74 ± 17 | 117 ± 13 |
| Pomeranian | 136 ± 12 | 76 ± 13 | 131 ± 14 |
| Beagle | 140 ± 15 | 79 ± 13 | 104 ± 16 |
| Dachshund | 142 ± 10 | 85 ± 15 | 98 ± 17 |
| Saluki | 143 ± 16 | 88 ± 10 | 98 ± 22 |
| Greyhound | 149 ± 20 | 87 ± 16 | 114 ± 28 |

| | | | |
|---|---|---|---|
| Pointer | 145 ± 17 | 83 ± 15 | 102 ± 14 |

**GUIDELINES**[1]

Mean Arterial Pressure (MAP): Minimum to adequately perfuse all peripheral tissue beds: 60-70 mmHg.

Hypertension: Suspect with systolic pressure greater than 150 mmHg; affirmed when above 160 170 mmHg; also affirmed in cats when diastolic pressure is above 100 mmHg.

Hypotension: During anesthesia, generally maintain systolic pressure above 80 mmHg.

[1]Info per Dr. Donald Sawyer, Michigan State University

# *APPENDIX 3 - DEAD SPACE*

**Cause, Effect, & Control in Small Animal Anesthesia**

**Robert M. Stein, D.V.M.. DAAPM**

**Founder www.VASG.org**

Dead space is an often misunderstood and overlooked aspect of veterinary anesthesia patient management. Dead space is always present as a component of the patient's airway and, to a variable degree, as a component of the anesthetic system. Ignoring the harmful consequences of system dead space can lead to potentially fatal patient outcomes. This is especially worrisome when managing small patients.

There are three different types of dead space: anatomic, alveolar, and mechanical (equipment). Dead space ventilation involves that component of the respiratory gases that does not participate in gas exchange. Simply said, there is no patient benefit from dead space ventilation. If mechanical dead space volume equals or exceeds alveolar ventilation volume the patient will not be able to clear carbon dioxide at all. Ideally, your goal should be to minimize dead space through proper patient planning and to detect excess dead space consequences through end-tidal CO2 monitoring.

**Anatomic dead space** is comprised of the upper airway structures that do not participate in gas exchange. This includes the gases in the nasal passages, nasopharynx, larynx, trachea, and in the larger airways. **Alveolar dead space** represents those alveoli that are ventilated with fresh gas but not perfused by the pulmonary circulation. **Mechanical or equipment dead space** is made up of any portion of the endotracheal tube extending beyond the patient's incisors, veterinary monitor adaptors (ET CO2, apnea alert, etc.), any adaptors used to facilitate patient/system positioning (right-angle or swivel adaptors used to reduce the risk of tracheal trauma during patient rotation), the pace within a mask not occupied by the patient's nose, humidification management exchangers (HME), and the "Y" piece (defined as the terminal end of an F circuit or noncircle system and the inhalation/exhalation hose connector in a circle system).

Exhausted soda lime or malfunctioning one-way valves can also contribute to increasing mechanical dead space. Dead space also increases in a non-rebreathing system when fresh gas flows are inadequate or when certain defects are present in the system (for instance, when the center tube of a Bain system or F circuit is cracked or broken). These dead space contributors can all be controlled through proper system inspection and maintenance.

Mechanical dead space gas is the first gas inhaled at the beginning of the each respiratory cycle. As the mechanical dead space volume increases, less fresh gas moves into the patient's alveoli, limiting gas exchange.

| Anesthetic System | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Norman Elbow | Jackson-Rees | Bain | Ped circle | Adult circle | Adult F | Ped F |
| Dead space | <1 ml | 3 ml | 4 ml | 4 ml | 8 ml | 8 ml | 15 ml |

| Adaptors | | | | | |
|---|---|---|---|---|---|
| | ET tube | Monitor - ped | Monitor - adult | Positional | Heat & Moisture Exchanger (HME) |
| Dead Space | 2 ml | 2 ml | 7 ml | 8 ml | 2.5 to 90 ml |

**The consequences of excessive mechanical dead space can be substantial and, potentially, fatal.** As dead space volume from any cause increases, effective alveolar ventilation decreases. In patients breathing 100% oxygen there may be negligible initial effect on arterial oxygen tension. Arterial CO2, however, can reach impressive levels. It is possible to have an end-tidal CO2 level greater than 110 mmHg in patients with a normal pulse oximeter reading.

- Increased arterial CO2 causes:
  - Respiratory acidosis
  - Sympathetic stimulation
  - Cardiac arrhythmias
  - A mix of sympathetic stimulation and hypoxemic effects
  - Variable peripheral vasoconstriction (sympathetic effect) followed by peripheral vasodilation as a direct effect on peripheral vessels
  - CNS depressant effect and, eventually narcosis
  - Pa CO2 levels above 100 mmHg have an anesthetic effect

- Increased cerebral blood flow and intracranial pressure
- Tachypnea and an increased work of breathing which can negatively impact a debilitated patient

- Arterial O2 levels may eventually decrease enough to cause hypoxemia, especially in a patient breathing room air
- Inadequate ventilation interferes with adjustments in anesthetic levels

**Controlling mechanical dead space is a simple matter.**

- Mechanical dead space is most concerning for patients under 6 kg body weight
  - Minimize the connectors attached to the endotracheal tube, particularly in small patients.
    - For example, in a 6 kg patient under anesthesia the patient's alveolar ventilation volume would be 31.5 ml. Using a pediatric F circuit with adult EtCO2 monitor and right angle adaptor (or apnea alert adaptor) could create 30 ml of mechanical dead space; effectively eliminating 95% of normal spontaneous alveolar ventilation.
- Make sure you regularly inspect all anesthetic machines and systems paying particular attention to valve function and inner hose integrity
- Make sure that the ET tube is not excessively long
- Select your anesthetic system carefully
  - DO NOT use a pediatric F circuit as a substitute for conventional pediatric circle hoses or a noncircle system
- Using no more than one monitor adaptor
  - Make sure it is a pediatric, low volume adaptor for smaller patients to avoid any significant impact on total mechanical dead space
- Avoid the use of positional (right angle) adaptors in smaller patients
- Avoid maintaining anesthesia with a facemask

Simply put, anesthetized patients should have their end-tidal CO2 monitored for maximal patient safety.

# *APPENDIX 4 - DIRECT BP MONITORING*

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Blood pressure is considered an important component of patient monitoring in emergency and critical care medicine. Blood pressure is a product of several cardiovascular parameters including cardiac output (stroke volume x heart rate), volumetric compliance of peripheral blood vessels (systemic vascular resistance) and effective circulating blood volume. Veterinary medicine has

embraced blood pressure measurement as an important monitoring tool for a variety of medical and surgical situations. In most cases, current clinical practice measures blood pressure by an indirect technique which relies on surface pressure occlusion of a superficial artery using a pneumatic cuff and a method to detect blood flow distal to the site of cuff occlusion. Accepted detection methods to identify blood flow include auscultation, oscillometry, palpation, ultrasonic, and photoelectric methods. Although valuable, it has long been recognized that all indirect methods have limitations in accurate measurement associated with both patient and operator factors. Also, indirect blood pressure measurement is not robust, meaning that it cannot be accurately measured during low pressure and vasoconstricted states.

Because there are limits to indirect blood pressure measurement, there is increased interest in direct blood pressure monitoring in patients demonstrating abnormal physiology that may render indirect measurement techniques inaccurate or impossible. Direct blood pressure measurement requires introduction of a catheter into an arterial or venous lumen and equipment and supplies to transfer pressure from the catheter tip to a measurement device. For this reason, direct measurement is technically more demanding than indirect techniques but less prone to measurement error. The purpose of this presentation is to review the theory, practice, and techniques for direct arterial blood pressure measurement in dogs and cats.

**Equipment needed for direct blood pressure measurement**

*Equipment and supplies:* Essential equipment and supplies needed for direct blood pressure monitoring include arterial catheters (see below), side port catheter adapter, low compliance extension tubing, three way stopcocks, pressure measurement device (transducer), pressure analysis and display device (ECG/BP monitor), heparinized saline, and syringes/needles. For long term placement, a constant flush device (Intraflow®), IV tubing, 1L normal saline, heparin, and pressure infuser device permits continuous flush infusion to prevent clot formation. General supplies such as elasticized and regular tape, suture, scrub solution, and assorted needles should be available. Local anesthesia (2% lidocaine HCl) may be injected in the vicinity of the artery to reduce vasospasm during the procedure.

*Catheter selection:* Either short or long catheters may be successfully used for direct blood pressure measurement. The preferred biomaterials for arterial catheters are either PFE (Teflon®) or polyurethane. In most cases, short length catheters (2-3”)are used in patients who require short term blood pressure monitoring (i.e. anesthesia, short term procedures) or are relatively immobile. Long length indwelling catheters (4+”) are preferred for long term monitoring or in mobile patients. The gauge of catheter is based on vessel diameter at the placement site. In dogs, 20-24 G x 2-3” over the needle catheters are used in the dorsal pedal, metatarsal, and popliteal arteries. In cats, a 22-24G x 2” catheter is selected for the same arterial sites. Large diameter arterial segments (femoral and brachial a.) may accommodate a 20 G x 2-3” over the needle catheter in the dog and a 22 G x 2-3” catheter in the cat. Several manufacturers (Arrow, BD) offer an over the needle catheter system with a built in guide wire that is intended to facilitate arterial catheter placement. In these systems, the guide wire is first advanced and the catheter is then placed over the guide wire. This system is helpful when challenging cases are encountered. Long catheters are generally selected in large bore (femoral and brachial a.) arteries where stabilization is challenging. The additional length of the catheter allows the catheter tip to be located in a more central arterial location and adds additional length that reduces accidental catheter dislodgment.

**Technique for setting up direct blood pressure monitoring**

*Equipment set up and preparation:* Prior to beginning the procedure, all equipment and supplies should be assembled and be ready to use. The first step is to attach the pressure transducer to the patient monitor at the appropriate plug site. Following attachment, connect three way stopcocks to the luer adapters in the transducer housing. In permanent transducers, two stopcocks are required, in disposable units, only one may be necessary.

Leave one stopcock “open” to room air and fill the chamber with heparinized saline being sure that ALL air bubbles are removed. After filling, leave the stopcock open and “zero” the transducer to the machine by pressing the zero control button on the monitor panel. This adjusts the electronics to provide accurate measurement. This step will be repeated after patient attachment occurs. After filling and zeroing the transducer, a flush infusion device is attached to one stopcock unless it is embedded in the transducer device. An IV bag with heparinzed saline is placed in a pressure sleeve and an IV infusion set (microdrip) is attached to the flush device and the bag pressurized to 300 mm Hg. A 6-12” length of low compliance IV tubing is attached to a stopcock to interface the catheter to the transducer. This tubing is flushed and filled with heparinzed saline. The stopcock is turned off to prevent fluid drainage once the tubing is filled. A catheter adapter with a side port is flushed with heparinized saline filled syringe with the syringe attached after flushing. The catheter, catheter supplies, and prep solution are assembled and organized on a work surface for easy access.

*Catheter placement sites:* A superficial artery amenable to catheter placement is identified. Reported sites for arterial catheter placement in dogs and cats include the dorsal pedal, metatarsal, popliteal and femoral arteries in the hind limb and the brachial artery

in the forelimb. In general, distal rear limb sites are selected based on ease of identification, catheter placement, and stabilization following catheter insertion. The selected site must be clipped and surgically prepped prior to catheter placement. Failure to aseptically prepare the area can lead to systemic infection.

*Catheterization technique:* The artery is palpated for pulse quality. In hypotensive patients, peripheral arterial sites may not be detectable due to low blood flow and poor pulse quality. Following identification, a small amount of 2% lidocaine is infiltrated in proximity to the vessel to reduce vasospasm and desensitize the area for catheter placement. Do not remove the filter cap from the needle hub prior to placement. You will be entering a high pressure vessel and will have a sudden burst of blood back through the catheter hub if it is uncovered. The catheter is initially introduced through the skin. In some cases, a pilot wound is created if skin is tough and may damage initial catheter insertion. Once the catheter is inserted through the skin, it is SLOWLY advanced while a finger is kept over the artery to “feel” when the catheter intersects the vessel. You can feel the vessel wall because it is a muscular structure and may actually feel a pulsation as the needle tip engages the arterial wall. At this point, a “flash” may be noted in the needle hub. Once the “flash” is noted, stabilize the catheter unit. If you are using a guide wire catheter, slowly advance the wire stylette. It should move easily or only encounter slight resistance if you are in the vessel lumen. Once the guide wire is inserted full length, slowly advance the catheter until the catheter hub is at the skin surface. If using a standard catheter, slowly advance the catheter. There should be slight resistance due to tissue “drag” but the catheter should go smoothly. After catheter placement is confirmed, gently compress over the vessel at the catheter tip, remove the stylette and needle, and cap the catheter hub with the adapter. An initial aspiration should easily produce a blood “flash” into the saline solution. Flush in 2-3 cc of heparinized saline solution to clear blood from the catheter lumen. Secure the catheter in place prior to proceeding further.

*Connection to BP monitor:* Flush the connecting tubing with saline using the flush device embedded in the disposable transducer or by using a saline filled syringe attached to the stopcock immediately adjacent to the extension tubing. Be sure that there are no visible air bubbles following the flush procedure. Attach the connecting tubing to the catheter adapter extension. You should see a pressure waveform on the monitor screen after opening the stopcocks to the system. Level the transducer at the estimated base of the heart (point of the shoulder). Close the line to the patient and open it up to room air using the stopcock. Press the zero button again to recalibrate the system to the patient. Close the stopcock to air and open the line to the patient. You are now measuring direct blood pressure.

**Blood pressure waveform**

Arterial waveforms emanate from the pulse pressure created by ventricular systole and diastole. The arterial pulse pressure wave begins as left ventricular contraction and forward blood flow (stroke volume) creates aortic distention within the closed vascular system. Peak aortic blood flow produces the initial upstroke in the pressure pulse while continuous ejection of blood from the ventricle during systole fills out or sustains the pulse waveform. As pressure and flow reach their maximum values, the curve flattens and reaches peak pressure. The rounded, sustained portion of the pressure wave represents a combined effect of ventricular volume ejection, distention of the entire aorta, and runoff into aortic branches. Following this point, the curve begins to descend until a defined upstroke or “notch” on the downside of the pressure curve is noted. This notch, referred to as the dicrotic notch, represents closure of the aortic valve and secondary pressure generation that occurs by distention and compression of the aortic root following valve closure. As pressure falls further during “run off” of blood into the arterial ranches, the pressure curve descends to its lowest pressure point just prior to the next cardiac cycle.

The arterial waveform varies with the site of catheter placement and its distance from the aortic root. The further the distance from the heart, the more “tented” or “peaked” the waveform appears. This is accompanied by a narrower base or distance from the beginning to end of the waveform. This appearance change is due to several factors including pressure drop and diameter of blood vessel. The important point is that the waveform change reflects a lower mean arterial pressure, which is essential for forward blood flow to all tissues and organs.

When concurrently monitoring electrocardiogram (ECG) and arterial blood pressure, one notes a slight “delay” between the ECG signal and blood pressure waveform during a cardiac cycle. This delay represents the time required to produce electromechanical coupling and isometric ventricular contraction prior to forward blood flow and pressure wave generation.

**Factors affecting measurement**

Direct blood pressure measurement is affected by both patient and technical factors. Physiologic status of the patient including circulating blood volume, cardiac contractility, neuroendocrine status, and peripheral vascular state all contribute to blood pressure values. Support measures such as mechanical ventilation or other procedures which impact on cardiovascular physiology also contribute to accurate measurement. The reader is referred to reference material for further discussion of these issues. Technical issues also affect accurate measurement. Technical issues generally fall into three categories, catheter management, appropriate set up and management of the measurement apparatus, and operator error. Arterial catheter management is a critical issue in success. Placement should be on a “flat” surface away from joints or other structures which may intermittently occlude the catheter lumen due to position or movement.

Continuous flushing of the catheter to avoid intraluminal clots is essential for long term patency and accuracy of measurement. Ensuring an uninterrupted fluid interface between the catheter and transducer device is essential. Air bubbles in the transducer or extension tubing may “dampen” the signal producing errors. Correct procedural set up with “zeroing” the system is critical to ensure accurate values are measured. Attention to detail of the catheter and operating system by personnel is important to avoid errors and complications. Any break in the protocol may contribute to inaccurate measurement and increased patient risk.

**Complications**

Reported hazards of invasive arterial pressure monitoring include vascular injury, disconnection, accidental injection of drugs, infection, and damage to nearby nerves. In the author's experience, accidental disconnection and infection are two most common complications. Accidental disconnection can produce rapid exsanguination with the risk of hypotension, shock and death is possible if not immediately identified. Constant monitoring of the extension tubing and connection points is important to avoid this complication. Nosocomial infection may lead to bacteremia and sepsis. Sources of infection include catheter wound site, contamination of tubing and stopcocks during routine maintenance procedures, and reuse of non-sterile transducers. Attention to standard protocols targeted to reduce introduction of pathogens at tubing connection sites or ports is also important to decrease risk in these patients. In recent years, "closed" tubing systems which isolate operator maintenance functions from the primary system have become popular in human medicine.

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# APPENDIX 5 - SPECTRAL BROADENING

(Taken from Appendix B of IRMA CO2 Probe Developer's Manual, and Section 7.8 of NomoLine ISA CO2 Analyzer Developer's Manual)

The presence of oxygen and nitrous oxide can cause some interference in the CO2 measurement. This is known as spectral broadening, and must be compensated.

## I. Nitrous oxide, $N_2O$

Nitrous oxide is measured and automatically compensated for in all IRMA or NomoLine® ISA™ CO2 probes except for in IRMA $CO_2$ or NomoLine® ISA™ CO2 modules that don't measure $N_2O$. When using a gas analyzer without this capability, the current nitrous oxide concentration should be transmitted to the NomoLine® ISA™ CO2 or IRMA Gas analyzer using the Set$N_2O$ command.

For most applications, sufficient $CO_2$ accuracy will be achieved by setting $N_2O$ to one of two standard values depending on the $N_2O$ concentration in the patient circuit. If for instance a Set$N_2O$ value of 0 is used for patient circuit concentration below 30 vol% $N_2O$ and 50 is used otherwise, the maximum $CO_2$ error will be limited to 3.2 % relative (please refer to the table below).

| $N_2O$ range | Set$N_2O$ parameter | Midmark Multiparameter Monitor Setting "$N_2O$ Compensate" |
|---|---|---|
| 0-30 vol% | 0 | OFF |
| 30-70 vol% | 50 | ON |

Below is the typical effect if using the default value (0 vol% $N_2O$) when measuring on gas mixtures with different $N_2O$ concentrations:

| $N_2O$ conc. in gas mix | Effect on gas reading | Displayed value if true conc. is 5.0 vol% $CO_2$ |
|---|---|---|
| 0 vol% | 0 % relative | 5.0 vol% |
| 30 vol% | 5.17 % relative | 5.3 vol% |
| 60 vol% | 10.34 % relative | 5.5 vol% |
| 82 vol% | 14.14 % relative | 5.7 vol% |

## II. Oxygen $O_2$

The current oxygen concentration should be transmitted to the IRMA or NomoLine® ISA™ CO2 probe using the Set$O_2$ command.

For most applications, sufficient $CO_2$ accuracy will be achieved by setting $O_2$ to one of three standard values depending on the $O_2$ concentration in the patient circuit. If for instance a Set$O_2$ value of 21 is used for patient circuit concentrations below 30 vol% $O_2$, 50 is used for patient concentrations in the range 30 to 70 vol% $O_2$ and 85 is used otherwise, the maximum $CO_2$ error will be limited to 1.2 % relative (please refer to table below).

| $O_2$ Range | Set$O_2$ Parameter | Midmark Multiparameter Monitor Setting "$O_2$ Compensate" |
|---|---|---|
| 0 – 30 vol% | 21 | LOW |
| 30 – 70 vol% | 50 | MED |
| 70 – 100 vol% | 85 | HIGH |

Below is the typical effect if the default value (21 vol% $O_2$) when measuring on gas mixtures with different $O_2$ concentrations:

| $O_2$ conc. in gas mix | Effect on gas reading | Displayed value if true conc. is 5.0 vol% $CO_2$ |
|---|---|---|
| 21 vol% | 0 % relative | 5.0 vol% |
| 50 vol% | -2.76 % relative | 4.9 vol% |
| 70 vol% | -4.67 % relative | 4.8 vol% |
| 95 vol% | -7.05 % relative | 4.7 vol% |

# *APPENDIX 6 - ACCESSORIES*

The following items are included in the standard monitor kit and can be reordered from your distributor or directly from Midmark using the associated reorder codes.

| Reorder # | Description | Qty. |
|---|---|---|
| SV1 | Small animal BP cuff for 3-6cm limb circumference | 1 |
| SV2 | Small animal BP cuff for 4-8cm limb circumference | 2 |
| SV3 | 3.5cm BP cuff for 6-11cm limb circumference | 3 |
| SV4 | 4.0cm BP cuff for 7-13cm limb circumference | 3 |
| SV5 | 5.0cm BP cuff for 13-20cm limb circumference | 2 |
| SV8 | Large animal BP cuff for 13-20cm limb circumference | 1 |
| SV10 | Large animal BP cuff for 18-26cm limb circumference | 1 |
| NIBP-TUBE | NIBP Inflation Tube | 1 |
| 016-10177-00 | ECG trunk cable | 1 |
| 016-1604-00 | 3-lead ECG wire set | 1 |
| 016-10178-00 | 3-lead ECG cable/lead/clip set | |
| ECG-A3 | Copper ECG alligator clips | 3 |
| V-SAT | Nellcor VetSat SpO2 sensor w/ lingual clips | 1 |
| VSC-S | Small animal SPO2 sensor clip | 1 |
| VSC-L | Large animal SPO2 sensor clip | 1 |
| 01-02-0183 | Nellcor SpO2 extension cable | 1 |
| 016-10164-00 | Esophageal/Rectal temperature probe | 1 |
| PAPER-4F | Printer paper (50mm) (1 package contains 4 rolls) | 1 |
| 015-1338-06 | Power cord, domestic, hospital grade | 1 |
| 015-10793-00 | Rechargeable Li-ion battery | 1 |
| PL-200 | Redux gel for ECG use | 1 |
| 015-3091-00 | Ground wire | 1 |
| 061-1016-00 | Blood pressure cuff selector | 1 |
| 015-3322-01 | USB-Midmark Multiparameter Monitor Visualizer | 1 |
| 016-10180-00 | IBP Trunk cable for IBP monitors only | 1 |
| 016-1587-00 | Disposable IBP transducer and administrative set for IBP monitors only | 1 |

The following are optional accessories for use with the Midmark Multiparameter Monitor series:

| Reorder # | Description |
|---|---|
| C-STAT5 | Capnostat Mainstream CO2 Sensor |
| LoFlo | LoFlo Sidestream CO2 Sensor |
| 6063-00 | Capnostat small animal airway adapter |
| 6312-00 | Capnostat exotic airway adapter |
| 3473ADU-00 | LoFlo large airway adapter |
| 3473INF-00 | LoFlo small airway adapter |
| 3475-00 | LoFlo filterline with luer lock adapter |
| 1027730 | LoFlo mounting bracket |
| 002-1895-00 | Masimo CO2 Mainstream sensor kit |
| 002-1896-00 | Masimo CO2 Sidestream sensor kit |
| 002-10171-00 | NomoLine® ISA™ CO2 Phasein CO2 and Multigas Scavenging Kit |
| SV600 | Package of 5 Cardell small animal cuffs (1 of each size) |
| MaxFast-1 | Nellcor MaxFast Reflectance sensor & posey wrap |
| 016-10232-00 | Extra small esophageal ECG |

| | |
|---|---|
| 016-10233-00 | Small esophageal ECG |
| 016-10234-00 | Large esophageal ECG |
| CD-0019 | Flat ECG clips (5PK) |
| 016-1603-00 | 5-lead ECG wire set |
| 016-10179-00 | 5-lead ECG Cable/lead/clip set |
| ECG-SN | Snap-on ECG clip |
| 01-05-0507 | Small pregelled electrode for snap-on wire sets 60/box |
| NIBP-TUBE10 | NIBP Equine Inflation Tube |
| 015-0363-03 | Power cord, UK |
| 015-0363-04 | Power cord, Australia |
| 015-0363-00 | Power cord, Europe |
| 8008-005 | Touch rolling stand w/ basket and mounting plate |
| 8008-006 | Monitor mount for Canis Major lift table |
| 9A465009 | Monitor mount for VMS Plus anesthesia machine |
| 9A465010 | Monitor pole mount |
| 9A465011 | Monitor Stud mount |
| 9A465012 | Monitor wall mount |
| 002-1684-00 | 5-lead conversion kit |
| 002-1745-00 | Multi-gas Mainstream sensor kit |
| 002-1746-00 | Multi-gas Sidestream sensor kit |
| 016-1651-00 | Masimo small airway adapter |
| 016-1652-00 | Masimo exotic airway adapter |
| 016-1653-00 | Masimo sampling line with large airway adapter |
| 016-10120-00 | Masimo sampling line with small airway adapter |
| 016-1654-00 | Masimo sampling line with male luer adapter |
| 016-1655-00 | Masimo tee airway adapter |

# Index

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